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Modern Information Systems in Management - Challenges and Solutions

Scientific Editor
Agata Wawrzyniak, Barbara Wąsikowska

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Scientific Editors
Agata Wawrzyniak, Barbara Wąsikowska

Authors

Paweł Stępień, Ireneusz Miciuła– ***CHAPTER 1***

Habib Shabazigigasar, Akram Abbasifar, Zohreh Abbasifar – ***CHAPTER 2***

Jerzy S. Zieliński – ***CHAPTER 3***

Joanna Paliszkiewicz, Jerzy Gołuchowski– ***CHAPTER 4***

Rafik Nafkha –***CHAPTER 5***

Marta R. Jabłońska – ***CHAPTER 6***

Marcin W. Mastalerz – ***CHAPTER 7***

Hossein Noori, Mohammad Soleimani – ***CHAPTER 8***

Dariusz Zając, Małgorzata Nycz, Zdzisław Pólkowski – ***CHAPTER 9***

Reviewers

Tomasz Królikowski, Kesra Nermend, Anna Borawska, Jarosław Wątróbski, Paweł Ziemba

Scientific Editors

Agata Wawrzyniak, Barbara Wąsikowska

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Contents

Preface

This book explores the intersection between information technologies and management. The two contributing fields have seen a phenomenal growth in recent years. The management helped by computer science technologies influences the effectiveness of the realization level of tasks and on the creation of the new value added arising as result of the suitable use of resources of the information, the knowledge and the experience.

In particular, this monograph is intended for researchers and practitioners in informatics and economic sciences. It may also be read by students and interested laypersons – they can profit from interdisciplinary insight into IT in management. The issues explored in the book are broad and significant, and thus the book may appeal to sizable audience in management, economics, information technologies, artificial intelligence, education, sociology, and so on. The book brings together economic scientists and computer scientists, with a wide range of background and expertise, to address the dual issue of understanding the role of IT in management and role of management in business informatics.

The first three chapters demonstrate applications of computer science in economy in the macro dimension. Chapter 1 presents the nature of Big Data in the contemporary e-economy and comprises an analysis of the current trends, which are of key importance for building business in this industry. It shows the importance of Big Data services in e-business, which seem inevitable in the era of global information society.

Chapter 2 concerns socio-economic evaluating of water supply policies. Iran government and international institutions try to implement suitable policy and project for increasing water efficiency Iran. In this chapter the results of calculation of the environmental, economic and social benefits of the Irrigation Water Supply Project (IWSP) practice are explained.

The aim of Chapter 3 is to present the development and the current state of artificial intelligence in power system using literature review as well as data from various sources.

The issues discussed in Chapters 4 and 5 refer to the micro level and concern managing organizations. The aim of the study presented in Chapter 4 is to build a conceptual model capturing the relationship between knowledge sharing, use of social media, the level of trust in the organization and organizational

performance. Chapter 5 presents application of linear programming to solve project management problems.

For the last group of chapters the common thread is training, coaching and broadly defined education management. Chapter 6 presents social media as an online coaching tool. This chapter has the form of case study of Polish fitness trainers.

An example of concept of the workflow system design for training organization provides Chapter 7. It demonstrates that the finite-state machine (FSM) concept can be successfully applied in designing a range of specific information solutions which make the integration of the two different systems easier.

In Chapter 8 is presented a complete framework for generating an optimized university timetable based on reducing the overall costs with considering the improving the quality of education evaluation parameters.

The purpose of Chapter 9 is to conduct an analysis related to the graduate profile of Business Informatics. The research has been focused from the perspective of the labour market. This chapter proposes a concept for a new graduate profile of Business Informatics with analysis of the functionality of existing profiles and recent publications in scientific journals about labour market needs.

Editors would like to thank all the contributing authors. Their efforts and engagement helped to ensure the quality of this book.

These chapters, written by researchers in various disciplines, provide new insights into relevant issues, as well as solid research results pertinent to these issues. The topics addressed in the monograph do not exhaust the subject of modern information systems in management. Yet, in the opinion of the editors, it shows well the diversity of challenges and solutions concerning this subject.

Agata Wawrzyniak
Barbara Wąsikowska

Chapter 1

Big Data – Prospects for Development and Key Industries. Challenges for the Polish Government

1.1.Introduction

Almost every innovation brings about progress which facilitates the lives of individuals and businesses. In the case of the Internet, this is easy access to data and information, and quick and direct contact with various economic and social institutions. This, in turn, creates a possibility to conduct business activity on the Internet, at least partially. The revolution related to the introduction of modern information technologies in the area of business management is comparable to the industrial revolution in the field of production means. The notion of "new economy" (e-economy, electronic economy) is inextricably connected with the notion of the Internet. It irrevocably changed the face of today's business and it should be borne in mind that this is just the beginning of changes. Globalisation of the market is gaining unprecedented momentum. When choosing a business partner, geographic factors are now of very little importance. Products and services are available irrespective of the physical location of the sellers and buyers. The electronic economy affects every area of social and economic life, modernising traditional activities by using ICT in all sectors. It is estimated that there are over 2 billion users of the Internet around the world and turnover in e-commerce, which constitutes a part of e-economy, amounts to approx. 8 trillion dollars annually [15]. Within two decades, IT in Poland has changed the social and economic reality of the country. The Internet is a huge mosaic composed of millions of transactions, instances of on-line communication via mobile devices and downloads of tools and entertainment applications. However, it is yet to be seen how and, most importantly, to what extent the Internet as a whole will contribute to global economic growth, efficiency and employment. This chapter presents advantages of managing huge databases and the technology used for that purpose, and helps to explain the direct relation between the Internet and economic activity. It also shows the directions of changes in the economy resulting from the application of ICT.

The actual explosion of information is still ahead of us. The tipping point is the emergence of the Internet of Things, i.e. an idea whereby identifiable objects can, either directly or indirectly, collect, process and exchange data through a computer network (www.computerworld.pl, 25.01.2015). There is also the Internet of Everything, which is a network of people, processes, data and objects which are connected to the Internet. In houses, clothes, vehicles and the human body, there are sensors and micro-components which record and send all types of information that will soon dominate our reality. Large amounts of information comprise knowledge which the human brain is unable to perceive. Only adequate analytical tools allow for finding regularities which are invisible to humans, which in turn allows for improving the existing solutions. Apart from gaining a better understanding of the world, we can discover completely unknown connections. What we can identify in sets of data are correlations between elements, but not causality. It follows that we know what is happening, but we do not know why. In the future, however, the humanity will use the correlations discovered thanks to Big Data to compare hypotheses concerning cause-and-effect relations with the reality. The aim of this chapter is to present the nature and importance of Big Data in today's electronic economy and analyse, and try to systematise the most important trends for building business in this industry.

1.2. Electronic Economy

The electronic economy is a strong market with stable growth, but what is important is that the IT sector is the driving force of the economy. The Internet is the key element of the development of today's economy in that it contributes to an increase in the effectiveness of business and living standards and the creation of new jobs and new social and economic opportunities. The electronic economy encompasses all economic sectors, irrespective of whether they produce tangible or intangible products. This gives rise to a new socio-economic order in which new entrepreneurship rules and new technologies remain closely interrelated. The electronic economy is thriving, which is why there are a number of its definitions in the literature.

Table 1.1. Definitions of the electronic economy (e-economy)

No.	Author	Definition
1.	Wrycza S.	Virtual arena where business is operated, transactions are made, values are created and exchanged and where direct contacts between participants develop [23].
2.	*Miciuła I.*	The use of IT in economic processes (production, sales, distribution of products or services) through ICT networks.
3.	Kisielnicki J.	Part of the economy, both domestic and international, where information technology is used. The electronic economy is the exchange of goods, services and intellectual property of any kind through electronic media. It is also a way to operate business via universal and widespread computer networks. The e-economy is the consequence of technological development and convergence, i.e. combination and diffusion of data processing technologies, telecommunications and knowledge.
4.	Chmielarz W.	An artificial socio-economic organisation, which exists temporarily in wide-area networks, mainly the Internet, in normative and extra-normative realm, whose architecture – due to its dynamic complexity and specificity of infrastructure it uses – cannot be applied in a static manner in the real world, however, goods and payments in this area belong to the real world [6].
5.	Borowiecki R., Kwieciński M.	Management of resources (information, finance, personnel, and objects) in the process of commercial exchange (services) with the use of IT systems and networks. The e-economy involves among others electronic exchange of documents, electronic banking, electronic shopping, electronic cash transfer, interactive voice messaging systems, reservation systems, etc. [3].
6.	GUS (Central Statistical Office)	Modern model of the economy which is developing in the virtual realm where economic activity is operated, transactions are concluded and contacts between business participants are established and exchanged. Basic business processes such as: order processing, payments, promotions, supply of digital services and products, settlement of transactions, contact with customers, contact with suppliers and invoice issuing can take place electronically on the Internet, i.e. the basic medium (GUS, 2014).

Source: own elaboration

Information technologies are the key element of new forms of business. The development of the Internet and ICT instruments changes processes taking place inside enterprises, between enterprises, in contacts with individual cus-

tomers and even between customers themselves. Basic processes such as order processing, payments, promotions and supply can take place electronically.

The creation of an economic system based on the e-economy is not only a technical question, but also an issue related to the organisation, management and creation of a suitable economic environment. This is not a question of fashion related to the emergence of new ICT solutions, but rather a question of understanding that these are the tools that appeared as a result of transformations in the way the economy operates. The emergence of the Internet and globalisation of the economy create an opportunity for small- and medium-sized enterprises to expand their business activity on the market. This creates a level playing field in terms of access to information, acquiring new orders and competition. Knowledge and technology are the basic factors which accelerate socio-economic growth. Intellectual capital is now of key importance and it is the main factor determining success by transforming the environment and creating an ever stronger competition. Implementing IT and employing qualified staff intensify an enterprise's activity by creating the ability to operate in the virtual space, which is an element of the electronic economy [8]. New technologies also destabilize corporate environment and entail the necessity to adjust to changes.

The era of the e-economy, like most innovations, entails progress which facilitates the life of individuals and enterprises. As a result, easy access to large amounts information and direct contact with various legal and financial institutions create the opportunity to operate business activity on the Internet, at least partially. Currently, the global economy is developing in the virtual space, where there is no direct contact between parties to transactions. The e-economy is based on ICT solutions and Internet applications. The virtual space is where economic activity is operated, financial transactions are concluded and contacts between business entities (producers, distributors and recipients of goods and services) are established. The Internet enables business processes which allow for:

- reducing costs related to communication (both inside and outside the company),
- presenting commercial offers,
- processing orders,
- meeting customer requirements,

– creating company image,
– reducing the costs of service,
– entering new (global) markets.

The e-economy affects each and every area of socio-economic life and modernises traditional business by applying IT solutions in all branches of the economy. The continuous increase in the importance of e-business accompanies the technological development of the world; it is estimated that e-commerce currently accounts for almost 8 trillion dollars annually. A lot of social and business activities would be impossible without the use of ICT. This confirms the existence of a direct relation between the Internet and business activity. This is also indicative of the directions of changes in the economy resulting from the application of IT tools. Analysis of large sets of data is a new trend in the IT industry and creates new ways and possibilities of operating business, and changes the rules of cooperation between major market players.

1.3. Big Data - Nature and Importance

The idea of Big Data was conceived in the first decade of the 21st century. The idea encompasses a number of attributes, which are incompatible with traditional data management methods because of their quantity and the fact that they are unsystematised and undergo changes at a fast pace [7]. Internet companies and start-ups founded on the basis of large unsystematised sets of data, whose amount was increasing at a very fast pace, were the first enterprises to implement such technologies. Big Data is a term which denotes all aspects related to the analysis of large and diverse data subject to fast changes, which is of key importance to business. There is no doubt that we live in the era of big data. Currently, the estimated value of the market is 3.8 billion dollars and the growth potential is enormous [15]. The idea of four V's is often referred to in the context of Big Data:

– volume,
– variety,
– velocity,
– value.

In the world of Big Data, it is not only the data itself that is of value; it is also the technology enabling its management and analysis. Therefore, apart from data, Big Data comprises also hardware and software.

Table 1.2. Components of Big Data

Big Data		
Data	**Infrastructure**	**Software**
- huge sets of data (volumes of several terabytes and petabytes), - unsystematised and various formats of data, - continuous influx of data	- large-scale dispersion, - standard hardware (available on the market), - linear scalability	- intelligent software which copes with the analysis of repositories such as data lakes of various formats, - natural language processing, - machine learning

Source: own elaboration

The components of Big Data presented in Table 1.2 account for the fact that huge sets of data cannot be efficiently used by means of traditional software for databases and single servers. Therefore, a family of intelligent software for dispersed processing of diverse data was developed. The Hadoop project, whose first version was published in 2011, is a response to the need for mechanisms which would allow for gaining a business advantage from the analysis of huge sets of data stored in companies' ever-growing IT systems. Hadoop is a modern platform which enables collecting and analysing large sets of data such as social networks, website statistics, login servers, transaction systems, video files and sensory data from associated devices. Thanks to the shift from "data analysis" to "big data analysis" this data became valuable to the business.

Big Data is not so much a technological trend but rather a new model of building business. The biggest challenge is the ability to segregate data in the right way and use them in making business decisions. According to the IBIS World report, it is estimated that in the case of Big Data revenues will increase at 5.8% annually and increase of 35.7% annual margin of profits from business analysis and profit from the software industry until 2017 [14]. The Internet became the key element of the contemporary world. A total of 2 billion people worldwide use the Internet. Given the additional 5 billion people who use mobile phones, it is clear that the trends behind the digital growth of communication networks to a large extent determine the pace of social and economic development.

1.4.Trends for Business Building in the Industry of Big Data

In the era of information society, where information is treated as an exceptional non-material good, which is often times even more valuable than material goods, the e-economy has been providing crucial analytical tools which support decision-making processes in enterprises. Being able to use various IT tools is a competence which plays a significant role in the e-economy. Without such tools, effective management of companies, efficient public administration and international cooperation would be impossible. The dynamic growth of information society and the increasing demand for a higher quality of ICT products and services became the reason for widespread development of e-economy in various areas of life. Against the background of the increasing openness of the economy and globalisation processes, the economy is subject to an ever-stronger influence of external factors, which is also reflected in its development trends, which are related to the global economic situation.

According to Gartner, strategic technology (trend) is something which with a high degree of probability will have a significant impact on corporations in the next three years. This refers to technologies which may interfere with IT or business operations, require significant investments and entail a high risk if implemented too late (Gartner, 2015). Strategic technologies include both the existing technologies, which matured or were adapted for wider application, and emerging technologies, with large potential for those who are the first to implement them. The problem faced by enterprises does not concern only the questions of when and how to adapt new technologies, but how to transform one's own activity so as to take the full advantage of the existing opportunities, while at the same time avoid threats related to the use of ICT. The pace of social, cultural, institutional and HR (development of competences) changes is usually slower compared to the fast pace of ICT development, which results in a number of significant problems. And after all it is the ability to adapt and the pace of changes that determine the effects of propagation and further development of new technologies. The context in which enterprises and institutions function changes very dynamically. The ability to adapt to changes and take advantage of trends seems to be the key competence of entities operating in the changing world [2]. Advances in electronic and information technologies and global expansion of the Internet are becoming stimulators of the development of the world economy. They translate into continuous development and achieve-

ment of subsequent levels in the evolution of the electronic economy, which is based on information in the broad sense, new technologies, the Internet and communication. The e-economy has experienced continuous development. It is not surprising, therefore, that enterprises show a dynamic increase in the use of e-business solutions in their economic activity. Comprehensive Big Data solutions comprise elements such as mechanisms for collecting, storing, managing, analysing and sharing information.

Big Data enables significant optimisation of activities in various fields. Business analyses conducted on huge sets of data become a daily reality for many enterprises. Big Data gives businesses a competitive edge because it enables drawing conclusions in real time on the basis of processes currently taking place on the market. Thanks to real-time analysis of large amounts of data companies are able to offer recipients real value. Ten main areas in which the Big Data trend applies include the following:

1. Financial data (including banking) – banks and investment companies possess and analyse huge amounts of data in order to stay ahead of the competition. American Bankers Association has reported that 10,000 credit transactions are performed each second around the world. Applications of the Big Data trend include enormous data bases related to electronic banking services and analysis of banking operations. Collected data concerning customers is also analysed in order to select information on customers including demography, geolocation, expenses, etc. in order to improve products and marketing campaigns and to assess credit risk;
2. Retail transactions. Majority of traders already store huge amounts of data on transactions with their customers in their points of sale. Analysis of financial data and information concerning customers in order to increase sales. General planning and enterprise management;
3. Telecommunications industry, where companies need such data a.o. to develop strategies, marketing campaigns, product offers, to create customer loyalty, etc.;
4. Tourist industry;
5. Social media activity – analysis of huge amounts of data (data exploration) in order to capture millions of items of data from social networks such as Facebook, Twitter, YouTube, etc.;

6. Public administration institutions e.g. in health care – medical registers, patients' medical electronic documentation (medical history);
7. Bioinformatics, e.g. analysis of DNA, genome or protein sequences to support the development of new drugs or medical diagnostics (by looking for correlations) and morphometrics, i.e. the analysis of data from images for medical purposes. Criminal databases containing biometric characteristics. Recognition of image, speech and writing,i.e. systems for analysing photographs in criminal files, looking for particular relations in digital photographs (image recognition), supporting medical diagnostics, genetic tests, etc.;
8. Processing customer data in large companies e.g. in the telecommunications, finance, and energy sector; companies commission analyses of their customers' data in order to discover business dependencies e.g. effectiveness of promotion, target characteristics (segmentation), customer loyalty, resistance to competition, sales forecasts, potential for acquisitions, etc. This affects the development of the advertising industry, i.e. promoting a company by e.g. creating targeted commercials;
9. Mobile market – popular application as geo-localizers for logistics in companies from various industries, e.g. transport, courier and taxi companies and uniformed services;
10. Big Data in science – in experiments e.g. in physics, for instance a number of sensors in an accelerator.

Recorded Future is the most impressive example of the application of Big Data; it analyses on-line content, including events and trends and current indicators in order to predict the future. On the basis of the information scattered across the Internet, maps of future development are created to be used by e.g. financial markets. By 2015, over 85% of companies classified in the Fortune 500 ranking will not be able to effectively use the data resources they have. Those who invest in the right solutions may achieve sustainable competitive advantage on the market and increase operating profit by up to 60% [21]. We are witnessing the next computer revolution, whose most important elements include the omnipresence of broadband Internet and unlimited processing of huge sets of data on the activity of entities in real time. It will force entrepreneurs and organisations to adapt or even abandon previous business models, but it will also translate into endless possibilities for development. Information has

become the new cornerstone of business, the economic equivalent of capital and labour, and a new production factor. Today, data processing is the cheapest resource used to solve management problems. The winners will be those who appreciate this emerging opportunity faster than others [20].

1.5. Recommendations for Poland in Terms of the Development of the e-Economy

In Poland, expenditures on information technologies in 2015 constituted 2.2% of GDP. The average in the EU-25 is 3.4% (over 4% in Sweden and Great Britain). The necessary – but insufficient – condition of building information society and, therefore, achieving cohesion objectives is ensuring general access to the Internet. The sector of services has been systematically developing and becoming increasingly important for the economy. In 2014, its share in generating gross added value was 64.5%, with the EU average at 69.7%. Employment in services has also been increasing dynamically. By creating jobs in services, the e-economy has a significant impact on this state of affairs. In 2014, employment in services accounted for 59.8% of the total workforce [5]. It is assumed that the sector of services has an enormous potential for employment. Given low costs of labour in Poland and large resources of young and educated staff, Poland may be the place for foreign investors to locate their service centres, which provide services to companies and large corporations. Such service centres already operate in Poland. They provide accounting, IT and other types of services. Poland's membership in the EU is also an opportunity to increase export of Polish services to other EU member states. Propagating access to electronic services will also be of significant importance. Investment activities should include both IT services and databases of central and territorial administration as well as the development of commercial networks and electronic services.

In the ranking of countries best adapted to the era of new technologies, Poland ranked 32 out of 65 countries [9]. Strengths of Poland's ICT branch include:

– intellectual capital (employees – computer scientists, particularly programmers) develop dynamically, also in foreign markets,

- comprehensive solutions (combination of hardware, software, services and competence support. These yield tangible business effects, either by reducing costs or by increasing profits),
- outsourcing services at prices lower than in western EU countries,
- complex innovative IT services such as cloud management,
- dynamic development of the games sector,
- excellent business class solutions, numerous mobile services supporting sales are developed in Poland.

In the 21st century, Poland has faced a large number of social and technological challenges. The way Poles cope with these challenges will determine the country's strategic development, material well-being of Polish families, their economic independence and sense of security. The key task for Poland is to become involved in the process of building the information era by using modern ICT solutions, creating conditions for direct access to information, increasing social awareness and developing people's intellectual and economic potential. The following measures should be taken in order to adjust Polish solutions to the economic and social standards of the emerging information society:

- increase the scope of services available via e-administration to the average level in the EU-27,
- adjust domestic economy to the requirements of the global electronic economy by implementing relevant legal regulations to facilitate access to IT and reduce its costs,
- prepare the Polish society to face challenges posed by the new labour market and new methods of work i.e. support the development of human capital,
- promote processes related to the development of the value of the intellectual capital,
- use ICT tools to create transparent rules for public administration, which would meet the needs of an open information society,
- create conditions conducive to balanced and sustainable regional development with the aid of modern ICT solutions by further investments in information infrastructure, which is inherently changeable,
- support the development of modern sectors of the industry and boost their innovativeness in order to increase competitiveness of the Polish economy,

- participate in a larger number of EU programmes in order to raise financial means for IT projects (in 2013, the percentage was small in the SME sector and amounted to 4% and 13% respectively),
- provide scientific support for the electronic economy in order to take greater advantage of the opportunities offered by the model of information society.

1.6. Summary

Enterprises which want to operate and develop are forced to pay more and more attention to e-business, which became the key element of the contemporary world. The world economy is in the globalisation phase, which affects primarily electronic commerce, services and manufacturing based on advanced technologies. Therefore, it can be stated that trends propelling the development of digital communication networks will have a significant impact on social and economic development. The information era is in its initial phase, where – with the use of modern ICT solutions – we are creating conditions conducive to direct access to information and development of intellectual and economic potential in the world. Enterprises and organisations with enormous sets of data have to face a new fundamental challenge, namely, looking for new meanings and unexpected correlations, which translates into new possibilities and business advantages. IT systems, which make these transformations possible, can be classified as strategic systems which are ground-breaking in achieving future economic goals. This is of great importance in terms of e-business. Big Data has many advantages but the most important one is that it increases effectiveness and competitiveness of enterprises. This makes it one of the most significant trends in ICT in the 21st century.

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Chapter 2

Socio-Economic Evaluating of Water Supply Policies

2.1. Introduction

Today human life is dependent on agricultural production. Agriculture is considered as one of the world's most comprehensive employment sectors. Since the 1960s, the world's population has doubled (from 3.1 billion to 6.7 billion) and per capita income has nearly tripled because of the high growth of population and the continuous increase in the demand for food, a shift in the quantity, quality and variety of agriculture products is inevitable. Thus, optimal management practices in the agriculture sector are not possible due to the absence of a proper policy on the use of actual and potential sources of production, production methods, control and monitor production processes. Hence, it is necessary to review agricultural policies in order to formulate appropriate strategies to achieve the optimum conditions of production focused efforts. Furthermore, identifying, categorizing and prioritizing government agricultural policies are essential for their better implementation. Ellis [1] categorizes agricultural policies in developing countries into price policies, marketing, inputs, credit, mechanization, land reform, irrigation, and research which itself is divided in three groups of price policies, technologies and institutions. Since Iran is located in a hyper arid region (near to desert and with mean annual rainfall of about 250 millimeters), so water saving and water use optimization is a very important and necessary issue. This issue is more important in agriculture sector because it consumes more than 90% of the available water resources. So, in additional of Iran's government, International Institutions are trying to implementation suitable policy and project for increasing water efficiency and saving in Iran. One of projects is Integrated Natural Resources Management (INRM) Program in the Middle East and North Africa Region (MENARID) that its goal is to bring national investment projects in the field of Integrated Natural Resource Management (INRM). This project are implemented is several village in Iran. But, We chose Kamkooyeh village in the Behabad Site (in Yazd province,

Iran) where a Village Development Group (VDG) has been established by following participatory and capacity building approaches such as social mobilization and micro credit mechanism. A set of complementary activities and interventions were recommended and implemented in the site by consultation and active participation of the local communities and beneficiaries [5], [7], [8]. The proposed interventions include implementation of an Irrigation Water Supply Project (IWSP) by installing a pipeline system for improving water supply efficiency (instead of using a 20 years old, cemented canal which has a lot of cracks and as a result, large amount of water transmission loss).

Since Kamkooyeh village is located in a hyper arid region (near to desert and with mean annual rainfall of about 153.9 millimeters), so water saving and water use optimization is a very important and necessary issue. This issue is more important in agriculture sector because it consumes more than 90% of the available water resources. One of the solutions for water saving and improving water supply efficiency is improving cover of earth irrigation canals by cement. For improving water efficiency, a comprehensive plan has been designed by local experts (under supervision of the MENARID Team). It is expected that by implementation of this project, about 20% of water transmission and distribution loss would be saved. The saved water could be used for improving the irrigation system or reducing water stress for cultivated crops or extending under irrigation lands or using it for ground water recharge.

Low efficiency of the existing irrigation water supply and distribution system, increasing weeds in the canal beds, high evaporation rate, water seepage from earth canal or from joints/cracks of cemented canal and low speed of irrigation water are few weak points of the traditional irrigation system. For improving irrigation water efficiency, a project for using a pipeline system for irrigation water supply and also isolating reservoir pools was suggested by local communities to the MENARID team.

Irrigation water of Kamkooyeh village is from a Qanat (Kariz) which its discharge is about 17 litters/second and in the wet season its discharge increased to 26 litters/second.

Traditional system for irrigation water management is in such a system that water, after outlet of Qanat (Figure 2.1), flows in 2 main cemented canals, and the main canal is passing from southern part of the arable lands and the other one from the northern part. Since most of the lands are irrigated from the-

southern canal so there are two reservoir pools on its way to the arable lands (for collecting water to improve its irrigation efficiency).

Figure 2.1. Outlet of Kamkooyeh Qanat

Water from pool flows to the cemented main canals (Figure 2.2) but secondary canals are earth canal (with a high rate of transmission loss) and current irrigation system is flooding irrigation, therefore the irrigation water efficiency is very low.

Figure 2.2. A view of the traditional irrigation water supply by cemented canals

(a)

(b)

Figure 2.3. The first (a) and secondary (b) reservoir poll for collecting irrigation water

Low irrigation water supply and distribution efficiency, increasing weeds in the canal beds, high evaporation rate, water seepage from earth canal or from joints/cracks of cemented canal and low speed of irrigation water are few weak points of the traditional irrigation system. In Figure 2.3, the first and secondary reservoir poll for collecting irrigation water a.re showed

For improving irrigation water efficiency, a project for using a pipeline system for irrigation water supply and also isolating reservoir pools was sug-

gested by local communities to the MENARID team (it should be mentioned that few farmers did not agree with this idea[1]).

Polyethylene(PE) pipes with 200 mm diameter and 4 atmosphere pressure (SF=1.25) have been used for transmission of water to downstream lands (Figure 2.4). For water distribution at field level, Hydro flume Pipeline system with 250 mm diameter and drip irrigation for trees and tape drip irrigation for crops, could be used. If such a comprehensive and modern irrigation system could be executed in the village, water irrigation efficiency could be improved from 35% (current situation) to 85% (desired situation) which has a lot of advantages.

Figure 2.4. New pipeline system beside the old cemented canal

This project has different components including the installation of pipeline plus isolating both reservoir pools and also installation of hydro flume pipe-

[1]Reasons for their objection:

i. Less trust to pipeline system (water in canal could be seen by everyone) and to be worry about the possible damages to it and as a result, loosing water;
ii. Difficulty in using pipeline system (opening or closing of the water valve is very difficult for old farmers);
iii. High cost of the maintenance of the pipeline system (high risk of damages in pipeline and also valves);
iv. High cost of implementation because farmers not only should contribute in installation phase but also they should pay for valves and outlet pipelines (about 3600000 Rials);
v. The pipeline system still is not under operation;
vi. Seepage/water loss from bed of reservoir pools;
vii. Difficulties in finding pipeline failures/hole because it is covered by soil (recently last part of the pipeline has been broken by over passing a tractor machine. See Figure 2.5);
viii. Small size of the farms and scattered farms that irrigation time for them is very short.

line and tape drip irrigation system, in addition, restoration of Qanat system and also using Geomembrane materials for water conservation in a dry part of Qanat gallery. Figure 2.5 shows the route of canals and pipelines and also the location of reservoir pools.

Figure 2.5. Location map of the canals and pipelines and also location of reservoir pools

Implemented part of the designed pipeline by the MENARID team is about 600 meters from the second/lower pool to the north part of the arable lands which its quality is very good and the pipeline is fully covered by soil and all valves are installed but for those part of the pipeline that local communities have gotten support from Behabad township governor or Behabad agricultural office (under ministry of Jihad-Agriculture) and implemented by themselves, the work quality is very low and there are some technical issues in these parts.

At present, the implemented part by the MENARID has no problem but other parts have few technical problems. Based on existing minute of meetings

between the MENARID team and local administrative/executive agencies (under government) and also local farmers, the MENARID team has tried to achieve a good coordination and cooperation among them in completing the irrigation pipeline system but unfortunately, there are few problems and still some part of the system is not completed and part of pipeline are out of the ditch (under sunlight). As a result, the pipeline system is not under operation so farmers are still using old canal system for irrigation (Figure 2.4).

In one case, the last part of the pipeline (about 70 meters) which has been directly installed by few farmers has been broken by over passing a tractor machine on it(see Figure 2.6).

Figure 2.6. The Broken part of the pipeline by over passing a tractor machine

Project sustainability and continuous use of the pipeline needs to consider technical and engineering considerations for protection of the pipeline and its life time utilization. On the other hand, old cemented canal (which has been reconstructed last year and has now good condition) should be reserved for emergency cases (if there is any problem with pipeline the farmer can irrigate their crops or orchards by using the old system) but there are some nonchalance like, forgetting to build a safe bridge for passing the pipeline over the flood route (see Figure2.7). Instead of using a special bridge for support of the pipeline, they used the existing metal canal which is acting as a barrier for water flow.

Figure 2.7. Using existing canal for support of the pipeline instead of building a bridge between upper & lower reservoir pool

By considering the discharge of the Qanat, it seems the dimension of the reservoir pool is over designed (it should be mentioned that the pools are constructed a few years ago and before the MENARID intervention). The dimension of the first pool is about 18 by 18 meters and the second one, about 30 by 26 meters. Considering low discharge of canal, the bad geological formation of the material of the pool bed (mostly gypsum) with high seepage rate, the low size of the fields and their scattered pattern, cause that the reservoir pool could not be filled up during farmer's irrigation time/turn.

For counting the irrigation water share they use "Tub" as a water unit which is equal to 12 minutes of the Qanat water discharge. One hour irrigation water is equal to 5 tubs. It seems the constructed pools are so big for this amount of water and a large surface of the water will cause a lot of evaporation because the mean annual potential evaporation in this region is about 3000 millimeters.

Rural development policy impact study could evaluate from economic, ecosystem and social aspects. These appraisals are categories to two approaches of ex-ante and ex-post evaluations [2], [3], [4]. One of evaluation method is benefit-cost analysis approaches. IWSP in Kamkooeh village is not operational yet. So, IWSP impact study is an ex-ante evaluation. This executive MENA-

RIDpolicy in Iran will be evaluated from economic, ecosystem and social aspects by ex-ante benefit-cost analysis approach. Benefit-cost analysis is a method for project relative advantage according to the optimal and effective allocation of resources.

In this section, first of all, the objectives of the impact study were mentioned then the study area was introduced. After that, the implemented project (intervention) in the study area was introduced and was evaluated. In the next section, the methodology of the impact study will be explained. In the third section, calculation of the environmental, economic and social benefits of the practice and B/C analysis (financial, economic and social) would be explained. In the final section, conclusion and recommendation would be explained.

2.2.Material and Method

We chose Kamkooyeh village in the Behabad Site where a set of complementary activities and interventions were recommended and implemented in the site by consultation and active participation of the local communities and beneficiaries including implementation of an irrigation water supply project (IWSP).

Due to the short time elapsed since the start of that intervention (approximately one year), so nobody expects to observe the resulting impacts in such a short period. Therefore, an ex-ante study was done to predict the potential impacts in the future.

In this project, we should consider all of the intervention or measures simultaneously while predicting the potential impacts. Accordingly, the impacts of this intervention (technology) on maintenance, restoration, or improvement of productivity, ecosystem functions, and social welfare of local communities were evaluated separately by considering the following steps:

2.2.1. Ecosystem functioning (environmental, biophysical and biological) benefits

Ecosystem functioning (environmental, biophysical and biological) benefitsof IWSPare including:decreasing of ground water recharge[2], carbon sequestration & CO_2 sequestration, saving of the evaporated water from the open canal and prevention of deposited sediment in the canal and reservoir pool[3].

Decreasing in ground water recharge benefits

Calculation of "decreasing in ground water recharge" benefits is as follows:

$$V_{GWR} = R_{WL} \times T_{WR} \times P_w \tag{2.1}$$

Where:

$V_{GWR}$is decreasing of ground water recharge benefits (actually, it has a negative impact),

R_{WL} is water loss coefficient,

T_{WR} is total irrigation hour (a traditional unit for water trade in rural area),

P_W is the market price of water (*Rials*/irrigation hour-h-) in that region.

The loss coefficient (R_{WL}) would be determined by calculation of the ratio of the required time for filling up the pool with water, before and after installation of the pipeline.

CO_2 sequestration benefits

Calculation of "CO_2 sequestration" benefits is as follows:

$$V_{CS} = R_{AV} \times A_i \times T_{Con} \tag{2.2}$$

Where:

$V_{CS}$is *CO_2 sequestration* benefits,

R_{AV} is the amount of the sequestrated carbon (ton/ha),

[2] Although the irrigation canal was covered by cement but after 20 years of operation, it has so many cracks and in some part it was broken so there was a large amount of water loss in the canal which would be reduced by installation of pipeline).

[3] Since farmers are irrigating their farms by using a reservoir pool so "reducing water availability timeliness cost" which was expected after implementation of IWSP, is not so important.

A_i is increased area of cultivated lands (in ha) or improved plant cover (because of more water availability), and

T_{Con} is an average tax on CO_2 dispersion by considering an average of few countries (*Rials/ton*).

Saving of the evaporated water from open canal benefits

Calculation of the "saving of the evaporated water from open canal" benefits is as follows:

$$V_{ER} = L_{canal} \times W_{canal} \times EVP \times P_{WV} \tag{2.3}$$

Where:

$V_{ER}$is "saving of the evaporated water from open canal" benefits,

L_{canal} is the length of the irrigation canal (in meters),

W_{canal} is average width of canal (in meters),

EVP is annual mean evaporation in the region in meters,

P_{WV} *is* price of water in the region (*Rials/*m^3).

Prevention of deposited sediment benefits

Calculation of "prevention of deposited sediment" benefits of is as follows:

$$V_{SR} = L_{SR} \tag{2.4}$$

Where:

$V_{SR}$is *prevention of deposited sediment* benefits,

L_{SR} is the annual total cost of labor for cleaning deposited sediments in the canal and reservoir pools (employed labors' wage).

The sum of decreasing of ground water recharge, carbon sequestration, CO_2 sequestration, saving of the evaporated water from the open canal and prevention of deposited sediment benefits is ecosystem functioning (environmental, biophysical and biological) benefitsof IWSP practice (it means, $V_{IWSP} = -V_{GWR} + V_{CS} + V_{ER} + V_{SR}$).

2.2.2. Economic (improving productivity) benefits

Economic (improving productivity) benefits *of IWSP is* as follows:

$$E_{IWSP} = A_i \times P_i \tag{2.5}$$

Where: $E_{IWSP}$is economic benefits of IWSP, A_i is potentially added area for cultivation (*ha*) (There is no seepage from the bed of the broken cemented canal after installing the pipeline so by the saved water, more lands could be cultivated) and P_i is price/revenue of cultivated crops (*Rials/ha*).

2.2.3. Social benefit/well-being

Social benefit/well-being of IWSP could be determined by using the following equation:

$$SV_{PI} = \lfloor 1 + ((IN_{nmd} / IN_{pre\text{-}nmd}) \times \gamma_{IWSP}) \rfloor V_{IWSP} + E_{IWSP} + EM \tag{2.6}$$

Where:

SV_{IWSP} is the social benefit of *IWSP*.

V_{IWSP}, E_{IWSP} and EM_{IWSP} are ecosystem functioning, economic benefits and employment value (temporary job opportunity for the local community in installing the pipeline) of IWSP, respectively.

In addition to environmental and economic benefits of IWSP, there are other impacts such as increasing active participation of local communities, improved group working manner, a social mobilization which will cause improvement in social capital, therefore the rate of social participation could be calculated by using the $[(IN_{mnd} / IN_{pre\text{-}mnd}) \times \gamma_{IWSP}]$ equation.

Actually, by considering this coefficient (rate), social benefits of IWSP would be increased (equation 2.6). In this equation, IN_{mnd} is average income of the village after implementation of the MENARID project, $IN_{pre\text{-}mnd}$ is average income of the village before implementation of the MENARID project and γ_1 is the technology acceptance rate for IWSP.

***EM_{IWSP}* benefits**

Calculation of "EM_{IWSP}" benefits is as the followings[4]:

$$EM_{IWSP} = Q_{EM1} \times P_{w1} \tag{2.7}$$

Where:

$EM_{IWSP}$is employment value of IWSP activity,
Q_{EM1} is number of the employed labors,
P_{w1} is labor daily wage in that region.

2.2.4. Benefit-Cost analysis

Net annual equivalent uniform benefits of IWSP could be calculated according to SV_{IWSP} for life period of the projects (for example, 20 years) and then the net annual uniform cost of IWSP interventions for useful life period of the projects. Benefit-cost analysis would be determined based on the following equation:

$$B/C = \left[SV_{IWSP} - EM_{IWSP}\right] \Big/ \left[C_{IWSP}\left[\frac{r(1+r)^n}{(1+r)^n - 1}\right] + K_{IWSP} \right] \tag{2.8}$$

Where:

SV_{IWSPi} is annual social benefits of IWSP intervention,
EM_{IWSP} is employment value of IWSP intervention,
$C_{IWSP}$is net annual uniform cost (operational and overhead Expenses) of *IWSP* intervention,
n is the life time of the project,
r is the annual discount rate,
K_{IWSP} is the annual working capital cost (operational and maintenance costs).

[4] Although in economic and project evaluations literature, employment of installing projects is a cost item, but in social evaluations, this item is social benefit because of income development of farmer. For accurate evaluations benefits in comparison of cost, we subtracted employment benefits from social benefit (equation 2.8).

2.2.5. Data

Some data such as water price in the study area, production price and agricultural production quantity are collected by questioners from local beneficiaries in the village, some data such as soil and carbon sequestration properties are collected from baseline studies, some data such as budget of projects (the allocated budgets) are collected form provincial project team. As it was mentioned before, the required data for doing this impact study were collected from different sources. First of all, those data that could be extracted from existing reports (base line study, the filled questioners by the MENARID team), field visit, were organized.

2.3. Results

In this section, the obtained results would be explained. That is, calculation of the environmental, economic and social benefits of the IWSP practice will be explained. *B/C* analysis (financial, economic and social) of the projects would be presented in the last section.

2.3.1. Evaluation of ecosystem and socio-economic benefits

The total length of the pipeline is about 1340 meters which its specification has been explained in the previous section. Ecosystem and socio-economic benefits of the *IWSP*have been calculated as the followings:

Calculation of water loss benefits

IN THIS PART WE CONSIDER TWO DIFFERENT SCENARIOS:

A. Water requirement of each 100 square meters (m^2) of arable lands is about 12 minutes of irrigation water.

B. Water requirement of each 100 m^2 of arable lands is about 20 minutes of irrigation water.

In scenario (A), each hectare of arable lands is irrigated for 1200 minutes (equal to 20 hours). Since in Kamkooyeh village there are 5.5 hectares (*ha*) of

orchard and 26.5 ha of irrigated lands, so in total, 32 ha of arable lands are under irrigation. It means:

32 ha × 20 hours = 640 hours of irrigation

Based on the baseline study, the water loss in the cement irrigation canal is about 20 percent. So after operation of the pipeline, 128 hours (640 hours × 20%) of irrigation water, would be saved.

For evaluation of the monetary value of 128 hours of irrigation water, water price is required. In the year 2013, water price was varying between 250000 to 300000 *Rials/ hour*, therefore in this section, value of the saved water would be calculated based on both price:

A1. If price of one hour irrigation water considered as 250000 *Rials* then value of the saved water would be:

128 hour × 250000 Rials = 32000000 Rials

A2. If price of one hour irrigation water considered as 300000 *Rials* then value of the saved water would be:

128 hour × 300000 Rials = 38400000 Rials

In scenario (B), each hectare of arable lands is irrigated for 2000 minutes (equal to 33.33 hours). Therefore 32 hectares of under cultivation of arable lands requires:

32 ha × 33.33 hours = 1066.7 hours of irrigation

By considering, the water loss of 20 percent, it would be calculated that after operation of the pipeline, 213.34 hours (1066.7 *hours* × 20%) of irrigation water, would be saved which its monetary value could be calculated as:

B1. If price of one hour irrigation water considered as 250000 *Rials* then value of the saved water would be:

213.34 hour × 250000 Rials = 53335000 Rials

B2. If price of one hour irrigation water considered as 300000 *Rials* then value of the saved water would be:

213.34 hour × 300000 Rials = 64002000 Rials

Since in calculation of the value of the saved water, the most important component is the water loss coefficient, so its sensitivity analysis is also important.

Sensitivity analysis of water loss benefits

A. in the case of A, water requirement of 100 m^2 of irrigated lands is 12 minutes of irrigation water

A1. Assuming 1 percent decrease in the water loss coefficient:

In this case, the water loss coefficient would be considered as 19% instead of 20% so,

$$640 \text{ hours} \times 19\% = 121.6 \text{ hours}$$

It means, 121.6 *hours* of irrigation water would be saved. If the price of one hour water considered as 250000 *Rials* then the value of the saved water would be calculated as 30400000 *Rials* and if the price of one hour water considered as 300000 *Rials* then the value of the saved water would be 364800000 *Rials*.

A2. Assuming 1 percent increase in the water loss coefficient:

In this case, the water loss coefficient would be considered as 21% instead of 20% so,

$$640 \text{ hours} \times 21\% = 134.4 \text{ hours}$$

It means, 134.4 hours of irrigation water would be saved. If the price of one hour water considered as 250000 *Rials* then the value of the saved water would be calculated as 33600000 *Rials* and if the price of one hour water considered as 300000 *Rials* then the value of the saved water would be 403200000 *Rials*.

It is shown that in the case of the unit price of water about 250000 *Rials*, by one percent increase or decrease in the water loss coefficient, the monetary value of the saved water will vary in the range of 30400000 to 33600000 *Rials* (30400,000 < 32000000 < 33600000). Also in the case of the unit price of water about 300000 *Rials*, by one percent increase or decrease in the water loss coefficient, the monetary value of the saved water will vary in the range of 36480000 to 40320000 *Rials* (36480000 < 38400000 < 40320000).

B. in case of B, water requirement of 100 m^2 of irrigated lands is 20 minutes of irrigation water

B1. Assuming 1 percent decrease in the water loss coefficient:

If the water loss coefficient considered as 19% then 202.67 hours of irrigation water would be saved:

$$1066.7 \text{ hours} \times 19\% = 202.67 \text{ hours}$$

If the price of one hour water, considered as 250000 *Rials* then the value of the saved water would be calculated as 50667500 *Rials* and if the price of one hour

water considered as 300000 *Rials* then the value of the saved water would be 608010000 *Rials*.

202.67 hours × 250000 Rials = 50667500 Rials

202.67 hours × 300000 Rials = 608010000 Rials

B2. Assuming 1 percent increase in the water loss coefficient:

If the water loss coefficient considered as 21% then 224 hours of irrigation water would be saved:

1066.7 hours × 21% = 224 hours

If the price of one hour water, considered as 250000 *Rials* then the value of the saved water would be calculated as 56000000 *Rials* and if the price of one hour water considered as 300000 *Rials* then the value of the saved water would be 672000000 *Rials*.

224 hour × 250000 Rials = 56000000 Rials

224 hour × 300000 Rials = 672000000 Rials

It is shown that in the case of the unit price of water about 250000 *Rials*, by one percent increase or decrease in the water loss coefficient, the monetary value of the saved water will vary in the range of 50667500 to 56000000 *Rials* (50667500 < 53330000 < 56000000). Also in the case of the unit price of water about 300000 *Rials*, by one percent increase or decrease in the water loss coefficient, the monetary value of the saved water will vary in the range of 608010000 to 672000000 *Rials* (*608010000 <64000000 <672000000*).

As a conclusion, one percent increase in water loss coefficient will increase the value of the saved water for 5% but one percent decrease in water loss coefficient will decrease the value of the saved water for 9.5%. Therefore, the value of the saved water is more sensitive to a decrease of water loss coefficient than its increase.

Carbon sequestration function benefits

In the dry season (drought condition), discharge of the *Qanat* is about 17 *lit/sec*. Since all 32 *ha* of the arable land are irrigated by this amount of water so by each liter of this water, 1.88 *ha/sec* of lands could be irrigated. If installing the pipeline causes 20% increase in water transmission efficiency in each one kilometer (*km*) of the pipe line so 3.4 *lit/sec* water would be saved.

17 lit/sec × 20% = 3.4 lit/sec/km

On the other hand, total length of the pipeline is 1340 meters (equal to 1.34 *km*) therefore in total length of pipeline, 4.56 *lit/sec* would be saved:

3.4 lit/sec/km × 1.34 km = 4.56 lit/sec

(It could be assumed that the water discharge has been increased for 4.56 *lit/sec* therefore in total water discharge could be considered 21.56 *lit/sec* -17 + 4.56-).

As it was mentioned before, each *lit/sec* of water could irrigate 1.88 ha of arable lands, therefore, the amount of the saved water (4.56 *lit/sec*) could increase the irrigated lands by 8.58 *ha* (in total it could be 40.58 *ha*).

4.56 lit/sec × 1.88 = 8.58 ha

32 + 8.58 = 40.58 ha

There is an important remark in this regard. In ideal condition (in the case of high productivity), by each one litter per second of water, 4 *ha* of lands could be irrigated. In this situation, by using 17 *lit/sec* of water, 68 *ha* of lands could be irrigated and after installing the pipeline and saving 4.56 *lit/sec* of water, irrigated land could be increased by 18.24 *ha* so in total, irrigated lands could be 86.24 *ha*. It means in the current situation and by using 17 *lit/sec* of water, only 32 *ha* are irrigated but by optimization and improving water productivity it could be increased to 68 *ha* (instead of 32 hectares) and by using pipeline system for water supply, it could be increased to 86.24 *ha*.

4.56 lit/sec × 4 ha = 18.24 ha

18.24 68 = 86.24 ha

In wet season, *Qanat*'s discharge would be 26 *lit/sec* therefore all above calculation would be changed as the followings:

26 *lit/sec* × 20% = 5.2 *lit/sec(saved irrigation water loss per km of pipeline)*

5.2 *lit/sec* × 1.34 = 6.97 *lit/sec (saved irrigation water loss in whole of pipeline length*)

It means by installing the pipeline system, water discharge would be increased about 6.97 *lit/sec* and in total it would be 32.97 *lit/sec* (26 + 6.97 = 32.97). In this condition, if the scenario of using 1 *lit/sec* for irrigation of 4 hectares could be valid then after installing the pipeline, irrigated lands could be increased by 27.88 *ha* and in total, it could be 95.88 *ha*.

6.97 lit/sec × 4 ha = 27.88 ha

27.88 + 68 = 95.88 ha

But in the current situation that by each liter of water only 1.88 *ha/sec* could be irrigated so after installing the pipeline, irrigated lands could be increased by 13.1 *ha* and in total, it could be 45.1 *ha*.

6.97 lit/sec× 1.88 ha = 13.1 ha

13.1 + 32 = 45.1 ha

Sensitivity analysis of carbon sequestration function benefits

A. Assuming 1 percent increase in the water loss coefficient.

In this case, the water loss coefficient would be considered as 21% instead of 20% so,

A1. In dry season (drought condition)

17 lit/sec × 21% = 3.57 lit/sec/km of pipeline length

3.57 × 1.34 = 4.78 lit/sec (in whole length of the pipeline)

4.78 lit/sec × 1.88 ha = 8.99 (increased irrigated lands)

A2. In wet season

26 lit/sec × 21% = 5.46 lit/sec/km of pipeline length

5.46 × 1.34 = 7.32 lit/sec (in whole length of the pipeline)

7.32 lit/sec × 1.88 ha = 13.75 (increased irrigated lands)

B. Assuming 1 percent decrease in the water loss coefficient.

In this case, the water loss coefficient would be considered as 19% instead of 20% so,

B1. In dry season (drought condition)

17 lit/sec × 19% = 3.23 lit/sec/km of pipeline length

3.23 × 1.34 = 4.33 lit/sec (in whole length of the pipeline)

4.33 lit/sec × 1.88 ha = 8.14 (increased irrigated lands)

B2. In wet season

26 lit/sec × 19% = 4.94 lit/sec/km of pipeline length

4.94 × 1.34 = 6.62 lit/sec (in whole length of the pipeline)

6.62 lit/sec × 1.88 ha = 12.44 (increased irrigated lands)

As a conclusion, one percent increase in water loss coefficient will increase the area under irrigation for 5% but one percent decrease in water loss coefficient, will decrease the area under irrigation for 5.26%. Therefore, similar to the re-

sults of the equation 2.1, the area under irrigation because of installing the pipeline is more sensitive to decrease in water loss coefficient.

Finally, for calculation of V_{CS} (CO_2 sequestration benefits), R_{AV} (the amount of the sequestrated carbon) and T_{Con} (average tax on CO_2 dispersion) are needed. R_{AV} for arable lands is calculated in the following Table 2.1.

Table 2.1. Carbon sequestration (*CS*) in arable lands

Crop	Area (*ha*)	CO_2 Sequestration (*kg/year*)	CO_2 Sequestration (*kg/year/ha*)	Share of crop area	Share of crop from CO_2 Sequestration (*kg/year/ha*)
Cereals	11	125947.4	11449.8	0.47	5359.5
Saffron	3	5291.41	1763.8	0.13	225.2
Forage	5.5	201249.8	36590.8	0.23	8563.8
Orchards	3	17912.3	6637	0.13	762.2
Others	1	4817.76	4817.8	0.04	205.0

Source: summary selection ofKamkooyeh base line study and own results

It means, in average, annual carbon sequestration in each hectare of arable and orchard lands are about 15115.8 *kg/ha/year* (equal to 15.1 *ton/ha/year*).

For estimation of T_{Con}, Based on the records, the average tax on CO_2 dispersion in the European Union is 20€/ton in 2014 [3], [5] so V_{CS} for dry and wet season could be calculated as:

Dry season:

8.58 (increased cultivation-ha) × 15.2 (CS) × (20€ × 43000 Rials)= 111535639 Rials per year

Wet season:

13.12 (increased cultivation-ha) × 15.2 (CS) (20€ × 43000 Rials)= 170553332 Rials per year*

The function of reducing evaporation from surface of the canal Benefits

The length of the canal is 1340 meters and its width is 0.5 *meter* so its surface area is 1340 × 0.5 = 670 m^2. Annual *Evapo-Transpiration* from the plant in the area is about 1473 millimeter-mm- therefore volume of the evaporated water from the canal is about 984.9 cubic meters (1.47 × 670) that are equal to 16.09 irrigation hour in dry season.

Since average water used for each hectare in this region is about 6748m^3 and for irrigation of each hectare of land 20 to 33.33 hours water is required, therefore each 984.9m^3 Evapo-Transpiration is equal to 2.91 *hours* irrigation (if each hectare of land irrigated 20 hours) or 4.86 hours irrigation (if each hectare of land irrigated 33.33 *hours*).

If the price of water is 250000 *Rials*/*hour*, then monetary value of decreasing Evapo-Transpiration will be in the range of 730000 to 1216000 *Rials* and If the price of water is 300000 *Rials*/hour, then monetary value of decreasing Evapo-Transpiration will be in the range of 876000 to 1459000 *Rials*.

By considering evaporation from free surface which means annual evaporation in the region is about 3000 millimeters (equal to 3 meters) so total volume of evaporation would be

$$3\ m \times 670\ m^2 = 2010\ m^3$$

By assuming water requirement of 20 irrigation hours for each hectare of lands, a decrease in evaporation would be equal to 5.96 irrigation hours and by assuming water requirement of 33.33 irrigation hours for each hectare of lands, a decrease in evaporation would be equal to 9.92 irrigation hours.

The monetary value of this function (service) in both scenarios of water requirement of 20 to 33.33 irrigation hours for each hectare of lands by considering water unit price of 250000 *Rials* respectively would be 1489000 to 2482000 *Rials* and by considering water unit price of 300000 *Rials* would be 1787000 to 2978000 *Rials*.

The function of reducing sedimentation in the reservoir (irrigation pool) Benefits

The monetary value of this function by considering annual labor cost for cleaning the irrigation pool could be evaluated in case there was no pipeline. In the last year, farmers paid 3500000 *Rials* for cleaning the irrigation pool which could be considered as the value of reducing sedimentation in the irrigation pool.

2.3.2. Economic value (benefits) of IWSP

In the previous section, it was evaluated that after installing the pipeline, in the dry season, the area under irrigation could be increased by 8.58 hectares and in the wet season, it becomes 13.12 hectares.

Average net income for each hectare of arable lands in the region is about 5655000 *Rials* and for orchards is about 4286000 *Rials* which its weighted average is about 5107000 *Rials* in each hectare. Therefore economic value of increased under cultivation area, after installing the pipeline, in both scenarios of dry & wet season is as:

Dry Season*: 8.58 × 5107000 = 43819000 Rials*

Wet season*: 13.12 × 5107000 = 67006000 Rials*

2.3.3. Social benefit of IWSP

First of all, we should calculate the benefit of employment creation for *IWSP*. Since usually 10% of total cost of a project will be used for implementation cost (labor cost) so from the total cost of installing the pipeline, 42640000 *Rials*, its 10% which is equal to 42640000 would consider for human resources (labor) and as a benefit of employment creation for *IWSP*.

It is necessary to mention that by changing 1% in this ratio, it means by 1% decrease, share of labor in total cost of the project, would be 9% and its monetary value would be 38030000 *Rials* and by 1% increasing in it, share of labor in total cost of the project, would be 11% and its monetary value would be 46486000 *Rials*. In this condition, 1% decreasing in the ratio cause 11% decrease in employment creation benefits and by 1% increase in the ratio, employment creation benefits would be increased by 22%.

Another important point is that the daily labor cost in the region is about 400000 *Rials* so for implementation of *IWSP*, about 106 man day, temporary job has been created.

46486000 / 400000 = 106 man day

For calculation of social benefit/well-being of *IWSP* in addition of V_{IWSP} (ecosystem functioning), E_{IWSP} (economic benefits)and EM_{IWSP} (employment value), we need to an acceptance rate of the project (equation 2.7).

Calculation of acceptance rate of the project

The main objective of this project IWSP was to improve water efficiency from 35% to 85% but the complementary activities in the field of irrigation water distribution have not been started so far therefore by installing the pipeline, irrigation water efficiency has been increased to 55%.

Acceptance rate = (55 – 35) / (85 – 35) × 100 = 40%

Before the implementation of *IWSP*, average monthly income of households at village level was 41910000 *Rials*.

Further, the monetary value of participation of the villagers would be determined by comparing it to the average monthly income of rural households at national and provincial level.

Based on the records of *the Central Bank of Iran* and also *Center for Census data of Iran* in the year 2012:

- average monthly income of rural households at national level = *101281362 Rials*
- average monthly income of rural households in Yazd province = *110312101 Rials*

A1. by considering national level: 10128136.2/4191000 = 2.42

2.42 × 40% = 0.97 participation at national level

A2. by considering Yazd province level: 11031210.1/4191000 = 2.63

2.63 × 40% = 1.05 participation at province level

The summary of the results of Eco systemic, economic and social benefits of *IWSP* is shown in Table 2.2.

Table 2.2. Benefits of implementation of irrigation water supply project IWSP (in 10000 Rials)

Condition		Wet Season			
Number of required hours (for irrigation)		12		20	
Unit price of irrigation water hour		25	30	25	30
Decreased sedimentation in canal & pool		35			
Carbon sequestration		17055.3			
Decreased evapo-transpiration		148.9	178.7	248.2	297.8
Decreased infiltration rate		3200	3840	5333	6400
Economic values		6700.6			
Employment creation values		4264			
Ecosystem benefits		14039.2	13429	12005.5	10988.1
Social Benefits with considering participation values based on	No Considering	25003.8	24393.6	22970.1	21952.7
	Yazd province condition	51257.8	50006.9	47088.7	45003
	Iran condition	49257.5	48055.4	45251.1	43246.8
Condition		Dry Season (Drought)			
Number of required hours (for irrigation)		12		20	
Unit price of irrigation water hour		25	30	25	30
Decreased sedimentation in canal & pool		35			
Carbon sequestration		11153.6			
Decreased evapo-transpiration		148.9	178.7	248.2	297.8
Decreased infiltration rate		3200	3840	5333	6400
Economic values		4831.9			
Employment creation values		4264			
Ecosystem benefits		8137.5	7527.3	6103.8	5086.4
Social Benefits with considering participation values based on	No Considering	17233.4	16623.2	15199.7	14182.3
	Yazd province condition	35328.5	34077.6	31159.4	29073.7
	Iran condition	33949.8	32747.7	29943.4	27939.1
Total Average					39586.6

2.3.4. Benefit-cost analysis of IWSP

For calculation of Benefit-cost of the implemented projects, equation 2.8 has been used. In this section, both financial and social Benefit-cost analysis has been done.

Before benefit-cost analysis, implantation cost of the project including *GEF*, *UNDP*, Iran's Government, *MENARID* and local community costs (Budgets) has been shown in Table 2.3.

Table 2.3. Operational and overhead expenses in the Kamkooyeh village (GEF, Government of Iran & UNDP) in 10000 Rials

Stakeholders	type		Level	Cost
GEF	Official	Management	National	50
			Provincial	7
		Official & Equipment	National	1
			Provincial	1
	Travel		Provincial	60
	Operational		Provincial	26000
Government of Iran	Official	Management	National	20
			Provincial	90
		Official & Equipment	National	2
			Provincial	4
	Operational		Provincial	10000
Local Community	Operational		Cash	2500
			In Kind	L1
Total				38735

DW: Distance Work

L1: 1500 meter of water canal establishment as a labor work

Financial benefit-cost analysis

In this section, only financial and economic benefits of the *IWSP* have been considered. It means financial benefits of *IWSP* in comparison to their costs would be analyzed. If the lifetime of the projects considered as 20 years and annual discount rate assumed to be 12 percent, annual uniform cost of *IWSP* has been presented in Table 2.4. In this table, it is assumed that annual cost (cur-

rent cost) of the project to be equal 30 percent of their financial and economic benefits. As it is clear in the Table, the benefit-cost ratio of *IWSP* is less than 1 (about 0.83) and therefore financially is not acceptable.

Its sensitivity analysis for change in discount rate as 11 and 13 percent has been done which the result shows 1 percent increase in discount rate, the benefit-cost ratio will be decreased to 0.80 and 1 percent decrease in discount rate, the benefit-cost ratio will be increased to 0.87.

Socio-economic benefit-cost analysis

In this section, only Social benefits of the *IWSP* have been considered. It means social benefits of *IWSP* in comparison to their costs would be analyzed. If the lifetime of the projects considered as 20 years and annual discount rate assumed to be 12 percent, annual uniform cost of *IWSP* has been presented in Table 2.4. In this table, it is assumed that annual Cost (current cost) of the project to be equal 30 percent of their social benefits. As it is clear in the Table, in a benefit-cost ratio of *IWSP* is more than 1 (2.32) and therefore economically and socially are acceptable which is very impressive.

Its sensitivity analysis for change in discount rate as 11 and 13 percent has been done which the result shows 1 percent increase in discount rate, the benefit-cost ratio will be decreased to 2.28 and 1 percent decrease in discount rate, the benefit-cost ratio will be increased to 2.37.

2.4. Summary

According to the findings from calculations, we can conclude, firstly, in the arid and semi-arid region which are facing with water shortage issue, using pipeline could improve water supply efficiency and could have a significant impact on the socioeconomic condition of villagers. Secondly, Absolute attention to aspects of the economic benefit and sectoral viewpoint is a serious threat to the success of the projects. As the results show, socio-economic evaluation can lead to better and more accurate evaluation of the project impacts. Hence, integrated planning is more effective and efficient tool in design and implementation of the projects. Thirdly, There is a risk that MENARID team are being more involved in the details of the implemented projects (hardware work) and paperwork so there is less attention to software works (institutional coherence

and strengthening to achieve the goals of INRM). Fourthly, integrated management/planning should provide a full coordination among all stakeholders. In some cases, there is a lack of coordination among the key stakeholders. As an example, in the project of irrigation water supply, the responsibilities of MENARID team have been well-fulfilled, however, those responsibilities by the local government and the villagers remains to be accomplished. As a result, during the field visit, it was observed that the pipeline system was not under operation.

Table 2.4. Summary of cost, benefit and B/C ratio of IWSP intervention

Type of Evaluation (in 10000 *Rials*)			Financial	Socio-economic
Benefits			5766.3	39586.6
Cost			38735	38735
Annual uniform cost	Discount rate (%)	12	6915.7	17061.8
		13	7243.9	17390.1
		11	6594	16740.2
B/C	Discount rate (%)	12	0.83	2.32
		13	0.8	2.28
		11	0.87	2.37

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Chapter 3

Artificial Intelligence in Power Systems

3.1. Introduction

Artificial Intelligence (AI) is one of the key steps in the history of humanity that attempts to understand how our brain operates. A true answer to this question was developed in the nineteenth century, and it resulted from the progress in biological research (Ch. Babbage developed a mechanical and programmable computer at that time). In the twentieth century a new system theory allowed to link all results of that biological investigation, and the development of electromechanical computers (MARK I, II, III, IV, Z3) and electronic computer ENIAC provided researchers with very important tools to perform further AI research.

High expectations concerning the ENIAC characteristics facilitated development of a project which aimed to build a model of human brain with all its functionalities; unfortunately, results of this project included several functionalities that are only available to babies. This unsuccessful attempt triggered discussions and numerous critical opinions published in papers and books. On the other hand the project led to formulation of another research target: how to build a system that would apply the computer to solve any problem as effectively as an expert. This approach was successful in terms of developing pioneer systems, called Expert Systems (ES), which were then used in practice: Dendral, Macsyma, Hearsay (1965) Mycin (1972) [11], etc. The investigation in the area of brain modelling was continued however the lack of suitable software and hardware tools delayed its success. Consequently, ES was the first AI tool of a practical importance.

Further development of theoretical research and practical application of AI also includes another environment, i.e. evolution processes, Swarm Intelligence, Immune processes, and in this context we currently have access to the following AI tools: Expert Systems (ES), Artificial Neural Networks (ANN) supported with Fuzzy Logic (FL) Evolutionary Computing, Swarm Intelligence, Immune Algorithms [11]. It is worth mentioning that such authors as Siddique

N., Adeli H. in their book "Computational Intelligence" [6] did not mention the Expert Systems. All the above-mentioned tools can collaborate with one another in the hybrid systems thus provide solutions characterized by a better efficiency, and some of the latest papers contain references to hybrid chains which consist of several tools, sometimes also with different mathematical algorithms.

Before further considerations the author would like to address the following question: why are AI methods so popular in research, engineering, healthcare and in other fields? The answer is as follows: nonlinear growth of data (Big Data problem) of different types which must be transformed to the form that will be comprehensible to the user, e.g. when transformation is too complex, when the process models are difficult and expensive to evaluate, or when the process is distributed, or nonlinear and not well defined. If one of the above occurs, we can apply one of the AI tools presented above.

3.2. Expert Systems in Power Systems

Electrical power systems are big and complex systems different from other [10] characterized by:

1. The importance of the electrical energy in the contemporary world,
2. High investment expenses in power systems with a relatively low rate of return,
3. Dispersion in a large area,
4. Near to the velocity of the light in vacuum, velocity of electromagnetic waves implying simultaneity of transients in power systems,
5. Electrical energy is generated and utilized simultaneously.

The first information on a working ES which controlled large pumps in one of the U.S. nuclear power plants was published in 1980, and from that time numerous concepts, projects and implementation of ES, not only in power plants but also in power grid operation, started to develop. According to the author's collection of data extracted from 182 publications (until 1990) 30% support planning, 45% - control when implemented ES deals with nearly about 5% in each of the group only [8]. The most popular programming languages included LISP, FORTRAN, PROLOG and C [11]. One of the utility examples of ES implemented in Lodz is presented in [9]. Review of the papers collected in the Third Symposium on Expert Application in Power Systems ES demon-

strates [5] that only a small part of ES presented were implemented, which means that the period until 1990 was of an introductory nature in the history of ES operating in power systems.

Evaluation of ES application in Power Systems (PS) is positive in general, nevertheless the following weaknesses have been observed: it is difficult to determine the time of inference, which is a very serious limitation in real-time applications, for areas with not well defined boundaries solutions require more knowledge, and in this context ES is of little use. These two weaknesses and the application of Artificial Neural Network (ANN) in PS, which took place at the end of the twentieth century was the reason for stopping development of ES as individual applications. Nevertheless ES are applied as one module in the hybrid chain of tools.

ES sometimes are referred to as "Knowledge Based Systems" (KBS) and the publication [5] considers the following application of KBS in PS:

- Forecasting and planning in power systems,
- Design of electrical plants and systems,
- Alarm processing,
- Event and fault diagnosis,
- Other applications in power system operation and control,
- Future trends in intelligent systems in power systems.

The last paragraph of this publication contains considerations on knowledge acquisition, model-based reasoning, case-based reasoning and data mining. In the end of this paragraph, the author presents integrated solutions to complex problems in the way similar to solutions currently applied in Smart Grid.

3.3. Artificial Neural Network in Power System

One of the first collections of papers on ANN application to PS is presented in the *Proceedings of the First Forum on Applications ANN to PS* (1991) where papers have been combined in ten groups and ANN is the basic tool, and in some cases together with the following tools:

- Electric Load Forecasting: 7ANN, ANN+ Fuzzy Logic, Temporal Difference Method.

- Power System Security Assessment and Control: 6ANN, two Hybrid (ANN+ES).
- Power System Transients, Faults and Protection: 6ANN.
- Power System Stability and Control: 5ANN, ANN+FL, Genetic Algorithm.
- Identification and State Estimation: 4ANN.
- Power Quality: 2ANN.
- Power System operation in Planning: 3ANN, ANN+ES.
- Advances in NN Technology: 4ANN.
- Economic Dispatch, Unit Commitment and VAR Control: 5ANN, Genetic Algorithm.
- Power System Monitoring, Observability and Diagnosis: 4ANN.

The above composition implies the following conclusions:

– ANN supports all important activities in PS operation.
– Among 54 applications of ANN only 6 are hybrids (two with FL and three with ES), which means that ANN is a suitable AI tool supporting PS.

Application of ANN for a short term load forecasting system, which was successfully implemented in Zamość utility, has been presented in [2].

N. Siddique and H. Adeli (2013) [6] presented ANN application for control and described neural systems applied in identification and control. Identification and control are also important in PS operation.

3.4.Application AI in Power Systems

A review of papers published after 1991 demonstrates a growing number of uses of all types of AI (listed in paragraph 3.1) as well as their combination with other tools in hybrid systems for PS problems solving. The author reviewed selected journals, and the results of this review are compiled in three tables:

– Table 1 presents a collection from 10 journals and a seminar proceeding in the period 1998-1999 [12],
– Table 2 presents a collection from 11 journals and a seminar proceeding in the period 2000-2001 [13],
– Table 3 presents a collection from three IEEE journals only and a seminar proceeding in the period 2002-2004 [14].

The following conclusions result from papers compiled in Table 1:

- Most of the publications describe conceptions and/or projects of application.
- The papers mostly present applications of the AI tools in control and monitoring systems.
- A slowly growing interest in ES application can be observed in relation to the previous period, when this tool became almost unused; most of the solutions are applied in hybrid systems.
- The number of HS combining more than two wools as well as linking the AI and non AI tools is growing.
- The number of wavelet transform applications both in HS and alone is also growing.

The following observations based on Table 2 hold true:

- ANN and HS dominate in supporting PS activities.
- FL, GA/GP and TS play an important role in HS applied in PS.
- A growing complexity of HS combining more than two tools.
  - AI and accompanying tools can support some of the key functions, such as cuttiong the clearing time of the relay protection.
  - The same observations as the ones made for the data presented in Table 2, with an additional finding of the "come back" bifurcation method, hold true in table 3.

Additional comments on AI applications in Power one can find in [3] whereas combining knowledge on AI form [6] with needs in microgrids control in [4] it is easy to see a wide area application of these tools upon considerations.

3.5. Summary

The review of contemporary papers, books and reports presenting new methods application in PS indicates two following findings:

- A growing role of algorithm using new, sometimes very complex mathematical tools which can be solved by new computer systems only; in the past they could not be resolved due to the lack of that type computing tools and software.
- AI tools are used mostly as a part of a hybrid chain composed of other AI tools, mathematical algorithms, etc.; they are rarely used separately. In the author's opinion there are two different ways to develop AI tools. The first

one will be based on a new life or biological processes, while the other will involve manipulation of known AI tools (fuzzy neuron [4]).

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Chapter 4

The Relationship between Knowledge Sharing, Use of Social Media, Level of Trust in Organization, and Organizational Performance: A Proposal for Future Research

4.1. Introduction

Social media technologies are being used for various knowledge management activities within the organization [39], [48], [9], [42], [51], [106], [75], [7]. The widespread use of social media has driven new forms of interpersonal and inter-organizational collaboration and communication. Managers more often use social media tools to encourage knowledge sharing within the organization. Many research studies highlighted that many factors greatly influences the amount of knowledge sharing when using Web 2.0 technologies [71]. Trust is one of the most important of them [67], [68]. Also, it is highlighted that the knowledge management has a significant impact on organizational performance [3]. In many publications, researchers confirmed that the source of competitive advantage is the knowledge assets and benefits that organizations get from successful implementing knowledge management practices [29], [53]. As one of them, knowledge sharing is seen as a beneficial to organizations in many ways such as in its ability to increase organizational performance. The impact of social media on sharing of knowledge and the role of trust was not sufficiently researched. In addition, the lack of conceptualization of social media as informal knowledge management systems reflects a literature gap.

The primary goal of this study is to build a conceptual model capturing the relationship between knowledge sharing, use of social media, the level of trust in the organization and organizational performance. Within organizations, effective social media use may elevate trust among employees. Subsequently, the elevated trust among employees may contribute to the effective sharing of knowledge. Accordingly, the successful sharing of knowledge may enhance organizational performance. The frequency of use may moderate the relation between social media use and knowledge sharing.

4.2. Literature Review

Social media

Social media as a web-based application for communication and sharing information has become a part of everyday life of many people in the world. It is broadly observed that "It has brought many benefits to society, including the ability to reconnect with lost friends and family, make new relationships and instantly share experiences globally with others" [69].

More strictly, Hsu, Park and Park [38] described social media as a platform for everyday communication where users share ideas and discuss issues. Lai and Turban [46] stressed that it is a collection of online tools that enables collaboration and sharing information online. There are many different forms of social media, which can be used in organizations, for example, social network sites, video and audio media sharing platforms, blogs, micro-blogs, wiki [69]. The most popular platforms are Facebook, LinkedIn, Wordpress.org, Twitter, YouTube, Pinterest, Instagram, and Wikipedia. Organizations use social media to build virtual communities inside the organization, develop informal networks also to build a relationship with clients, to inform them about new products, to find an idea for development. Many researchers have proved that social media provide extensive benefits to organizations when they are used effectively [4], [61], [90]. Using social media can be important to build trust inside the organization [69] and to increase sharing of knowledge especially tacit knowledge inside organizations.

Trust

Trust is treated as a foundation for building the relationship in private life and inside an organization. Trust was described by scientists from different disciplines: psychology [105], [81], [26], sociology [52], [96], economics [104], [107] and management [67].

Psychologists describe trust as a personal trait [105], [81]. Gibb [26] described it as a mix of feeling and rational thinking. Sociologists Lewis and Weigert [52] suggested that trust couldn't be considered as only a personal characteristic; they described it as a social structure. In this context Sztompka [96] defined in sociology trust as the expectation that other people, groups, or institutions with whom we interact will act in ways conducive to our well-being. Economists explain trust as a rational choice mechanism [104]. Zak and Knack

[107] wrote that trust substantially affects economic growth, and it is a necessary factor for economic development. In management science, Paliszkiewicz [69] proposed the following definition of trust: Trust is the belief and optimistic expectation that another party will act in such a way that it is beneficial to the trusting party, and will act reliably and will behave or respond in a predictable and mutually acceptable manner. Trust determines how members share knowledge and information [71].

Sharing of Knowledge

Nowadays, knowledge is seen as a critical organizational resource that provides a sustainable competitive advantage in a competitive and dynamic economy [16], [23], [33], [94], [100]. Knowledge can be defined as "a fluid mix of framed experience, values, contextual information, and expert insight that provide a framework for information" [16]. Lam described individual knowledge as "that part of organization's knowledge which resides in the brains and bodily skills of the individual" [47]. It involves all the knowledge that can be applied independently to specific types of tasks and problems. It is usually specialized because people have cognitive limits in terms of storing and processing information [47]. Knowledge sharing is the act of making knowledge available to others (it is converted to the form that can be understood, absorbed, and used by other individuals) within the organization [40]. Similarly, Davenport and Prusak [16] described knowledge sharing as a means providing others with one's knowledge and receiving knowledge from others. Lowendahl, Revang, and Fosstenlokken [54] differentiate three types of knowledge that can be important for knowledge sharing: know-how (experienced – based knowledge that that is subjective and tacit), know-what (task-related knowledge that is objective in nature), dispositional knowledge (talents, aptitude, and abilities). An organization's ability to effective knowledge management depends on its people, who actually create, share and use knowledge. Leveraging knowledge is only possible when people can share the knowledge they have and build on the knowledge of others. Sharing of knowledge is voluntary and implies a relationship (especially trust) between at least two parties – one that possesses and the other that acquires the knowledge. Knowledge sharing has the risk that it involves workers "giving away" the source of their status, expertise, and power.However, the strategy of hoarding runs the risk of the importance of their

knowledge not being recognized and rewarded. The success of knowledge sharing depends to a great extent on how satisfied employees are on the job and how they are motivated in the workplace. Also, it depends on the level of trust in the organization.

Organizational Performance

Organizational performance is one of the most important constructs, which measures how well organization accomplishes its goals [76]. There are different ways of measuring organizational performance [87], [78]. In the literature various performance indicators are presented, for example: financial [70], flexibility [19], [103], the quality and quantity of the accomplishments of individual or group work [87], cost [19], [64], reliability [103], employees' and customer satisfaction [50], [56], [64], [70], learning and growth [70], [82], organizational effectiveness, survival, improvement or innovation [86]. According to Deshpande, Jarley and Webster [20] and Drew [21] organizational performance, it is assessed by the use of global output measures such as market shares, profitability, growth rate, innovation, success and the size of the business in comparison with key competitors. In our research, we used measures proposed by Sink and Tuttle [92], who described organizational performance using seven criteria:„1. Effectiveness: an output measure - the ratio of the expected output to the actual output. 2. Efficiency: an input measure - the ratio of the expected input to the actual input. 3. Quality: Quality is the key to the success of every organization. The quality is checked mainly at three levels input, output, and throughput or process quality. It can include actual input/output versus the expected accuracy, timeliness, etc. 4. Productivity: the ratio of output to input. 5. The quality of work life: Employee attitudes to work; 6. Innovation: Measures the organization's success in creating change. 7. Profitability/budget ability: An outcome to input ratio"[92].

4.3. The Conceptual Research Model

The conceptual research model is depicted in Figure 4.1.The model includes five elements: use of social media, the frequency of use social media, trust, sharing of knowledge, organizational performance. The frequency of use is the moderating variable, and trust is mediating variable. The model shows a

process in attaining successful organizational performance. Use of social media may help to increase knowledge sharing. Trust can increase thanks to building an informal relationship in social network and positively influence on the process of knowledge sharing. The frequency of use influences the relationship between use of social media and knowledge sharing. Finally, the effective sharing of knowledge results in successful organizational performance.

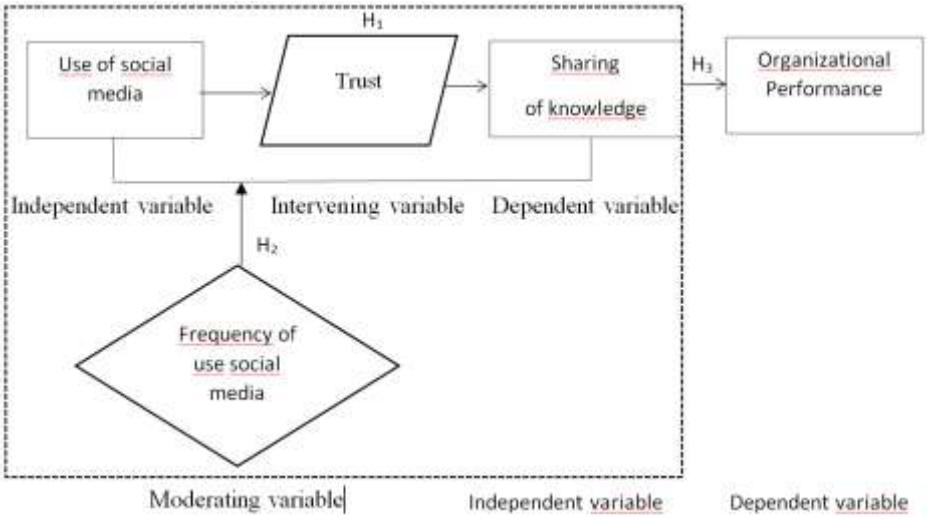

Figure 4.1. The research model

4.4. Hypotheses Development

Social media has changed the way in which people communicate with each other and cooperate [69]. It enables to get to know other people better and creates relationships between people also in organization. Using social media in the workplace complements traditional communication. These technologies have provided a virtual environment that is filled with personal data, preference, and interests [88]. It enables employees to identify those who share the same specialty and expertise, especially when a large number of individuals are involved in the organization. By using different media e.g. social media people creates social networks. According to Scott [89], thesocial network is a social structure made up of people connected by a set of social relationships. Accord-

ing to Ganley and Lampe [25], social networks refer to the structure of the direct and indirect relationships that people create which provide socioeconomic resources to the individual. Granovetter [31] suggests that being engaged in social networks accelerates the establishment and development of trust between people. In social media communication like in real life, trust can increase or decrease over time. Trust can also be considered as the essential to secure interactions in online social networks [108]. For members of a network, the social capital benefits contain broader sources of information that are otherwise unavailable. People build trust based on their previous experiences with others [31], [58], [109] also it contains online experiences. Trust is also related to the possibilities of predicting behavior in the future of others. In the online environment, there are different characteristics that may signal the existence of a trusting relationship, for example, the persistence of communications and the balance in participation [1] or frequency of use. Trusting relationships evolve from social interactions [30], it enables participants to know one another, share resources and create a common viewpoint [98], [12]. In literature, trust is described as an important element for successful knowledge management [10], [90], [79]. Especially, in the process of knowledge sharing it is a foundation [72], [16], [99], [37], [13], [84], [95]. According to many researchers, the relationship between trust and knowledge transfer is positive [16], [11], [2], [60], [15], [48]. The building of trust is also described as a process, which has to appear as a prerequisite to cooperation [24], [77], [58], [63], [100].

Knowledge sharing is a difficult challenge for organizations even if the knowledge management systems are implemented [97], [5], [6]. A lot of the knowledge management systems are designed for capture explicit knowledge, ignoring the fact the sharing of knowledge is related to informal activities. When sharing implicit knowledge, people tend to use personal social media and communicate informally. When trust is the foundation of a relationship, parties are more willing to cooperate and share resources [74], [8]. The willingness of people in the organization to share and use tacit knowledge may depend on the extent that they are trusted recipients and sources [98], [59], [18], [55]. Research has shown that levels of trust influence the exchange of resources within the organization [98]. Effective use of social media and trust which appear thanks to it can influence on knowledge sharing. Thus, in this research the following hypothesis has been proposed:

H_1 The degree to which individuals trust each other mediates the relation between use of social media and sharing of knowledge

Building and developing trust requires persons and organizations to interact continuously [22], the social media enables such contacts. Trust develops over time, according to the intensity of the relationship [73].The individual experience with social media may have a positive effect on knowledge sharing in the organization. People who have rich experience with social media and use if often are likely to understand better how their knowledge and expertise are relevant [12],increasing the extent to which knowledge is shared with others. Therefore, the following hypothesis was proposed:

H_2 Frequency of use will moderate relationship between use of social media and sharing of knowledge

Knowledge management positively influences on organizational performance [66] and can help to gain competitive advantage [93], [34], [36], [28], [102], [44], [27]. The process of sharing of knowledge is very important in the organization[14]. Effective sharing of tacit and explicit knowledge can bring in innovative organizations many advantages like for example: finding creative solutions, which enable to introduce new products and services to the market [65], [85], [62], [101], facilitates decision-making [41] and problem-solving [57] facilitates building customer relations [83], [91], and assisting in organizational learning [35]. Kim [43] found that knowledge sharing improved individual work performance measured for example by excellence, familiarity with work, frequency of compliments from supervisors, the number complaints from the public and problem-solving.

It can be seen from this discussion that, while some research has been done to examine the impact of knowledge management on organizational performance and knowledge sharing on organizational performance, there remains a need for further research to investigate the impact of knowledge sharing (enhance by effective use of social media and trust) on organizational performance. Therefore, the following hypothesis is formulated:

H_3Effective knowledge sharing (as a result of elevated of trust that is rooted in effective social media use) significantly contributes to the organizational performance.

4.5. Research Design

Survey instrument

An instrument will be used to

a) measure influence of using social media at work on knowledge sharing in the organization and the role of trust in this relationship;
b) measure the effect of frequency of use in therelation between use social media and knowledge sharing;
c) measure the effect of knowledge sharing on organizational performance.

The instrument is based on a proposed model that illustrates a process in achieving successful organizational performance with the essential elements of use of social media, trust, knowledge sharing. The instrument includes five constructs: use of social media, the frequency of use, trust, sharing of knowledge, organizational performance and demographic data. It is presented in the appendix.

Use of social media construct

The Technology Acceptance Model (TAM) was proposed by Davis [17] for identifying factors that influence the intention to use a new technology in an organization. Taking into consideration the advantage of using TAM model in predicting the attitude and behavior of individual on their intention to use a new technology, and based on the study presented by Lee [48] . TAM model is used in this study as a theoretical framework to create the construct of use of social media. The questions from 1-8 based on items presented by Davis for perceived usefulness and on the items presented by Lee. The questions from 9 to 13 based on items presented by Davis [17] for perceived ease of use and were also implemented in the research published by Lee [48]. In proposed instrument, following elements are underlined: work easier, quicker communication with employees, increase productivity, job performance, effectiveness, makes the job easier, quality of work, usefulness, easy to use, easy to learn, effort to be skillful, flexibility, understandability.

1. **Work easier.** My job would be difficult to perform without social media
2. **Quicker communication with employees.** Using social media enables me to accomplish the tasks of communicating with the employees more quickly
3. **Increase productivity**. Using social media increases my productivity
4. **Job performance.** Using social media would improve my job performance

5. **Effectiveness.** Using social media enhance my effectiveness on the job
6. **Makes job easier.** Using social media makes it easier to do my job
7. **The quality of work.** Social media improve the quality of the work I do
8. **Usefulness.** I find social media useful in my job
9. **Easy to use.** Learning to operate social media it easy for me
10. **Easy to learn.** I find it easy to get social media to do what I want it to do it
11. **The effort to be skillful.** It would be easy for me to become skillful leader
12. **Flexibility.** I would find social media flexible to interact with
13. **Understandability.** My interaction with the employees using social media is clear and understandable

Frequency of use construct

To measure the frequency of use of social media, one statement was proposed:

Frequency. How often do you use social media at work (1 –very rarely – 7-very often)

Trust in social media construct

To enhance validity, the existing measurement scales in the literature was used to develop the survey questions. The measurement for trust in social media was adapted from Usoro, Sharratt, Tsui, and Shekhar [99]. The dimensions: benevolence integrity and competence are taken under consideration to measure trust.

Benevolence

1. I believe that the competency group's virtual community in social media would act in my best interest.
2. If I required helping, the community in social media would do its best to help me.
3. The community in social media is interested in my well-being, not just its own.

Integrity

1. The community in social media is truthful in its dealings with me.
2. I would characterize the community in social media as honest.
3. The community in social media would keep its commitments.
4. The community in social media is genuine and sincere.

Competence

1. The community in social media is a competent and effective source of expertise.
2. The community in social media performs its role of sharing knowledge very well.
3. Overall, the community in social media is a capable and proficient source of expertise and knowledge.
4. In general, the community in social media is very knowledgeable.
5. I trust the community in social media when I ask them not to forward or share any sensitive material

Knowledge sharing construct

Knowledge sharing was measured with items adopted from Usoro, Sharratt, Tsui, and Shekhar [99].

1. I frequently share my knowledge with others in the community in social media
2. I am one of the most active contributors within the community in social media
3. I make a conscious effort to spend time engaged in activities that contribute knowledge to the community in social media
4. I try to share my knowledge with the community in social media
5. Other communities in social media members find my knowledge sharing contributions to be useful.
6. My contributions to the community in social media enable others to develop new knowledge.
7. I am a knowledgeable contributor to the virtual community in social media.
8. The knowledge I share with the community in social media has a positive impact on the business.
9. Overall, I feel the frequency and quality of my knowledge-sharing efforts are of great value to the community in social media.

Organizational Performance Construct

The organizational performance characteristics were taken from a study presented by Sink and Tuttle [92]. The operational definitions of these seven characteristics were defined by Paliszkiewicz, Gołuchowski, and Koohang [68].

1. **Effectiveness:** The ability to produce the desired result should be an important part of any organization.
2. **Efficiency:** The ability to accomplish a job/task with a minimum expenditure of time and effort should be central to any organizations.
3. **Quality:** The quality of a product (as a measure of excellence and state of being free from defects, deficiencies, and significant variations) brings about the competitive advantage to any organization.
4. **Productivity:** The ability to resourcefully generate, create, enhance, and/or produce goods and services is vital.
5. **The quality of work life:** The opportunity that is given to employees to improve their personal lives through their work environment and experiences can contribute to an organization's competitive advantage.
6. **Innovation:** The process of transforming an idea/invention into a product or service that creates value is vital to an organization's survival.
7. **Profitability:** A financial profit or gain gives an organization the ability to do more to gain the competitive advantage.

In the survey instrument the following measuring scale will be used: 7 = Completely Agree, 6 = Mostly Agree, 5 = Somewhat Agree, 4 = Neither Agree nor Disagree, 3 = Somewhat Disagree, 2 = Mostly Disagree, 1 = Completely Disagree. The survey instrument will be administered electronically via the Internet survey site to the subjects.

Sample

The subjects will be from all level of management in various organizations in Poland. Subjects' participation in the study will be voluntary. All subjects will be the age of 18. The subjects will assure confidentiality and anonymously.

Data Analysis

Collected data will be analyzed via a popular statistical analysis software.

4.6. Summary

Achieving successful organizational performance depends on many elements. This study enriches achievements presented in the literature by demon-

strating how the use of social media can influence on sharing of and the role of trust in this process, and organizational performance. Although, the primary purpose of design the social media technology was not to improve knowledge management processes in the organization but to enable communication between people. The study demonstrates their potential to support knowledge sharing, especially tacit knowledge sharing. Social media can be used to build trust and establish a relationship between people inside the organization. The study makes two sets of contributions: theoretical and practical to the existing body of knowledge in the area of knowledge management and social media.

Presented in the chapter a new model capture the following elements: use of social media, the frequency of use, trust, knowledge sharing, and organizational performance. Based on this model, developed instrument can be used to: a) measure influence of using social media at work on knowledge sharing in the organization and the role of trust in this relationship, b) measure the effect of frequency of use in relation between use social media and knowledge sharing, c) measure the effect of knowledge sharing on organizational performance. The model of relationships in organization depicted in the chapter is the first stride in developing an instrument that can measure organizational performance with the key interrelated elements of effective use of social media, the level of trust and maturity of knowledge sharing processes.

The significance of this model is derived from the fact that despite the current increase in the popularity of extensive research on knowledge sharing, there is no comprehensive and integrative model for examining the relationships between the above variables. Therefore, it is recommended that the next attempt should be to empirically validate the instrument by administering it to all levels of management in various organizations. It is needed to develop comprehensive frameworks and theories to understand how organizations can enhance their interaction with social media services. It will be important to create and develop strategies for social media use in organizations and to introduce using of social media in knowledge management strategies. According to Cao, Guo, Liu, and Gu [12] social media has deeply changed the pattern of knowledge workers' thus enabling a transition from the rigid workplace IT-infrastructure to more flexible forms of collaboration. Knowledge is situated in a social context, where social interactions between people are very important. This new approach provides a new idea for further investigation of the influence of social media in

organizations. The informal networking is an important mechanism that should receive attention in knowledge management studies. Managers can put attention to developing social media platforms to use it as knowledge sharing tool.

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Appendix

The Instrument

The purpose of this survey is to collect information about your opinion, as a manager/leader, regarding the characteristics of use of social media, the frequency of use, trust, sharing of knowledge and organizational performance within organizations. This survey consists of 5 parts and demographic data: Part 1: The Use of Social Media, Part 2: Frequency of Use; Part 3: Trust, Part 4: Sharing of knowledge, and Part 5: Organizational Performance.

In each part, please read the statement indicate your response to the statement using the scale below: 7 = Completely Agree, 6 = Mostly Agree, 5 = Somewhat Agree, 4 = Neither Agree nor Disagree, 3 = Somewhat Disagree, 2 = Mostly Disagree, 1 = Completely Disagree

Part 1: The Use of Social Media

1	My job would be difficult to perform without social media	1 2 3 4 5 6 7
2	Using social media enables me to accomplish the tasks of communicating with the employees more quickly	1 2 3 4 5 6 7
3	Using social media increases my productivity	1 2 3 4 5 6 7
4	Using social media would improve my job performance	1 2 3 4 5 6 7
5	Using social media enhance my effectiveness on the job	1 2 3 4 5 6 7
6	Using social media makes it easier to do my job	1 2 3 4 5 6 7
7	Social media improve the quality of the work I do	1 2 3 4 5 6 7
8	I find social media useful in my job	1 2 3 4 5 6 7
9	Learning to operate social media it easy for me	1 2 3 4 5 6 7

10	I find it easy to get social media to do what I want it to do it	1 2 3 4 5 6 7
11	It would be easy for me to become skillful leader	1 2 3 4 5 6 7
12	I would find social media flexible to interact with	1 2 3 4 5 6 7
13	My interaction with the employees using social media is clear and understandable	1 2 3 4 5 6 7

Part 2: Frequency of use

1	How often do you use social media at work (1 –very rarely – 7- very often)	1 2 3 4 5 6 7

Part 3: Trust in social media

1	I believe that the competency group's virtual community in social media would act in my best interest	1 2 3 4 5 6 7
2	If I required helping, the community in social media would do its best to help me	1 2 3 4 5 6 7
3	The community in social media is interested in my well-being, not just its own	1 2 3 4 5 6 7
4	The community in social media is truthful in its dealings with me	1 2 3 4 5 6 7
5	I would characterize the community in social media as honest	1 2 3 4 5 6 7
6	The community in social media would keep its commitments	1 2 3 4 5 6 7
7	The community in social media is genuine and sincere	1 2 3 4 5 6 7
8	The community in social media is a competent and effective source of expertise	1 2 3 4 5 6 7
9	The community in social media performs its role of sharing knowledge very well	1 2 3 4 5 6 7
10	Overall, the community in social media is a capable and proficient source of expertise and knowledge	1 2 3 4 5 6 7
11	In general, the community in social media is very knowledgeable	1 2 3 4 5 6 7
12	I trust the community in social media when I ask them not to forward or share any sensitive material	1 2 3 4 5 6 7

Part 4: Knowledge Sharing

1	I frequently share my knowledge with others in the community in social media	1 2 3 4 5 6 7
2	I am one of the most active contributors within the community in social media	1 2 3 4 5 6 7
3	I make a conscious effort to spend time engaged in activities that contribute knowledge to the community in social media	1 2 3 4 5 6 7
4	I try to share my knowledge with the community in social media	1 2 3 4 5 6 7
5	Other communities in social media members find my knowledge sharing contributions to be useful	1 2 3 4 5 6 7
6	My contributions to the community in social media enable others to develop new knowledge	1 2 3 4 5 6 7
7	I am a knowledgeable contributor to the virtual community in social media	1 2 3 4 5 6 7
8	The knowledge I share with the community in social media has a positive impact on the business	1 2 3 4 5 6 7
9	Overall, I feel the frequency and quality of my knowledge-sharing efforts are of great value to the community in social media	1 2 3 4 5 6 7

Part 5: Organizational Performance

1	The ability to produce the desired result should be an important part of any organization	1 2 3 4 5 6 7
2	The ability to accomplish a job/task with a minimum expenditure of time and effort should be central to any organizations	1 2 3 4 5 6 7
3	The quality of a product (as a measure of excellence and state of being free from defects, deficiencies, and significant variations) brings about the competitive advantage to any organization	1 2 3 4 5 6 7
4	The ability to resourcefully generate, create, enhance, and/or produce goods and services is vital	1 2 3 4 5 6 7
5	The opportunity that is given to employees to improve their personal lives through their work environment and experiences can contribute to an organization's competitive advantage	1 2 3 4 5 6 7
6	The process of transforming an idea/invention into a product or service that creates value is vital to an organization's survival	1 2 3 4 5 6 7
7	A financial profit or gain gives an organization the ability to do more to gain the competitive advantage	1 2 3 4 5 6 7

Chapter 5

Application of Linear Programming to Solve Project Management Problems

5.1. Introduction

Each project is a unique one-time undertaking with a set of interrelated activities which execution usually requires time and limited resources. Relation between activities can be represented as a graph. In the project, an activity is a task that must be preformed however an event is a milestone ending or starting one or more activities. The activities ordering is modeled with taking into account technological limitations and time succession (for example, some tasks may not start before the completion of its all predecessor) or resources integrity and substitutability. Some activity attribute values cause also a lot of difficulties. Activity duration or cost implementation is determined only with certain approximation. Graph can be modeled in two ways [12]. AOA - Activity on arc (arrow), in which the activities are represented on the arcs and milestones on the nodes. Over time some people began to use the graph as an activity on node (AON). Typically, in network programming the first way is applied. Activities on the arcs are labeled with information on time, cost and resources requirement. The objective of network programming is to find the longest path in the graph. This approach, which consists in calculating the length of all tracks, and then selecting the longest one, is computationally inefficient [11]. The Critical Path Method (CPM) seems to be more efficient in determining the path dimensions. It was developed around 1956 as a deterministic network model for project management where both the network structure and activity durations are known a priori. The network starts with one event and terminates with another one at the end. The different events in the network are numbered in accordance with activities sequence. With each activity four parameters: earliest possible start (ES), earliest finish (EF), latest start (LS) and latest finish (LF) time are associated. Critical activities i.e. those that ES=LS and EF=LF form the critical path. Algorithm identifying the critical path is widely described in [2], [8] and used to solve project management problems in [5], [6].

In 1958 another method was found – PERT (Program Evaluation and Review Technique), which based on the same CPM network principles, allowed the randomness in the activity completion times. The method uses three different time estimations including optimistic, most likely and pessimistic estimation for each activity duration to determine the expected or estimated longest (critical) path of the project [4].

The basic difference between the two techniques is taken into account by the PERT time value estimation. Other differences – present in the early development stages have disappeared and today these techniques can be treated as interchangeable and stages designation of the critical path almost coincide. Unfortunately, while estimating time, required for project completion, both PERT and CPM cannot form and control the schedules of the persons involved in the project.

The objective of CPM is to establish a feasible and desirable relationship between the time and cost of the project by reducing the target time and taking into consideration the cost of expediting. Problems related to time-cost tradeoff for the scheduling of linear projects can be solved using linear programming technique. The critical path problem can be always formulated as the longest path and a simple forward and backward pass of Dijkstra's algorithm [1], [7] suitable, modified for the longest path would give optimal under some circumstances. The forward pass formula is used moving from the first task (activity) to the last one in the network diagram. The backward pass is used as coming back on the other way around. If the network is made up of arcs representing activities, going from node (event) "i" to node "j", where "j" is greater than "i", than the critical path problem for linear programming model can be formulated as the longest path problem which can be solved optimally using a polynomial bounded algorithm whose optimality can be proved by the primal and dual relationships [10].

Usually the actual time to complete project individual activity is not known in advance. Its value is estimated based on historical data of analogous activities, expert judgment or other methods widely described in the project management for construction paper [3]. In order to meet desired project completion time - dictated by market conditions, which is generally shorter than the determined critical path, more resources can be applied. The project duration is then shortened but cost rises. Linear programming technique to meet these con-

ditions can be again used to complete activities at their shortest possible time according to crashing cost level.

The aim of this chapter is to show that the application of linear programming primal and dual relationships can be used to develop two models associated with project management problems. The first is to determine the longest path in the project network. The second model will minimize the cost of crashing the project's activities to complete project in the desired time. The application of linear programming to solve problems related to project management is desired. During critical path crashing, there can appear several critical paths at the same time, and finding the appropriate one, after several iterations based on traditional methods, may be adversely affected and incorrect.

5.2. Formulating the CPM Network as a Linear Programming

The project is a discreet and finite set of activities (tasks) with a set of attributes that describes each activity such as time and cost implementation or resources needed to accomplish those activities. Activities follow directly from the project scope and they are executed sequentially or in parallel depending on the adopted technology, or existing legal regulations in given area. Graphs have proven to be extremely valuable and convenient tool for modeling projects.

Let's assume a graph $G = (S, E)$, $E \subset S \times S$ represents a coherent and acyclic diagraph with a set of nodes (S) and arcs (E) representing respectively project events and activities. The graph is built such way that there is one node $S_j = 0$ from which the number of arcs coming out equal to 0, and one node $S_i = 0$, to which the number of arcs entering equal also to 0. Arcs connecting nodes (i) and (j) can describe task attributes such as time execution (T_{ij}), cost (C_{ij}) or resources required to accomplish individual activity execution. Nodes describing events identify earliest event time of node "i" (T_i) and the earliest event time of node "j" (T_j). Nodes in the graph are arranged and numbered in accordance with the condition if $(i,j) \in E$, then $(i<j)$.

5.2.1. Linear programming technique to find the critical path for the project network

Linear programming is a tool for decision making under certain situation. Designing project activities and events as a graph, will allow the longest route of a unit flows calculation, starting from the first node and terminating at the last one.

To formulate the linear programming model associated with the longest path problem of a network, it is necessary to start by defining the decision variables.

Let's illustrate:

$$\begin{cases} Xij = 1 \; if \; event \; flow \; i-j \; is \; in \; the \; longest \; path \\ Xij = 0 \; if \; event \; flow \; i-j \; is \; not \; in \; the \; longest \; path. \end{cases} \tag{5.1}$$

The objective function for a CPM/PERT network is to find the longest path of a project which maximize:

$$Max \sum \sum T_{i.j} X_{i,j} \tag{5.2}$$

Where: T_{ij} stands for activities durations, which is usually the time to complete the activity.

The procedure to solve this linear problem is very similar to the Dijkstra's algorithm for the shortest path problem [7], except, that the node will express the maximum as against the minimum of the times that is considered when solving the shortest path problem. From the network programming, it is known that the difference between the earliest event time at node j and the earliest event time at node "i" must be at least as great as the time activity [9]. A set of constraints that expresses this condition is defined as:

$$T_j - T_i \geq T_{ij} \tag{5.3}$$

Defining the forward pass that represents the earliest start of activities, and the backward pass representing the finish or latest finish of these activities, the primal and then, the dual can show how this labeling (5.3) is optimal, subject to:

$$Max\left(T_i - T_j\right) \quad \text{for the backward pass}$$

$$Max\left(T_j - T_i\right) \quad \text{for the forward pass} \tag{5.4}$$

To summarize the general linear programming longest path problem can be formulated as: find the project longest path (i.e. the critical path time) that maximize:

$$Max\ \Sigma\Sigma \mathrm{T_{i,j}X_{i,j}}$$

subject to:

$$T_j - T_i \geq T_{ij} \quad \text{and} \quad X_{i,j} \geq 0$$

5.2.2. Linear programming technique to meet the desired project completion time

The objective of the project crashing model is to minimize the cost of crashing activities taking into account the limits on how much individual activities time can be reduced. This relationship can be accomplished using the following steps.

First, it is necessary to determine the limit on how much the cost of an activity would change if activity is spend up or slowed down. This is expressed by the Cost slope (CC) equation:

$$\mathrm{CC} = \frac{\mathrm{C_{ij}^c} - \mathrm{C_{ij}^n}}{\mathrm{T_{ij}^n} - \mathrm{T_{ij}^c}} \tag{5.5}$$

Where:

C^c_{ij} and C^n_{ij} – The crash and normal cost for activity located between nodes (i) and (j).

T^c_{ij} and T^n_{ij} – The crash and normal time for activity located between nodes (i) and (j)

The general LP approach associated with project crashing model is to extend the formulated in previous section model by including crash time and cost. Having determined the project and activities times achieved from CPM or LP technique, the LP objective function associated with project time acceleration could reduce the project duration at the minimum possible crash cost.

$$Min\ \Sigma\Sigma y_{i,j} CC_{i,j} \tag{5.6}$$

Where:

y_{ij} – Amount of times that each activity (i,j) on the critical path will be crashed.

While reducing project duration, the following constraints must be met:

- Crash time constraints: $y_{ij} \leq$ activity time measured in time unit that can be reduced.
- Constraints unfolding the network: from the previous section, constraint (5.3) can be rewrite as:

$$T_i + T_{ij} \leq T_j$$

This constraint remains true by subtracting the amount by which activity (i.j) can be crashed from the left-hand side.

$$T_i + (T_{ij} - y_{ij}) \leq T_j$$

After some manipulation the constraint will be expressed as:

$$T_j - T_i + y_{ij} \geq T_{ij} \tag{5.7}$$

The earliest event time at node (j) is expressed by means of earliest event time at precedence node, activity (i, j) duration and amount of time that can be crashed.

Project start and completion constraints: the project starts at time equal to zero and last event time (T_n) must indicate the project time sought:

$$T_0 = 0;\ T_n \leq TD;\ T_i, T_j, T_{ij} \geq 0$$

Where:

TD – means project desired deadline.

5.3. Linear Programming Application to Find Project Longest Path

Let us consider an ERP (Enterprise Resource Planning) project implementation consisting of 8 strictly necessary tasks. Project specification, dependencies and planned amounts of time duration (in days) to complete individual activity are summarized in Table 5.1.

Table 5.1. Tasks and durations considered to implement ERP system

Nr	Description	Precedence	Activities duration
A	Project analysis	-	10
B	Software purchasing	A	3
C	Hardware and equip. purchasing	A	4
D	OS and DB installation	C	2
E	ERP software installation and initial configuration	B, D	2
F	Business Processes implementation	E	5
G	Implementation in branch offices	E	2
H	User training	F, G	4

Source: own elaboration

The project is modeled as a network diagram having AOA form Figure5.1. The network events that signify the beginning or ending of tasks are depicted as node, while Tasks are represented by arcs between the nodes. Tasks are in dependency relationships with other activity/activities. Nodes are marked with a sequential order and indication should be saved. Using the forward pass formula moving from the first task to last one in the network diagram, ASAP (as soon as possible) schedule can be generated. This technique gives values for individual task, earliest start and earliest finish time. Longest project tasks sequence that must be completed on time is then determined. In order to preserve the network integrity, it was necessary to add a dummy activity – the dropped arrow in Figure 5.1 with duration equal to zero.

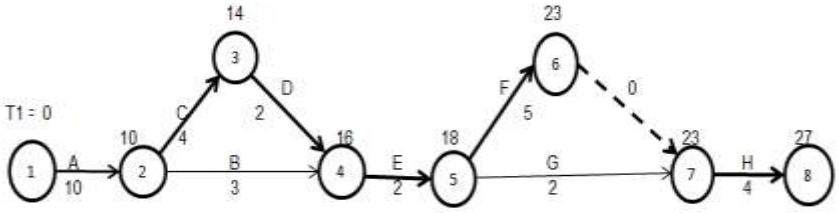

Figure 5.1 Network diagram as adopted in the project
Source: own elaboration

By writing linear programming primal and dual relationships, it can be shown that indeed the critical path obtained in the case study [6]using CPM/PERT algorithm and shown in Figure 5.1, would give the longest path on this network.

Let us write first the primal. From Figure5.1 and (5.1), the longest path should start from node 1 and finish at node 8. The arcs in the network go from node i to node j, where j is greater than i making the network unimodular, therefore for any node total input and output flows will satisfy the constraint.

$$\sum X_{ij} \geq 0$$

Subject to:

$$\begin{gathered} X_{12} = 1 \\ -X_{12} + X_{23} + X_{24} = 0 \\ -X_{23} + X_{34} = 0 \\ -X_{24} - X_{34} + X_{45} = 0 \\ -X_{45} + X_{56} + X_{57} = 0 \\ -X_{56} + X_{67} = 0 \\ -X_{57} - X_{67} + X_{78} = 0 \\ -X_{57} + X_{78} = 0 \\ -X_{78} = -1 \end{gathered} \tag{5.8}$$

The resultant can be then solved by using linear programming, which would give an optimal solution. Let us define now the dual variables: T_1, T_2, … T_8 associated with this problem. If the primal is set to maximize the result, than the dual will be formulated as:

$$T_1 - T_8 \geq T_{1,8}$$

Given that, T_j are unrestricted in sign, so each T_j can be replaced by minus its value ($-T'_j$), which is also restricted in sign. This can give to every (i, j) being in the ith and jth constraint the following inequalities:

$$(T'_2 - T'_1 \geq 10); (T'_3 - T'_2 \geq 4); (T'_4 - T'_4 \geq 3); (T'_4 - T'_3 \geq 2); (T'_5 - T'_4 \geq 2); (T'_6 - T'_5 \geq 5); (T'_7 - T'_5 \geq 2); (T'_7 - T'_6 \geq 0); (T'_8 - T'_7 \geq 4) \quad (5.9)$$

Staring for example from $T'_1=0$, the values for individual inequities are then determined:

$T'_1=0$; $T'_2=10$; $T'_3=14$; $T'_4=16$; $T'_5=18$; $T'_6=23$; $T'_7=23$; $T'_8=27$.

Having values from the dual then, it is necessary to check the ones that are satisfied in the equations (5.8). Thus, satisfied inequalities can give values (1 for basic variable and 0 otherwise) to corresponding primal basic variables. These 7 basic variables:

$$(X_{12}, X_{23}, X_{34}, X_{45}, X_{56}, X_{76}, X_{87}),$$

correspond to the 7 basic assumed values - the grey colored ones in (5.9):

$$(T_{12}=10; T_{23}=4; T_{34}=2; T_{45}=2; T_{56}=5; T_{76}=0; T_{87}=4),$$

can give a basic solution, which satisfies the primal. The objective function (5.2) value associated with this primal for the forward pass concludes the path (1-2; 2-3; 3-4; 4-5; 5-6; 6-7, 7-8) and gives the following value:

$$T_{12}* X_{12} + T_{23}* X_{23} + T_{34}* X_{34} + T_{45}* X_{45} + T_{56}* X_{56} + T_{67}* X_{67} + T_{78}* X_{78}$$

$$10*1 + 4*1 + 2*1 + 2*1 + 5*1 + 0*1 + 4*1 = 27 \text{ days}$$

Having dual feasible solutions and corresponding to them primal feasible solutions, it is possible to obtain value for the objective function (27 days) which is equal to the one obtained while using the CPM/PERT algorithm to solve the same case (27 days) [6]. This concludes that the stated objective function is optimal. The dual variable values obtained from (5.9) correspond to activities earliest start for the forward pass. The backward pass parameters can be obtained starting from the last node and setting latest start equal to event earliest start in the forward pass ($T_8 = T'_8 = 27$) and then coming back from the network, the latest start event can give values.

5.4. Linear Programming Application to Crash the Project

In order to meet sponsors project completion time, the project manager should study fast-tracking method consisting in overlapping tasks which were initially scheduled sequentially, or shift to an advanced technology. If nothing helps, more resources can be introduced. This will increase costs adopted in normal conditions. Then, the project manager has to find out an optimal solution to bring lower cost than the crash-cost limit. This optimal can be achieved by applying linear programming technique.

After determining the critical activities and the project longest path in the previous section, the objective function (5.6) to reduce critical path dimensions under time and cost constraints, is written as:

Min (Total cost) = $500*y_{12}+200*y_{23}+0*y_{34}+0*y_{45}+1000*y_{56}+0*y_{67} + 1000*y_{78}$

Where:

y_{ij} – the number of days each activity can be reduced.

This objective function subjected to the following constraints:

- Maximum reduction constraints: the amount of time each activity can be reduced (if possible) with the maximum permissible reduction limit. Based on Table 5.2, the constraints describing these conditions are:

$$(y_{12} \leq 3); (y_{23} \leq 1); (y_{24} \leq 0); (y_{45} \leq 0); (y_{56} \leq 2); (y_{67} \leq 0); (y_{78} \leq 2)$$

Table 5.2. Activity data in normal and crash conditions

Activity	Time in days		Cost in PLN		Cost Slop per day
	Normal	Crash	Normal	Crash	
A	10	7	5 000	6 500	500
B	3	2	600	800	200
C	4	3	800	800	200
D	2	2	2 000	2 000	-
E	2	2	2 000	2 000	-
F	5	3	5 000	7 000	1 000
G	2	2	2 000	2 000	-
H	4	2	4 000	6 000	1 000

Source: own elaboration

- Start time constraints: from (5.7) and using data associated with activities normal duration from Table 5.2, predecessors relations between activities, earliest start times and reductions are listed:

$$T_2 - T_1 + y_{12} \geq 10$$
$$T_3 - T_{21} + y_{23} \geq 4$$
$$T_4 - T_3 + y_{34} \geq 2$$
$$T_4 - T_2 + y_{24} \geq 3$$
$$T_5 - T_4 + y_{45} \geq 2$$
$$T_6 - T_5 + y_{56} \geq 5$$
$$T_7 - T_6 + y_{67} \geq 0$$
$$T_7 - T_5 + y_{57} \geq 2$$
$$T_8 - T_7 + y_{78} \geq 4$$

- Project start time (T_{start}) and desired completion time (19 days) constraints:

$$T_{start} = 0;\ T_8 \leq 19;\ T_i, T_j, y_{ij} \geq 0;\ (\mathrm{i,j}) \in (1,..8)$$

Using Excel Solver, an optimal solution for minimum additional cost (5 700 PLN) to meet desired project completion time (19 days) is found. The detailed results in Table 5.3 show also for each activity: earliest start time after crashing, maximum and final crash time. Decision variable values are also obtained. Reader should notice that even activity B is considered to be crashed by one day, the solver has not taken into consideration this constraints because it is not on the critical path and has a slack time equal to 3 days. Constraint summary indicates the status of whether, the constraint is tight or not.

Table 5.3. Solution of constraint summary by using Solver

Activity to crash	Max. Crash time	Status	Slack	decision variable	decision value
A crash max	3	tight	0	Y12	3
B crash max	0	Non tight	1	Y24	0
C crash max	1	tight	0	Y23	1
D crash max	0	tight	0	Y34	0
E crash max	0	tight	0	Y45	0
F crash max	2	tight	0	Y56	2

Activity to crash	Max. Crash time	Status	Slack	decision variable	decision value
G crash max	0	tight	0	Y57	0
H crash max	2	tight	0	Y78	2
Due date	19	tight	0	Start	0
Start	0	Non tight	0	T1	7
A constraint	10	tight	0	T2	12
B constraint	5	Non tight	2	T3	10
C constraint	4	tight	0	T4	12
D constraint	2	tight	0	T5	14
E constraint 1	2	tight	0	T6	17
E constraint 2	2	tight	0	T7	16
F constraint	5	tight	0	T8	19
G constraint	2	tight	0	Project time	19
H constraint 1	4	tight	0	Crash cost	PLN5700
H constraint 2	5	Non tight	1		
Finish	0	tight	0		

Source: own elaboration in Excel Solver

5.5. Summary

Linear programming technique to find the network longest path in normal and crash conditions was carried out and gave similar result to CPM technique. Beside the longest path problem, project manager's objective is to establish a feasible and desirable relationship between time and cost of any project. Project target time is then reduced taking into account the cost of expediting. The results concerning crash cost and project time obtained in the case study can be changed in case of introducing new constraints i.e. penalty or bonus components in case of shortest project time achievement. Project Manager has to balance than between fixed budget and opportunities resulting from crashing project time and costs. Linear programming technique has been proven again in this case to be suitable to minimize the cost of crashing the project's activities to complete project in the desired time. It can be then stated that the two closely related operational research techniques can be used simultaneously to assist the

project manager to solve a project management problem. In the network each activity was characterized with its duration. There will be situations where certain resources will be required to carry out these activities. Many times there are not unlimited numbers of these resources, so it will be constrained by resources which lead to resource constraint project scheduling problem. In such situation many activities cannot be carried out parallel and then the path will be extended and increased. The longest path under resources restriction cannot be seen as a linear programming problem but become an integer programming case and a solution can be obtained by extending the formulated critical path model by including resource constraints.

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Chapter 6

Social Media as an Online Coaching Tool: Case Study of Polish Fitness Trainers

6.1. Introduction

Today's society is getting increasingly complex [25] and that implies living in the face of ubiquitous change in every aspect of human or business life. Change itself can be perceived as an opportunity for personal development, though it requires the ability to get a handle on new conditions [28]. There is a need to facilitate people while their facing change and one of such practices is called coaching.

Despite growing popularity of coaching [11], there is still a lot of uncertainty and vagueness around its' definition, scope and aims [14]. This lack of agreement is emphasized by Passmore and Fillery-Travis [24], Ladyshewsky [16], Kempster and Iszatt-White [15] as well as Bond and Seneque [4]. Coaching is associated with personal or professional goal obtaining, performance development and individual potential enhancement [9]. On one hand it derives from business, education, psychology, psychotherapy and sport [38]. On the other, it is widely disseminated among many areas such as: health, dietetics, recruitment, management, business, talent coaching, teamwork, leadership coaching, job coaching, linguistic coaching, financial coaching, intercultural coaching, parenthood, relationships, sexual coaching, auto-coaching, Zen coaching, art coaching, breath coaching and life coaching (I).

Coaching can be defined as a social process comprising complex interactions between coach, coachee and context [42]. Though numerous researches associated with coaching have been conducted, from strict coaching-specific to basic not particularly related to coaching [10], there emerge a new view that should be taken into consideration. Since the internet has become a major medium for both – personal as well as professional – communication [35], new opportunities for coaches have become possible and desired. The most promising seems to be social media with their wide disseminations among users all around the world. Communication via this channel differ from face-to-face

coaching sessions, what is more, online coaching is most often still perceived as its traditional form carried out on Skype or other internet communicator. That is why this chapter concentrates on social media as a new tool for providing coaching and building relation between coach and coachees.

The remainder of the chapter is organized as follows. Section 2 briefly reviews the related literature. Section 3 is dedicated to social media, online communities and prosumers. In Section 4 an explanation of methodology and case study subject was stated. Findings and conclusions are given in Sections 5 and 6, respectively.

6.2. Related Works

The number of studies seeking to understand the essence of coaching shows an increasing trend. The issue has been considered at different levels and under various aspects, still its combination with social media hasn't been described widely. This Section describes selected works dedicated to coaching itself. Then its' role and dissemination on fitness market is presented.

Personal adult development means that individuals are not unchanging, but are continually learning, developing and growing [6] and coaching aims to improve this process. It can be defined as a process of providing guidance, encouragement and support through the establishment of relationships that make it easier to discover and to increase coachee abilities [20]. Main coaching features are presented in Figure 6.1.

Coaching

- Is a mesurable process
- Improves competences in selected area
- Is a partnership relation between coach and coachee
- Concentrates on specific targets
- Coach knows the questions, coachee knows the answers
- Is a process planned and thought out
- Is a process that lasts and is positioned in time.
- Need individual approach
- Takes into account the "whole person" rather than single life roles
- Is an investment in permanent and long-term development.

Figure 6.1. Main coaching features
Source: own elaboration based on [27]

Relation between coach and coachee is emphasised as one of a crucial factor of successful coaching. Among others, relationship with a 'human face' and agenda that do not focuses exclusively on goals and quick solutions are stated [36]. De Haan and colleagues [7] found that cochee's perception of the relationship with a coach is the key factor in determining how the whole process and its' outcomes were perceived by a client. Similar conclusions on correlation between coaching's success and a quality of working alliance were made by Baron and Morin [3]. Coaching based on strong relationship, where both parts are perceived as collaborating partners is inspired by third-generation coaching [36]. Due to the fact that a good alliance is essential for the success of coaching and because coach and coachee often judge the quality of this relation in a different way, active monitoring of the alliance throughout the whole process is recommended. To establish such a strong relation couch must respond non-defensively to a client's hostility or negativity [13]. Another study on relationship between coach and coachee was held by Lambert and Barley [17]. It makes clear that working alliance is a factor that has the highest significance in regard to coaching success:

- the relationship accounts for 30% of the variance in results,
- 40% of that variance is attributed to exterior or circumstantial factors,
- 15% to hope or expectancy effects,
- 15% to specific theory or techniques.

Stelter [37] distinguish five dimensions of successful coaching, presented on Figure 6.2.

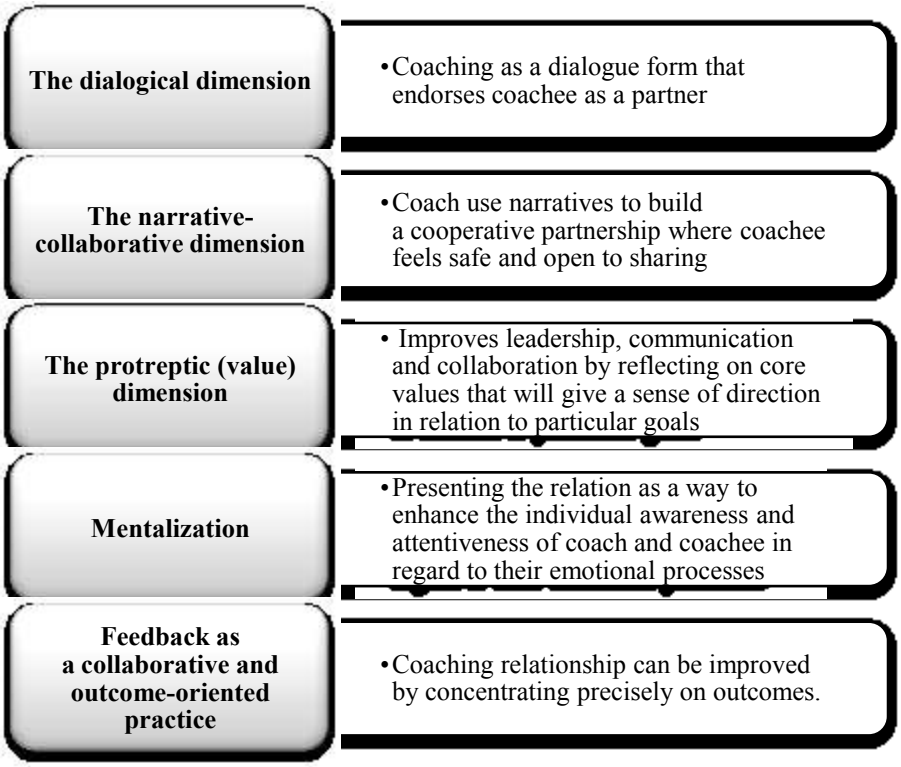


Figure 6.2. Five dimensions of successful coaching
Source: own elaboration based on [37]

Coaching partner's attitude towards coach and the whole process plays crucial role. Essential features that coachee brings to training sessions, such as life experiences, strengths, competencies, knowledge and willingness to change, account for 87% coachee's development [43].

Despite coaching partner perception of the process, the role of coach in delivering training programs thanks to intelligent and thorough use of significant and best up to date knowledge integrated with specialized practitioner expertise is also crucial and known as evidence-based coaching [10].

Connection that appears between coaching and sport seems to natural as even the word 'coach' from was first used in sports as a trainer (leader) that creates incentive, inspiration and performance improvement through their action

[8]. Still, fitness coaching is not the same as personal training. The aim of the first one is supporting changes that will lead to improvement in designated health categories thanks to motivational interviewing, goal setting, and education while the second one endeavours on helping individuals exercise [1]. Fitness coach should also help to break and prevent from entering the Vicious Cycle of Failure that is the set of wrong motivations that makes all coachee's effort ineffective [31]. The importance of fitness coaching was also underlined by Sforzo and colleagues [33], describing concept as a mix of mindfulness, empathy, optimistic emotions, autonomous motivation, appreciative inquiry, motivational interviewing, reflections, self-efficacy, visioning, and goal setting. This significance was also emphasised by Smith and McEwan [34].

Fitness coaching is based on both: individual performance and teamwork. The effectiveness of this process on personal self-efficacy during physical activity programs was described by Seghers et al. [32], while Carr and Peters [5] explain team coaching as an interactive dialogue over time to reflect upon, name, and maintain new ways of working together to achieve goals.

The strong bond between coaching and fitness was used by the author of that chapter as a background for analysis of social media dissemination in coaching process. In the following section some remarks on these tools usage in the context of motivational issues will be stated.

6.3. Social Media as a Tool for Coaching Online

Social media is an appealing area of research that is rapidly evolving [18] and the frequent publications dedicated to this subject seem to prove it. In the beginning of 21st century, there has been widespread of Web 2.0 services that especially put emphasis on user-generated content, usability and interoperability. The term was coined eleven years ago by Tim O'Reilly [23] and refers to new phase of WWW development and consists of a set of internet technologies that aid open and participatory work [26]. While the internet has been ordinarily used as a one-way communication channel, the concept of cooperating web has risen in popularity due to the dawn of social networking, which facilitates multi-way dialogue among internet users [40]. Consequently, websites have become co-created by the readers and social media have started to enable building long-term relations within community and drive beneficial customer actions.

Online coaching has been primarily developed as traditional sessions brought to the internet thanks to Skype or other applications dedicated to video conferences. Yet, social media allows to reach wider audience and offer not only one-to-one communication but also teamwork as well. Bringing coaching to the online community can be beneficial in a new way. The term 'online community' refers to the perpetual collections of individuals with common or complementary interests that use the internet to interact and cooperate with each other [44]. Benefits for coach and coaching partners were presented on Figure 6.3.

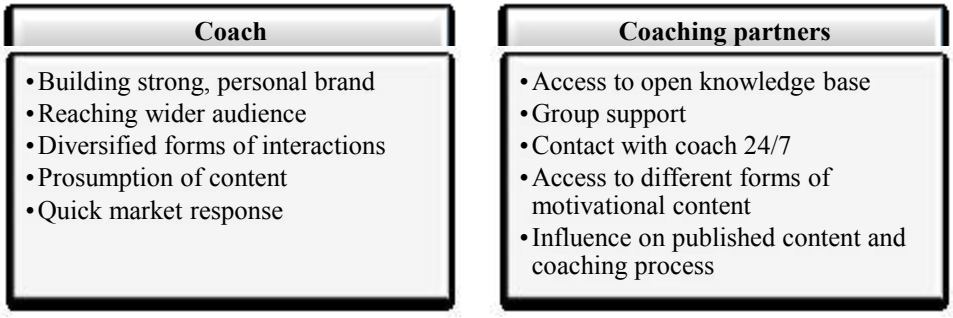


Figure 6.3. Benefits of coaching on social media
Source: own elaboration

Coach builds a personal brand and can become even a form of celebrity. Communication through social media has usually an informal character, so instructor gains more 'human face' and seems to be closer and more alike his coachees. Teenagers and young people often rely more heavily on feedback from their teammates and engage in direct comparison of ability [19], so this particular form of image can be more influential.

The content published by coach should be based on a close link between coachees and context. Various types of posted messages may impact more significantly as coaching partners thus become more aware of the impact of certain behaviours on their identity and self-concept, and how these actions are concerned in presenting life values and beliefs [36]. Social media allows diverse form of content: video, photo, text, contents, etc. And thanks to hashtags, folksonomy, marking users and private messages, it possess also high level of community interaction.

In one-to-many communication model, though, may emerge a risk of misguided, ineffectual content that will be unsuccessful. As what fits one, for another person may be not appealing at all and lead to decrease in motivation. Notwithstanding, social media offer a solution for quick response to current market (coaching partners) needs. The phenomenon called prosumption of context fit heavily into a nature of social interaction online. The term prosumer refers to an individual that produce many of his own goods and services [30]. Prosumer as a new form of client may interact in two models: client-client and organization-client. In that situation market changes into open forum, where active consumers may influence supply and demand [41]. This concept emphasises crucial role of relations between customers and market [22].

Prosumption of content on social media and online communities [2] evolves rapidly, for some internet users this process happens even unintentionally and unconsciously [39]. With a feeling of receiving a help without any charge, coaching partner uses contractual morality that requires reciprocating [39]. Internet users that feel strong relationship with a coach are also more willing to cooperate, interact and respond to published content. Furthermore, such a cooperation is perceived more like an entertainment without any obligation rather than collaboration with coach.

Prosumption of content is also related to viral, guerrilla and content marketing. Viral marketing, a form of guerrilla marketing, aims to provide content that in revolutionary manner proliferates across the internet users rapidly within a short period of time [12]. Campaigns based on guerrilla marketing should be original, appealing, connected with product, pass preoccupation in perception and find synergy effects [21]. Content marketing, though, can be defined as a management process where a company differentiate, analyze and gratify consumer demand to get profit with the use of digital content distributed through social media [29]. All these marketing approaches requires attractive, appealing content that has an effect on customers and prosumption may become a useful tool to achieve such material. Social media seem to be a promising environment for prosumption of content and that implies coaching process more responding to current market needs.

6.4.Approach to Case Study Analysis

As it was stated in Section 2, fitness coaching is gaining increased popularity. That is why this sector was chosen as the subject of conducted study. It's construction, aims and range are presented in this Section.

The first step in the preparation of research was a selection of social media tools. The following were chosen: Facebook, Instagram, YouTube and Twitter. The first analyzed tool was Facebook. With number of active users exceeding 1 663 million (II), that is probably one of the most popular social media service around the world. Instagram is a great example of visual content marketing tool as it relies heavily on short videos and photos with hashtags assigned. With growing popularity of this tool, it may shortly become important to enlist it into social media marketing strategies. YouTube is a platform dedicated for uploading and sharing online videos. Twitter is a microblogging platform, a social media network allowing users to publish short messages (up to 140 characters) very often including hashtags.

Next, an analysis of Polish fitness sector was carried out. As a result, twelve most recognizable and popular trainers were selected. Then, their official profiles on every service mentioned above were found and analyzed. Basing on number of fans, followers and subscribers, a trainer engaged the most in activity on social media was chosen for further examination considering coaching process and methods described in Section 2.

Statistics presenting popularity of most recognizable Polish fitness trainers according to number of fans, followers and subscribers were presented in Table 6.1.

Table 6.1. The most recognizable Polish fitness trainers according to number of fans, followers and subscribers

Trainer	Facebook	Instagram	YouTube	Twitter
Bilczyński Jacek	77 893	17 400	49 029	87
Brzezińscy Joanna i Dariusz	30 688	5 486	1 286	6
Chodakowska Ewa	1 906 908	752 000	186 889	13 700
Choiński Tomasz	130 117	27 300	1 681	Nd.
Gacka Natalia	95 616	37 600	6 634	159
Gruszecka Joanna	Nd.	1 241	1 900	Nd.

Lewandowska Anna	984 272	710 000	15 898	908
Mączyńska Małgorzata	22 486	16 300	155	280
Palka Adrianna	1 550	15 400	Nd.	Nd.
Szostak Sylwia	159 520	109 000	22 308	95
Tyszka Izabela	1 752	Nd.	3	0
Żelazo Aleksandra	24 505	Nd.	15 515	Nd.

Nd. – no data available
Source: own elaboration

According to the Table 6.1, the most active on social media Polish fitness trainer is Ewa Chodakowska and she will be a subject of further analysis.

6.5. Case Study Findings

Selected subject (Ewa Chodakowska) is a Polish fitness trainer and coach that publish her own trainings on DVDs, runs a fitness studio and online shop, publish a magazine and writes books. Still, her popularity has started on social media that helped to build a recognizable, personal brand. As Table 6.1 presents, this fitness trainer activity on social media was the highest among all analyzed subjects for every tool taken into consideration. That is why, she was chosen by the author of this chapter as a subject for case study.

On Facebook Chodakowska has more than 1,9 million fans, with average weekly growth at 0,22%. Fanpage ad-value, that is approximated cost to reach as many people with paid ads in other marketing channels as this fanpage did reach with its posts during the last 28 days, estimates for 474 000 €. She publishes at average 4,1 posts a day with post interaction that indicates how strong fans react to posts (the average number of likes, comments and shares per fan for all posts) at 0,58%. The engagement value shows the interaction of fans for a fanpage and is calculated by the average amount of likes, comments and shares per day, divided by the number of fans - and for this particular fanpage amounts for 2,4%. The overall strength of the fanpage was estimated for 46% (III). In comparison, another fitness trainer, Anna Lewandowska that reached second place in the number of Facebook fans, scored Average Weekly Growth at 0,71%, level of engagement 1,9% and fanpage performance at 55% (IV). The

first indicator could reach higher value due to smaller number of fans that makes every increase more significant in percentage. Still, it may imply slow saturation of market as the number of fans cannot grow continuously without broadening target audience. This index also influences total fanpage performance. Level of engagement was higher for Ewa Chodakowska. Comparison between these two fitness trainers performance on Facebook is illustrated in Figure 6.4.

Content published by Ewa Chodakowska on Facebook reaches fans all around the world, in 35 countries (Figure 6.5). 72,7% of followers react one time to the content, and 1,9% more than ten times (III). That presents that many people visit this page and read comments, but only a group of them responds regularly expressing their opinions.

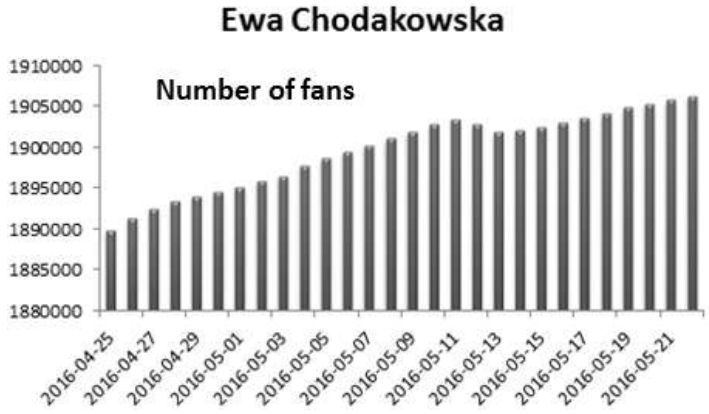
Some detailed statistics were also provided for YouTube channel and Instagram profile. This fitness trainer uploaded on YouTube 109 videos viewed 37,303,890 times. This channel was graded as B that means it can be considered as quite influential (V). On Instagram she has got 21 106 337 likes, 151 300 comments and 1 159 posts. Average likes per post amounts for 18 211, while average comments per post for 131. The most popular posts (by number of likes) presented content from private life and most popular according to number of comments to both – professional and private – content. Average number of posts is 7,95 daily (VI). This fitness trainer was also recognized as the 9th most influential person in Poland on Snapchat (VII).

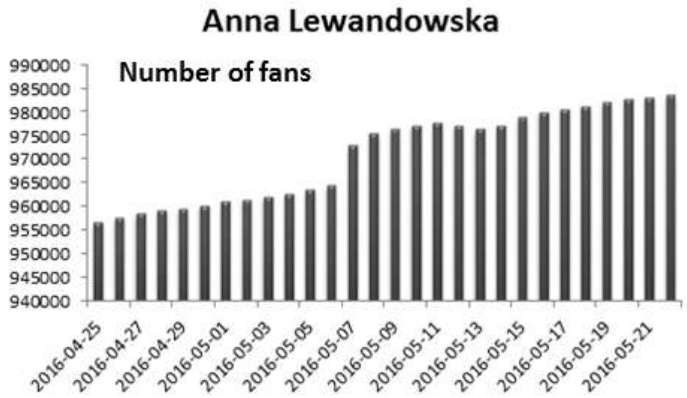
The main aim of the case study is to present the influence that social media can have on coaching online. After brief description of Ewa Chodakowska's presence on these services, her coaching practices will be examined.

As pointed in Section 1, one of the crucial factors affecting successful coaching is relationship between coach and coaching partners. On social media, these relations usually have one-to-more character as a coach is posting content available for everybody with only part of conversation taken to private messages. To create a well-established and effective relation, Ewa Chodakowska runs all her profiles herself. After uploading new content, she usually takes part in the following discussion in comments under the posts as well as respond for private messages sent by users. That gives a sense of her presence in the community and increase users interaction.

Building a good working alliance should be based on 'human-face' of the coach [36]. Using different social media services, this fitness trainer seems to reach the goal. Facebook is used in the most broad range. There is published different content: text, photo and videos describing professional issues (events, fitness studio and online shop offer, job offers etc.), effects of her training programs (client's metamorphoses), sponsored material (Adidas ambassador), but also numerous free materials (training and diet programs, psychological advices), photos with fans, as well as various information from private life. Instagram presents photos and videos with short descriptions, from business and private aspects of life, but with stronger emphasis on personal life, what lets coaching partner know better their coach. YouTube is dedicated mostly for dissemination of free training programs and on Twitter usually links to all the above content are published. With such broad spectrum of tools, Ewa Chodakowska can manage her image, presenting 'human-face'. This process is quite successful as many of her followers often claims that she is not a celebrity but an ordinary woman.

Figure 6.4. Facebook activity of Ewa Chodakowska and Anna Lewandowska (data from period: 25.04.2016-21.05.2016)




Anna Lewandowska
Number of fans
990000
985000
980000
975000
970000
965000
960000
955000
950000
945000
940000
2016-04-25
2016-04-27
2016-04-29
2016-05-01
2016-05-03
2016-05-05
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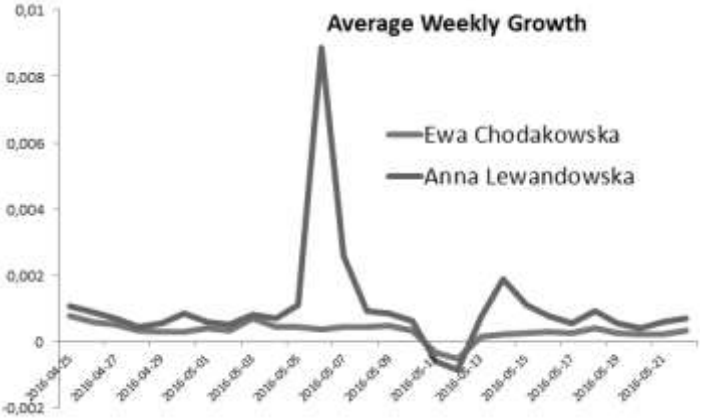
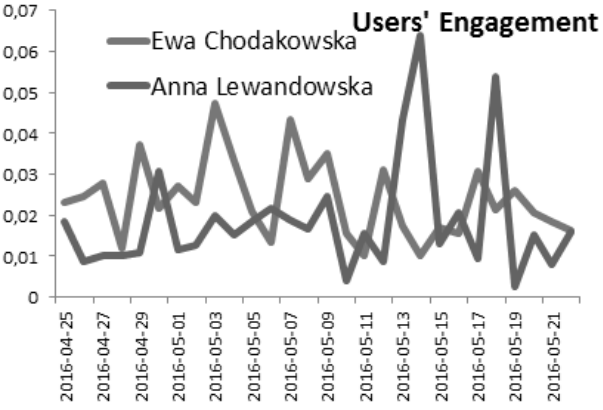
2016-05-19
2016-05-21


Average Weekly Growth
0,01
0,008
0,006
0,004
0,002
0
-0,002
Ewa Chodakowska
Anna Lewandowska


Users' Engagement
0,07
0,06
0,05
0,04
0,03
0,02
0,01
0
Ewa Chodakowska
Anna Lewandowska
2016-04-25
2016-04-27
2016-04-29
2016-05-01
2016-05-03
2016-05-05
2016-05-07
2016-05-09
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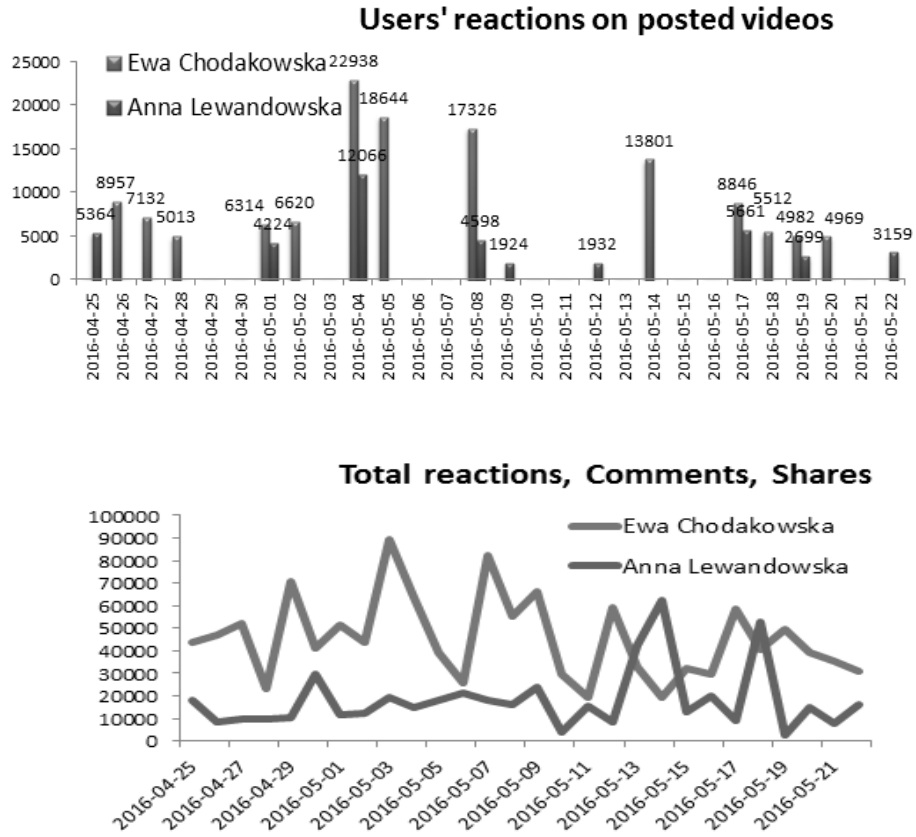
2016-05-21



Source: own elaboration based on data from (III) and (IV)

Figure 6.5. Range of Ewa Chodakowska's Facebook activity
Source: own elaboration based on data from (III)

Coaching through social media requires effective distribution of a content. Posting frequency, time and day of a week, type of material published – all can affect users engagement. Most of the content published by Ewa Chodakowska on Facebook is text supported by photos (86%), while 16 % refers to text supported by videos. Average users reactions on each type of a content presents Table 6.2. The relation between time and posts effectiveness for this case study subject is illustrated on Figure 6.6.

Table 6.2. Average numbers of coaching partners reactions on published content

Type	Avg. Likes	Avg. Comments	Avg. Shares	Avg. Total Reactions
Photos	10 480	339	336	11 628
Videos	5 288	539	821	7 281
Total	**9 674**	**370**	**411**	**10 455**

Source: own elaboration based on (III)

0The Figure 6.6 presents when this coaching trainer has posted. Bigger bubble means more posts, while the colour indicates fans reactions – the greener, the more likes, comments and shares.

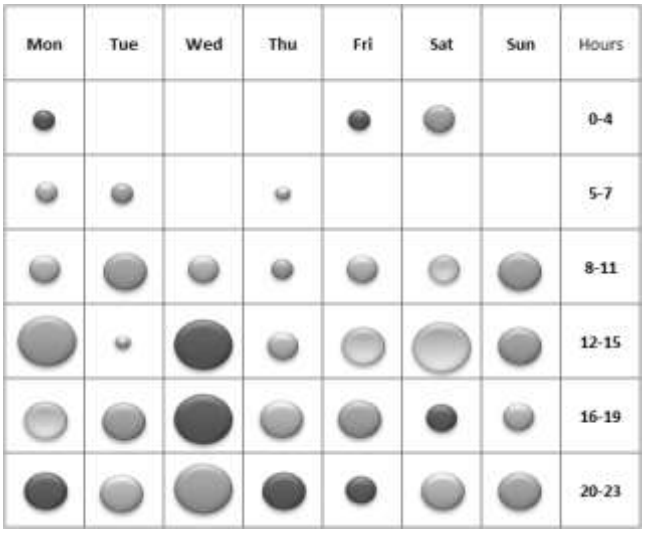


Figure 6.6. Relation between coachees' engagement level and posting daytime
Source: own elaboration based on data from (III)

Figure 6.7 is the engagement matrix. It indicates possible ways of improvement of published materials according to their quality or frequency of posting. The aim is to move all dots in the upper right area of the matrix, where number of users responses is high and posts appears often. Posts placed in the upper left area could be used more repeatedly, while these in the lower right area should be more appealing and interesting.

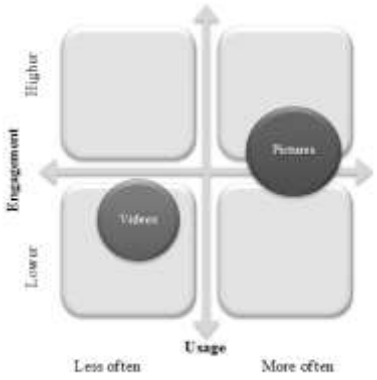


Figure 6.7. Ewa Chodakowska's fanpage effectiveness matrix
Source: own elaboration based on data from (III)

Establishing strong relationship requires emotions and they can be achieved with a high level of interaction between coach and coachees. Social media is a powerful tool to achieve such interaction. Real-time communication and quick responses to users comments, presenting emotions (from euphoria to anger) don't leave the community indifferent. Sometimes this fitness trainer responds directly to followers requests that strengthen this bond, like publishing videos with birthday wishes or sending pictures or motivational messages on demand. She also presents her devotion by memorizing the most active social media users and recognizing them during face-to-face events.

To motivate coachees, Ewa Chodakowska uses diversified approach. On one side, she presents free content available for everyone that allows to achieve required results in a given time without any costs or purchases. On the other, she advertises her studio and online shop, encouraging acquisitions. To keep coaching partners motivation she regularly posts client's metamorphoses and psychological advices. To improve interaction level, she organizes contents

available only for social media followers, participates actively in a discourse and publish material arousing emotions.

As it was described in Section 3, social media can be perceived as an effective tool for coaching due to prosumption of content that is widely disseminated on these services. Chodakowska uses this feature regularly, from bringing her company's Human Resources and publishing job offers, to responding quickly to market needs. Sometimes there are some post uploaded asking directly for new ideas or evaluation of existing, whereas from time to time, this information is derived from users comments. At the end, it results in new events, training programs and marketing strategies.

The hateful users responses that appears occasionally on the site, meet with strong reactions from the community. Though the coach usually answers herself, followers manifests themselves in strong sense of affection and devotion. This illustrates that Chodakowska's personal brand – thank to social media – is getting stronger and well established. With a considerable group of brand advocates, a brand can be considered as a cult one. the justification of this statement can be found directly in fans' comments, where this online community is often determined as a 'sect' (both by the fans and opponents).

Strong online community on social media allows additional advantage for coaching process, namely support and motivation is not only delivered by coach by also by individual group members that help one another.

Figure 6.8 presents the main advantages for coaching process derived from activity on social media, based on Ewa Chodakowska case study.

Coaching via social media

- Strong relationship between coach and coaching partners
- Sense of belonging to an online community
- Group support
- 'Human-face' dimension of coaching process
- Real-time communication
- Diversed content that keeps motivation at high level
- Prosumption of content
- Quick responses to clients' needs
- Personal brands advocates
- Wide public available
- Easy searching for new ideas and business opportunities for coach
- Building strong, presonal coach's brand

Figure 6.8. Coaching benefits derived from activity on social media (Case study example). Source: own elaboration

Nonetheless, analysing the case of Ewa Chodakowska coaching process through social media, there are some negative remarks that should be stated. First of all, there are some lacks in marketing approach. The vast part of her coaching efforts address people (usually women) with obesity problems. Client's metamorphoses, contents and motivational posts often are dedicated to a group of people that aims in weight loss. People without overweight can find less motivational content as it was assumed that their motivation will be permanently high.

The second issue is broadening the geographical customer target. Recently, some of the content have become translated into English, with the intention of going more international. Though, this is not a regular process and possible clients from other countries cannot find broad spectrum of coaching materials through this fitness trainer's social media channels.

The last argument derives from the vast number of followers and running all the profiles by the coach personally. Not every coachee question or comment may be responded and some individual bond will be never created as it is possible in face-to-face interaction. In the analysed period (from 25 April to 21 May), 94,66% of users posts were ignored by the coach and the average response time amounted for 6,4 hour (III).

6.6. Summary

Growing popularity of coaching in almost every part of human life makes this market more competitive. As a vast part of everyday life is brought to the internet and the number of social media users is growing continuously, these services should be considered as a new way of communication between a coach and his coaching partners. With some advantages typical for online communities existing on social media, online coaching through this channel can also benefit. still, there are some potential threats like weakening individual bonds or leaving some coaching partners without personal support. Also flaming and hateful messages that may appear on the profiles, may harm an image of coach's personal brand if they wouldn't meet the immediate and proper response.

The chapter described the idea of coaching and main factors of successful coach as well as the potential of social media usage in this process. Presented case study illustrated the potential of social media as an effective channel for coaching communication and establishing coach's personal brand. Though it concentrates on fitness coaching in Poland, the study could be successfully carried out for some other types of coaching as well. A natural extension of this chapter is to expand the proposed research to deal with fitness coaching internationally. In that situation, some additional social media services should be taken into consideration, as the ones selected for presented study were the most popular in Poland. Other directionsconsist of studying the influence of social media on coaching process in other aspects of everyday life or for business (i.e. recruitment, management, business, talent coaching, teamwork, leadership coaching and job coaching).

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Chapter 7

Concept of the Workflow System Design for Training Organization

7.1. Introduction

To guarantee the quality of certificates issued by training organization, it has set up the Quality Committee (further called in abbreviated form as QC) whose main objective is to monitor and further improve the system of implementation of the Quality Assurance Standards. The Quality Assurance System being created aims also at supporting all parties that are involved in the certification process in both technical terms as well as in those of merit. The process in question is highly complex. A number of parties participate in it (among others, a Candidate, an Examination Centre EC, an Examination Laboratory EL, an Examiner, an Auditor, a Member of the Quality Committee, an Quality Committee Office QCO, etc.). Thus, in order to make it work more efficiently, the need arose to build a corresponding information system. First, the implementation of the Examination System (further abbreviated to ES) became completed, which provided a candidate to the certificate with comprehensive support in the process of examination. Concurrently, the initial draft of the information system got created under the name of the Quality Committee System (abbreviated to QCS). It was designed to ensure the quality of entities authorised to certify, namely examination centres and examination laboratories. The author of the chapter focuses his attention only on the QCS system and puts forth the thesis that the finite-state machine theory which is an iterative model of behaviour of a dynamical system based on the table of discrete transitions between its consecutive states can be applied to design selected functionalities of the IT system.

7.2.Selected Aspects of Building the Quality Committee System

The process of building the QCS system became divided into several stages. At the first of them, the Transitory Quality Committee System,TQCS,

was worked out and implemented. However, it supported only basic processes of the Quality Committee. The TQCS system aimed also at collecting information to create a data base which was intended to be used in the target system. The second stage boiled down to creating the New Quality Committee System(abbreviated to NQCS) which offered comprehensive support for the Quality Committee's processes concerning accreditation of its entities and which was integrated with the already existing ES system.

On the stage of the analysis of the Quality Committee's operations, the most important processes were worked out on the basis of the Business Process Modeling Notation and divided into the following main processes: accreditation of an examination centre along with a basic laboratory, re-accreditation of an examination centre along with a basic laboratory, accreditation of a laboratory, re-accreditation of a laboratory, initiating / changing co-operation between an examination centre and a laboratory as well as the following auxiliary processes (supporting the main processes): audit, vote, payment, authorization.

A part of the process of accreditation of an examination centre along with a basic laboratory is illustrated by Figure 7.1. The process-oriented approach and application of the worked out processes made it easier to determine the range of the system and to establish the logic of how the system should operate.

At the stage of designing the system, the introduction of the object called 'application' proved to be a crucial notion. It was assumed that the object in question would have a unique identifier and its own values (connected to accreditation parameters). It would beset up for an entity to be accredited, such as an examination centre or a laboratory, from which it would inherit specific values.

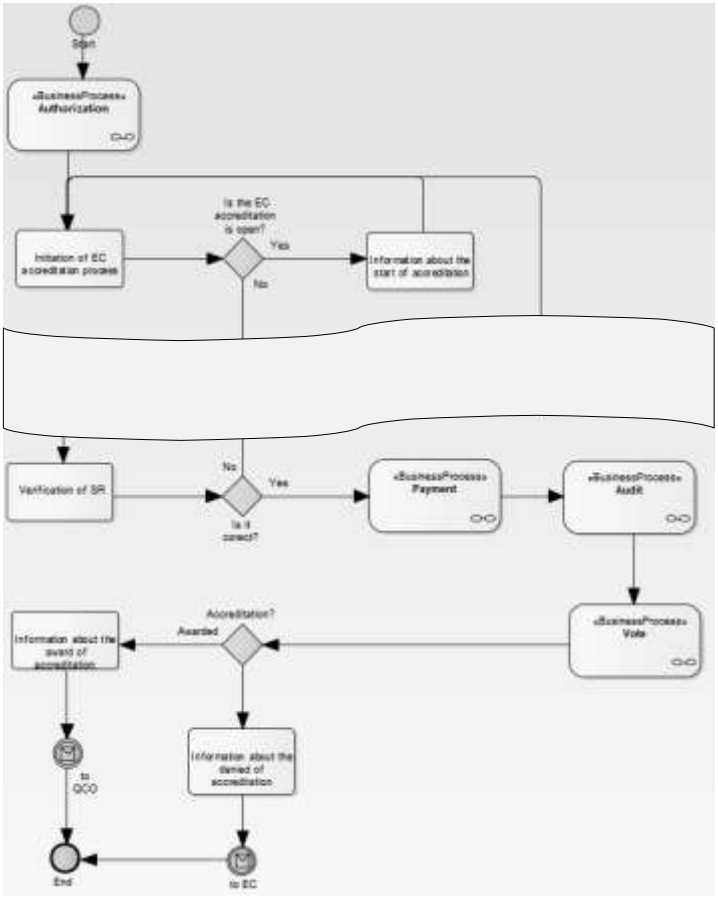

Figure 7.1. A part of the process of accreditation of an examination center along with a basic examination laboratory
Source: based on the author's research

It could be in one of a finite number of states – so-called 'application' statuses (see Figure 7.2). It was also assumed that all the QC main processes would operate on the object 'application'. Hence, the state diagram theory was applied in designing, which enabled description of changes in the object state, as well as in the entire system, while being altered by operations performed on this object. Defining the state of 'application' made it possible to determine what properties should the object have (which would be visible for different parties of the accreditation process) as well as what operation can be performed on the object (what operations are to be performed by the parties of the accreditation process) in the particular state of affairs.

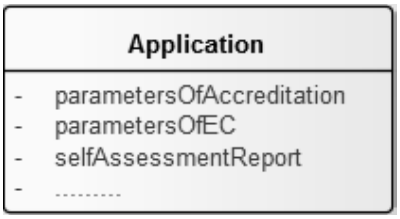

Figure 7.2. Selected elements of the object called 'application' for the process of accreditation of an examination centre along with a basic examination laboratory
Source: based on the author's research

The presumption was also made that the NQCS system should react to different statuses of each 'application' in the way defined for the particular state of the object. In addition to that, it would change the state (it would make the transition from one state to another) according to the defined activities performed by its user [3]. Table 7.1 contains the sample states and events of the 'application' object for the process of accreditation of an examination centre along with a basic laboratory, while Figure 7.3 shows the abridged state diagram. Such an approach enabled designing effectively most of the system as well as its proper implementation.

Table 7.1. The selected states of the 'application' object for the accreditation process of an examination centre along with a basic laboratory

State No	State	Event No	Event
1	Application activated	a	The self-assessment report is being sent by EL user to be evaluated
2	Self-assessment report posted to be improved (by EC)	b	The self-assessment report is being re-sent by EL user to be evaluated
3	Self-assessment report posted to be evaluated (by EL)	c	The self-assessment report is being sent by EC user to be improved
…	…	…	…
9	Self-assessment report SR approved (by QCO)	i	An invoice is being drawn up by QCO user
10	Invoice drawn up	j	An invoice is being sent by QCO user
11	Invoice sent	k	An invoice is being paid by EC user
12	Invoice paid	…	…

State No	State	Event No	Event
…	…	…	…
20	Voting ended	t	An accreditation is being awarded by QCO user
A	Accreditation awarded	u	An accreditation is being denied by QCO user
D	Accreditation denied		

Source: based on the author's research

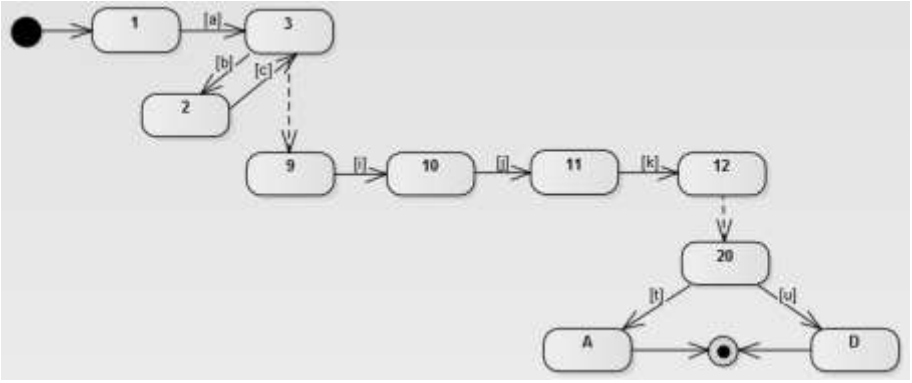

Figure 7.3.The abridged state diagram of the 'application' in the process of accreditation of an examination centre along with a basic laboratory
Source: based on the author's research

At the third stage, the integration of the NQCS system with the external financial and accounting system of the PTI (abbreviated to F-K) is planned. The integration of the two systems is meant to be carried out by a web service and it would boil down to the remote call by the NQCS system for a service of the F-K system, which is expected to result in reply information formed by a string of values. The integration will take place for, inter alia, the states 10 and 11 of the 'application' in the process of accreditation of an examination centre along with a basic laboratory and it will boil down to automatically obtained information on a status of the invoice for the 'application'. So far, the status has been changed as the result of an event manually caused by a user of the system (by a representative of the Quality Committee Office) after the preceding analysis of the status of the invoice in the F-K system. However, the whole problem lies in the fact that contrary to the already existing structure and behaviour of the de-

signed system, where transitions are the results of an event caused by a user, in the newly created solution, the system will activate the event automatically.

It will shift to one of the several states on the basis of a string of characters. In order to solve this problem, the author of the chapter suggested that the finite-state machine theory should be applied in further designing the NQCS system.

7.3. The Case of Application of a Finite-State Automaton

The theory maintains that a finite-state machine (FSM)[5] is an abstract mathematical iterative model of behaviour of a dynamical system which is based on the table of the discrete transitions between its consecutive states. The theory in question can be applied in, inter alia, mathematics and logic as well as in linguistics, philosophy, or biology. An FSM is also a standard model used in the mathematical foundation of computer science, e.g., in hardware applications, and a theoretical tool for creating and testing software [3], [4]. An FSM can be represented by means of the following elements [1]:

$<Q, \Sigma, Z, \delta, q_0, F>$

Q – (vertices) a finite set of states, normally represented by circles and labelled with unique designator symbols or words written inside them;

Σ - a finite collection of input symbols or designators;

Z - a finite collection of output symbols or designators;

δ - (edges) represents transitions from one state to another as caused by the input (identified by their symbols drawn on the edges);

q_0 - the start state $q_0 \in Q$ is usually represented by an arrow with no origin pointing to the state;

F - (accepting state(s)), usually drawn as a double circle;

ω - (output function) represents the mapping of ordered pairs of input symbols and states onto output symbols, denoted mathematically as $\boldsymbol{\omega} : \boldsymbol{\Sigma} \times \mathbf{Q} \rightarrow \mathbf{Z}$.

Following J.Carroll and D. Long [2], the simplified concept of an FSM is adopted in the present work. It consists of the five elements: $<Q, \Sigma, \delta, q_0, F>$ and is used to build, among others, a parser state machine (also called a recognizer or acceptor). To graphically model the FSM, the state diagram is applied

[5] FSM was introduced by C.E. Shannon and W. Weaver in their 1949 book "The Mathematical Theory of Communication".

(the one that has been used above)[6]. According to the simplified concept, the finite-state machine works on the basis of the analysis of the input characters from the finite alphabet Σ. Each read symbol triggers a transition to a different state q_i that belongs to Q (in some cases a transition leads to the very same state). After having analysed all the symbols, the finite-state automaton can reach one or more accepting states F.

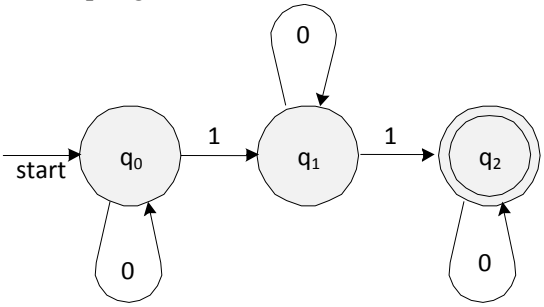

Figure 7.4.The state diagram of the finite-state automaton which accepts the binary string containing two 1s
Source: based on the author's research

To illustrate how the finite-state machine works and how it can be used in the suggested solution, the analysis of modelling a computational mechanism should be conducted. It answers the question whether a particular binary string input = 0,0,1,0,0,1, ∑={0,1} belongs to the set of strings that contain two 1s (the state diagram for the problem in question is presented by Figure 7.4). A finite-state automaton reads a particular string in and analyses it a character by a character. After having processed the entire string, it provides a positive answer under the condition that the system reaches the accepting state $F=q_2$. In a finite-state machine, transitions between states occur as a result of reading the consecutive characters of the analysed string in. In the case under the present research, the shift will take place only after encountering the value of 1. The mentioned above model belongs to the group of Deterministic Finite-state Automata (DFA), which means that only a unique computation of the automaton can be produced for each symbol that is contained in ∑.

[6] The state diagram is a notation which is based on the concept of a state machine.

7.4. The Model of Behaviour of the NQCS System in the Light of the Finite-State Machine Theory

The integration of the NQCS system with the external F-K system demands an application of data exchange between two different system environments. It has been assumed that the web service method, which has already been used to integrate the ES system with the F-K system, will be also applied this time. In the previous case, the Simple Object Access Protocol (SOAP) and the Extensible Markup Language (XML) were implemented. The data exchange occurred only occasionally and it was triggered by an event generated by a user of the ES system.

In the case under the present research, the NQCS system is to trigger the service automatically in a determined interval of time (e.g., every 12 hours) for the 'application' with the status 9, which will result in simple information in the form of a zero-one string. Depending on the accepted string value, the 'application' is expected to change its status for 10, 11, 12, or to remain unchanged.

At the stage of designing the behaviour of this part of the system (concerning determining a status of 'application' in accordance with the status of the invoice), the application of the finite-state machine theory is recommended. It has been assumed that the string will take the form of Σ which consists of four elements, where each of them means respectively: 1) 0 – does not concern, 1 – concerns; 2) 0 – the invoice not drawn up, 1 – the invoice drawn up; 3) 0 – the invoice not sent, 1 – the invoice sent; 4) 0 – the invoice not paid, 1 – the invoice paid. Then the behaviour of the system has been created, which is illustrated by the Figure 7.5. The state transitions between different patterns of behaviour are contained in the Table 7.2.

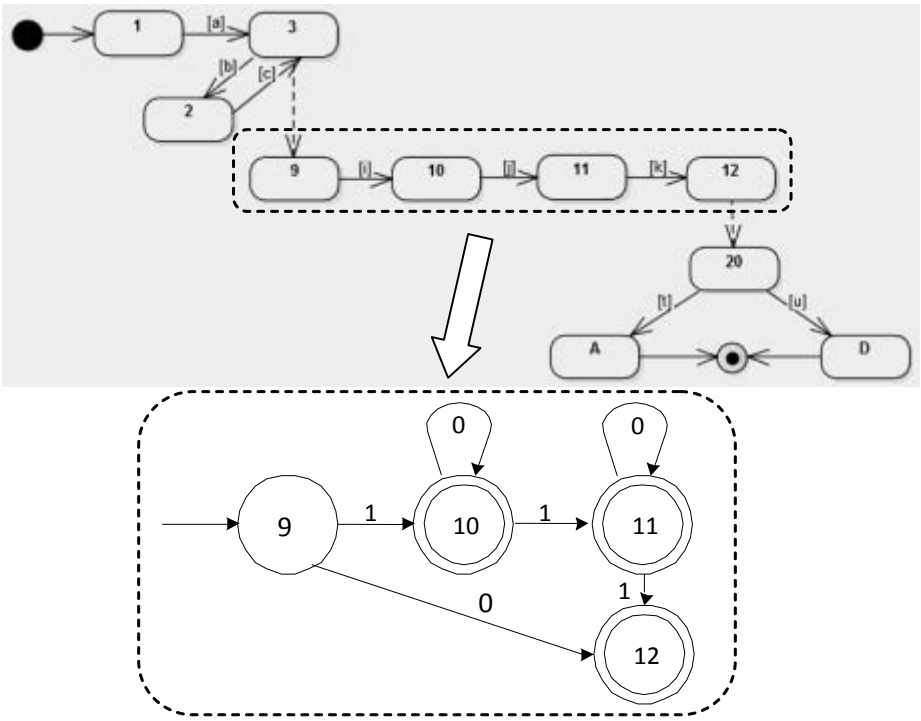

Figure 7.5. The state diagram of the finite-state automaton determining a status of 'application'
Source: based on the author's research

Table 7.2. The state transition table for the automaton

State (Q)	0	1
9	12	10
10	10	11
11	11	12

Source: based on the author's research

Every call for the service has boiled down to the interpretation of a string received and in case of acceptance(the accepting states F = {10, 11, 12} are related to the consecutive statuses of the matter), the change in the 'application' status will take place, which closes the operation of the automaton.

7.6. Summary

The finite-state automata theory is widely applied. In the field of information science, it became a mathematical basis for designing behaviour of computer hardware and software. The theory in question can be used in both designing and programming embedded systems. It can also be the theoretical basis for building, analysing and applying programming languages. Information system designers indirectly use it every time the behaviour of the system is modeled by means of state diagrams which share the same roots with the FSM.

This chapter has demonstrated that the FSM concept can be successfully applied in designing a range of specific information solutions which make the integration of the two different systems easier. Using the FSM in designing contributed to building clear, easy to program and having light usage on resources behaviour of the system after receiving the information in form of string of characters from another system.

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Chapter 8

SJUTF Framework for Timetabling with Focus on Reducing Overall University Costs

8.1. Introduction

The overall objective of the timetabling problem is to assign a set of entities (such as tasks, public events, vehicles, or people) to limited number of resources over time, in such a way as to meet a set of pre-defined schedule requirements [1]. there are many timetabling problems. which the purpose of almost all of them is to find an assignment of entities to a limited number of resources while satisfying all the constraints. In term of university timetabling focus is on optimized use of resources (time and space) considering the students, teachers, and university itself constraints [3]. Constraints are usually categorized in two types. Hard constraints and soft constraints. Hard constraints must be satisfied in the timetabling solution, but soft constraints are desired but can be ignored in special situation to make problem feasible to solve with hard constraints. Yet more Soft constraints are satisfied in the final solution, the better the quality of the solution.

In first tries for solving this problem linear approaches were popular. Some of earlier solutions of timetabling problem were using the integer programing approach. Kang and White (1992) propose the logic programming approach for the problem. Using backtracking technique and implemented their work in PROLOG .the main outline of these type of algorithms were the sequentially implementation of the given constraints. More Recent work by Schimmelpfeng and Helber (2007) uses the both the CPLEX (IBM ILOG Optimization Studio) and the mixed – integer solver. In their work they use the real world instances and the result shown in their paper describes that it required a very short running time[10]. Walker (2016) attempts to resolve each infeasibility in the smallest neighborhood possible, and utilizes the exactness of integer programming. Operating within a neighborhood of minimal size keeps the computations fast, and does not permit large movements of course events, which cause widespread disruption to timetable structure [12].

Another approach to solve timetabling problem is constraint satisfaction. The problem is firstly represented in the form of constraint satisfaction problem and afterward using the CSP solving techniques like backtracking and path consistency. Constraint satisfaction imposed the constraints and represents the problem in the form of linear equation and a set of variable describe the possible solution [11]. These constraints must be satisfied for the feasibility of the solution. Example no lecture should be idle in the first half of the given time slot in a day, for this the availability of teacher must be required. Badoni (2014) Proposes an algorithm which incrementally constructs a solution as is done by the usual backtracking algorithm. Whenever a dead-end is encountered, rather than backtracking to the previously assigned variable, it resolves its cause by using a local search min-conflicts-hill-climbing algorithm and then continues further progressives [7].

Graph coloring techniques attracted most of the researcher this is the reason recently graph theory is highly studied for solving the timetabling problem. Neufeld and Tartr (1974) give the earliest graph coloring approach for the solution of timetabling problem he reduced the problem in the form of vertex and edges the events are in the form of vertex and the given constraints are in the form of arc, and the vertex which are connected to the same node should not have the same color. Given the graph coloring approach in two phases. In this paper they use bipartite multi-graph in first phase, they represent the graph in the form of matrix which give the daily and weekly requirement and obtained a linear equation, for the variable they use the integer values. In the second phase they use the bipartite graph for assigning the lecture in the unconstraint time slot and the randomly generated dataset for example expert lecture and extra classes for each day. In a recent work Sabar [14] utilizes the hierarchical hybridizations of four low level graph coloring heuristics, these being largest degree, saturation degree, largest colored degree and largest enrollment. These are hybridized to produce four ordered lists. For each list, the difficulty index of scheduling the first exam is calculated by considering its order in all lists to obtain a combined evaluation of its difficulty. The most difficult task to be scheduled is scheduled first. To improve the effectiveness of timeslot selection, a roulette wheel selection mechanism is included in the algorithm to probabilistically select an appropriate timeslot for the chosen task [14].

Metaheuristic is formally defined as an iterative generation process which guides a subordinate heuristic by combining intelligently differently concept for exploring and exploiting to search space, learning strategies are used to structural information in order to find efficiently near – optimal solutions. Techniques which constitute metaheuristic algorithm range from simple local search procedures to complex learning procedure. In the past decade the researcher shows their great interest in metaheuristic algorithms for the timetabling problem. Most of the metaheuristic algorithms are bio – inspired (ACO) ant colony optimization, bee colony optimization (BCO), swarm intelligence based algorithms PSO (particle swarm optimization), AFS (artificial fish swarm) and the genetic algorithm. Metaheuristic algorithms basically work on three stages: highest degree, neighborhood search and the tabu search [5].

In this chapter the solving engine for this problem is just one part but important one of the entire framework which is based on a modified version of genetic algorithm [2] with a recursive approach to generating an optimized timetable. This algorithm tries to satisfy both hard and soft constraints.

Course timetabling problems occur every semester in universities. Although there are many educational systems in world many of them use same traditional system to generating handmade timetables with selecting a course and applying various constraints in its schedule. The SJAU University, a small-size university located in west of Iran have used this method for timetabling too. Because of problems and low effectiveness of generating timetables using these methods universities has been interested in using automated intelligent systems to accomplishing this complex job [4].

A good timetabling solution can generate an optimized feasible timetables which have considered pre-defined constraints. Due to inherent problem complexity and variability, most of the real-world university timetabling problems are NP-complete [8]. It is widely accepted that one way of dealing with NP-complete problems is to make use of approximation algorithms which while not being able to guarantee an optimal solution, will hopefully produce a solution that is good enough for practical purpose in the majority of cases. Metaheuristic methods are appropriate for these kinds of problems [13]. Many approaches have been used to solve timetabling problems like Graph Coloring, Tabu Search, Ant Colony, Particle Swarm, Genetic Algorithm and etc. [9]. In this chapter we have used a recursive version of genetic algorithm in our core com-

ponent of SJUTF (**S**ayyed **J**amaleddin **U**niversity **T**imetabling **F**ramework) to generate all feasible timetables based on our constraints. Constraints in this kind of problems can be entered manually or be generated using systems previous state like evaluation results.

8.2. How General Genetic Algorithm Works

Genetic algorithms (GA) are search procedures based on the mechanics of natural selection and natural genetics. They were developed by prof. John H. Holland and his students at the University of Michigan during the 1960's and 70's.

Genetic algorithms operate on a set of possible solutions. Because of the random nature of the genetic algorithm, solutions found by the algorithm can be good, poor or infeasible so there should be a way to specify how good that solution is. This is done by assigning a fitness value to the solution. Chromosomes represent solutions within the genetic algorithm. Two basic components of chromosomes are the coded solution and its fitness value [6].The outline of a basic genetic algorithm is:

```
procedure genetic algorithm;
    begin
        set time t: = 0;
        initialize the population P(t);
        while termination conditions not met do
            begin
                evaluate the fitness of each member of the population P(t);
                select members from population P(t) based on fitness;
                produce the offspring of these pairs using genetic operators;
                replace, based on fitness, candidates of P(t), with these offspring;
                set time t: = t + 1;
            end
    end
```

8.3. SJUTF Framework

This Framework consists of four essential components. First component gets the Data tables of student's marks and the statues of passed subjects and the results of trial pre-semester unit selection as input for first component. then it generates a list of available courses for next semester based on other input the program's subjects catalog (Approved Curricula) and for each subjects gets a number that is the total number of students who don't have problem for selecting that subject. Finally, the output of this component is the list of certain next semester courses.

Second component manages the constraints. It gets teacher evaluation logs from Teacher Evaluation System as data tables, costs of student's accommodation and costs such as scholarship Students Subsidies and grants from Students Nutrition System, Students Dormitory System, Students Financial Affairs System (All as Data Tables), Costs of teachers from Teachers Integrated Management System (Costs like Transportation, Nutrition, Hotel and etc.) this component simply sorts the list from Lowest Cost entities to highest. Then Generates Time and Space Constraints tuples using this sorted lists for every teacher and Student groups. It's possible to add constrain rules for system entities manually as direct commands.

In third and main component which plays a critical role in this system we have a list of candidate subjects and student groups, system resources and constraints tuples as input. Our recursive version of genetic algorithm then assigns subjects with respect to constraints to (time – space) slots. Hard constraints which are identified by their weight (equal to 100) must be satisfied but soft constraints (with lower than 100 weights) is desired to be satisfied and priority is with higher weights. It generates every possible timetables for the university.

Finally, the forth component formats the selected timetable as acceptable input for Education Enrollment system. Which is the list of subjects with their weekly schedule and assigned classroom(s) and related teacher(s) in semester. It's possible to see all feasible timetables as html documents.

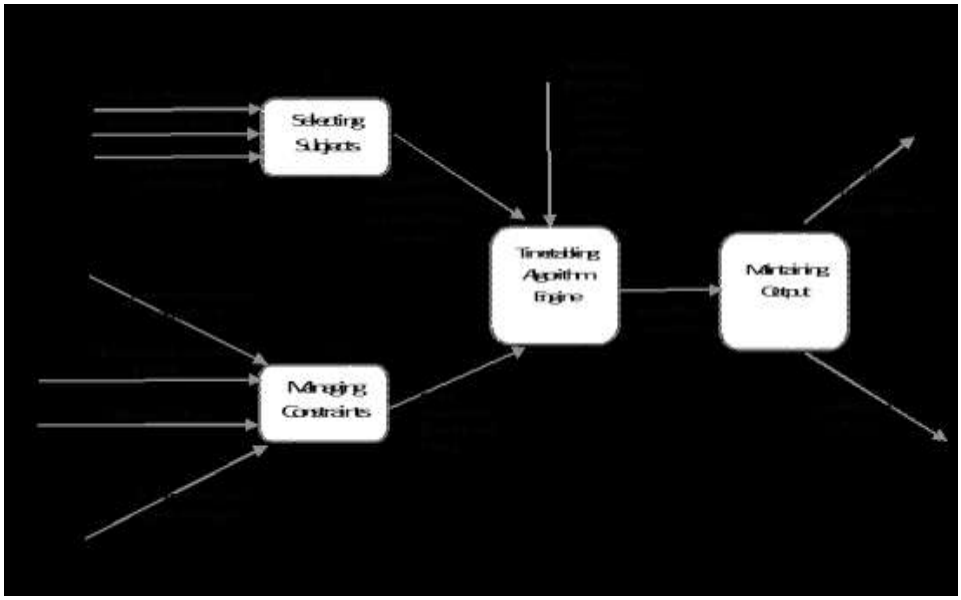

Figure 8.1. Components of SJUTF framework

8.4. How Main Algorithm Works

We have used a modified version of genetic algorithm as our timetabling algorithm. We generate U list as our unavailabilities based on set of hard and soft constraints (defined by their weight) as periods of time on specific spaces. Each course has a teacher and student group assigned. In every iteration of this algorithm after new time assignments the list U will be updated for next execution. the main function in this algorithm TTSolve function gets three parameters. The courses are listed in SJ[]. GAP is Genetic Algorithm Parameters and U is list of unavailabilities. After complete execution T will be our desired Timetable. At the beginning we empty lists. select a course, find a partial solution and add it to solutions lists S for that course, update U list and add partial solutions to final T.

```
TTSolve (SJ [], GAP, U)
SJ []: list of courses
GAP: Genetic Algorithms Parameters
U: agents unavailabilities
1       Empty (T)
2       for j←1 to LENGTH(SJ)
3               Do
4                 C←SJ
5                 Empty(S)
6                 S←GENETIC-ALGORITHM(C,U,GAP)
7                 U←EXTRACT-ASSIGNMENTS(S) ∪ U
8                 T←T ∪ S
9       return T
```

The fitness function F(C) evaluates course timetable based on its constraints violations. Course are selected in order of their complexity. A fitness value can be between 0 – 1 and a value closer to 1 is more desirable. A course with highest number of related constraints will be selected first. After all this component generate all feasible timetables.

The forth component converts this XML timetable to acceptable format for University Enrollment System which includes the course properties, weekly schedule and specify this course must be presented to which students. This component also generates html view of all timetables to see and choose desired one to import to Enrollment System.

8.5. Experimental Results and Conclusions

The experimental results for two continuous semester using this framework showed improvement in all pre-defined goals.

We used an experimental survey method to compare results both from semesters using timetables generated in traditional system (two continues semester as an educational year) and semesters which have used the SJUTF framework for generating timetables. Results summarized in Table 8.1 for students and Table 8.2 for teachers. In educational year (2013-2014) university used traditional method for timetabling and in educational year (2015-2016) SJUTF

framework replaced. Results for both students and teachers showed significant improvementin measured parameters except in Overall evaluation score for teachers which has not been changed significantly. The data to comparison collected from universities official statics for two educational years. The SJAU University uses various evaluation and survey systems for both students and teachers which helped a lot in data collecting phase. In comparing costs we ignored the average Inflation rate of year.

Table 8.1. Comparing **SJUTF** framework vs traditional method for timetabling – students' results

Parameters	Educational Year (2013-2014)	Educational Year (2015-2016) *	Improvement (%)
Staying time(Day)	4.2	2.7	- 35%
Living costs (food, accommodation, facilities and other costs) per student (IRR)	9658000 IRR	7961000 IRR	- 18%
Semester average mark (maximum 20)	12.3	15.7	+ 27%
Overall Satisfaction (Measured by Student's Survey System – maximum 10)	6.6	7.5	+ 13%

Table 8.2. Comparing **SJUTF** framework vs traditional method for timetabling – teachers' results

Parameters	Educational Year (2013-2014)	Educational Year (2015-2016) *	Improvement (%)
Average Staying time(Day)	2.2	1.9	- 14%
Living costs (food, accommodation,) per teacher (IRR)	1687000 IRR	1452000 IRR	- 13%
Overall Satisfaction (Measured by Teacher's Survey System – maximum 10)	7.4	8.1	+ 09%
Overall evaluation score (Measured by teacher's evaluation System – maximum 20)	17.2	17.6	+ 02%

Results showed that this framework which uses a wide range of input sources generates more accurate timetables comparing to the output of traditional and other automated approaches. Also another big advantage over other solutions like FET is a customized APIs to obtaining data from different sources and exporting generated timetables into educational management systems. This feature provides a good flexibility for SJUTF framework to be used in different educational systems with different management software.

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Chapter 9

The Graduate Profile in the Field of Informatics and Business Informatics in the Context of Labour Market Needs

9.1. Introduction

The discussion on the graduate profile in the field of Business Informatics should be preceded by an explanation what Business Informatics, Information Systems andManagement Information Systems mean. This should facilitate an understanding of the concepts analysed in this work. There are many definitions of the concept of Business Informatics.

According to Heinrich and Riedl, Information Systems (IS) is a scientific discipline with a global reach that investigates a development, use and impact of Information and Communication Technologies (ICT). Business Informatics (BI) as such constitutes a major scientific community within the IS discipline [12].

In a paper titled “Business Informatics: An Engineering Perspective on Information Systems” is noted that business informatics combines and complements informatics and business studies. Informatics is primarily concerned with the technology of information and communication systems, while business studies focus on management functions. Business informatics aims to support business functions by applying informatics principles and technologies [13]. Business Informatics is an emerging discipline which should be understood widely as it mixes various aspects of the economy, business management and ICT. The aim of this approach is to fully integrate computer science, the economy and business administration into one field.

The aim of this chapter is to conduct an analysis related to the graduate profile of Business Informatics. The study has been focused from the perspective of the labour market. The main approach is content analysis. The field of business informatics is taught at many universities, so it follows that on the market there are many types of graduates. The confrontation between the competence of the student and the real needs of enterprises and institutions is observed essentially after graduation. A student choosing a career path decides

whether to take paid employment, start their own business or work in a non-governmental organisation.

In the next section literature review is presented and in section two the methodology. The main section is section three, where results of the analysis are described. Finally, last section contains conclusions and suggests future actions.

9.2. Literature Review

Taking into consideration the result of the Top Universities for Economics in 2016, (based on the QS World University Rankings by Subject) the hegemony of American universities cannot be ignored [6]. It means that the best environment to study Business Economics is in the USA. Comparing the results of this ranking to 2015, the best European university - London School of Economics dropped from fourth to seventh. In a group of the best universities, only three places belong to the Europeans universities (including additionally the Universities of Oxford and Cambridge).

Also in Poland, issues concerning business and computer science are very important. It is worth mentioning that a study program "Business Informatics" is the result of years of research carried out by the Institute of Informatics, the University of Economics in Wroclaw on the improvement of teaching programs in applied informatics at business-oriented faculties (Nowicki, 2004, 2005, 2006). Furthermore, the University of Economics offers business informatics education oriented on small and medium-sized companies, but in future, it plans to extend its program including modules prepared for bigger companies. Other initiatives that make this major more attractive include offering studies in English, preparing "joint degree" diplomas and implementing doctoral studies in business informatics [16].

S. Sora [22] has been noted in his review that the thinking process for managers would be different if the field of informatics for business students were an integrated whole with all the business courses containing the informatics areas associated with that course.

According to M. Kwiecińska-Zdrenka [17], a student who attended classes should be able to move into the labour market. But, taking into consideration the limited number of classes, it is not possible to provide the student with full knowledge and competence. For this reason, already during

their studies, they assumed the necessity of individual work done by the student. The problem at the technical universities is focusing on the technical competences while ignoring or downplaying social issues (soft skills).

Hill (2016) in an article titled "What is Business Informatics?" writes that someone who is properly trained in business informatics can act as a go-between or a bridge to connect management with the information side of a company. By understanding both sides, qualified experts will ideally be able to help both those who build and those who use computers and information systems. It is speculated by many that companies structured around this discipline will increasingly become the norm. This is particularly the case with businesses in the life sciences industries, which need large amounts of data storage, and need it to work flawlessly. As business becomes more driven by the quality of information, most companies will likely see the need to apply business informatics to some degree, to remain competitive [26].

Based on the research done on this topic and the literature review above, there are numerous opinions from various authors on the graduate profile of Business Informatics. Also, there is inadequate information concerning the roles and significance Business Informatics. Existing graduate profiles of Business Informatics very often do not include the needs of the labour market and the expected profile of the graduates. In addition, the results obtained are inconclusive and not sufficient. Consequently, many researchers have concluded that more research is needed in Business Informatics area in particularly on graduate profile.

9.3. Research Methodology

In this chapter, information is analysed from several specialist representative papers on the current situation in teaching and learning business informatics. Additionally, the owners of many Polish companies have been interviewed. Based on the activities mentioned above the graduate profile has been specified. The data for conducting the study has been collected from primary sources: university and company reports, the official websites of universities, job portals, as well as from secondary sources: books, articles and journals. Data was also collected by meeting company owners and discussing the needs of the labour market. Moreover, the writer's personal experience from

running a small IT company and being a professor at University constitutes a significant source of valuable, reliable and up-to-date information on the graduate profile in business informatics in Poland.

Activities during this research have proved that the knowledge and abilities graduate students must possess to work effectively and succeed in the economy have been dramatically redefined, as has the application of informatics knowledge in all areas of life. Thus new teaching models of Business Informatics should be developed and implemented. The needs of the labour market and the graduate profile should be defined.

There are four main research questions:

1. Which needs does the labour market in Poland in Informatics and Business Informatics fields have?
2. Which needs does the labour market in other countries in Informatics and Business Informatics fields have?
3. What are the forecasts for the labour market concerning Informatics and Business Informatics?
4. For which graduates does the profile seem to be the most appropriate?

In the next part of the chapter, the results are presented.

9.4. Results

In particular, graduates need a comprehensive understanding of behavioural aspects as well as software engineering, programming and information technology. Interpersonal and communication skills, as well as problem solving and critical thinking capabilities, are also essential for information quality skills. However, at present information quality curriculum development is still in its early stages. For instance, in Europe, information quality study programmes are not common. It is expected that with the increasing importance of information quality aspects in practice, the demand for such programmes will increase. Funding for curriculum development programmes, such as within the European Union, might be an opportunity to develop innovative and comprehensive study programmes in information quality [14].

9.4.1.The Needs of the Labour Market in Poland

Recent years have seen the dynamic development of the IT market in Poland, and the result is high demand for professionals in this field. This is related to the development of the industry which is influenced by several factors: support for companies from State aid - non-repayable grants for research, tax exemptions in Special Economic Zones as well as the most important factors of high qualifications and the low cost of employment of IT professionals compared with Western European countries. All this has made Poland an attractive location for foreign companies operating in the IT sector in Poland with foreign capital (Microsoft, HP, Google, Oracle, IBM and SAP). These factors mean that Poland is becoming a leading country regarding information technology with a high demand for IT professionals with special emphasis on Business Informatics.

The value of the IT sector in Poland in 2013 was valued by the Ministry of Economy at about 30 billion zł, where in the industry nearly 9,000 companies work, employing more than 400 thousand. people. Its rapid development creates a huge increase in demand for IT professionals. Currently, in Poland, there are approx. 50 thousand skilled workers [9].

There is a scarcity of IT professionals on the market, as the European Commission described in the report "E-skills for a job in Europe". According to the report, demand for ICT workers is growing at 4 percent per annum, outstripping supply. Currently, the labour market in the EU lacks nearly 275 thousand employees with digital skills. Next year's estimated vacancies will be over 500 thousand and in 2020 around one million. The largest deficits of IT staff are being felt in the UK, Germany and Italy. Also, employers in Poland are the big problem. In particular, this problem is acute for companies operating in Wroclaw and the surrounding area. This is because many foreign companies choose Lower Silesia when establishing their branches and centres, call centres or research and development. As an analysis of the demand for positions, IT professionals can use job offers available on adzuna.pl. Table 9.1 shows the number of bids for each position.

Table 9.1. Most positions in the IT industry

Programmer	5230	The Network Administrator	78
IT Specialist	1706	Specialist SEO	77
Trainee	1056	Unix Administrator	69
Java Programmer	714	Solutions Architect	63
Programmer PHP	471	Network Engineer	39
System Administrator	434	IT Trainee	39
Animator	426	Linux Programmer	32
Junior IT Specialist	412	Graduate Of Computer Science	30
Sale	339	Cobol Programmer	22
Helpdesk Specialist	292	Computer Technician	22
Junior Programmer	275	Technical Architect	21
Editor	212	Social Media Specialist	21
c ++ Programmer	192	Coldfusion	20
Software Engineer	169	The Database Administrator	18
Linux Administrator	164	Java Architect	15
Cognos Specialist	134	HTML Programmer	15
SAP BE Specialist	130	A Software Test Engineer	13
SAP ABAP Specialist	122	Direct Seller	13
SAP SD Specialist	110	Seller Technical	13
SAP CRM Specialist	108	Data Architect	11
Data analyst	105	Graduate developer programmer	9
Consultant to IT	103	Business systems analyst	8
Technician engineer	95	User interface designer	7

Source: own elaboration based on [1].

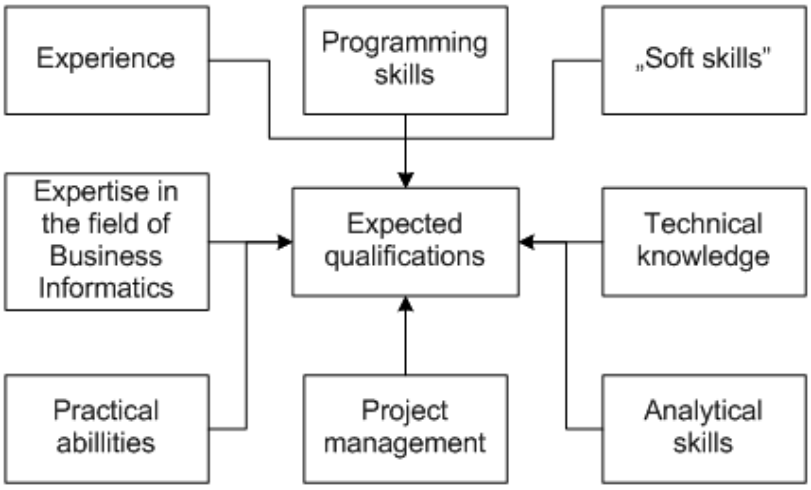

Figure 9.1. The most expected qualifications among employees in positions of informatics
Source: own elaboration

In Poland, more and more often there is a lack of developers and analysts, and companies increasingly recruit IT graduates who do not have the experience. The advantage of such people is the lack of habits from previous jobs, they are quick to learn the specifics of work in the new company and have the opportunity to shape their skills specifically for the needs of the company. More and more employers are looking for people, who, in addition to IT skills, also have experience in sales - which are in short supply because people with these skills work mostly in their companies. Increasingly, you can meet the requirements with a certificate of PRINCE II, ICIL and SCJP.

According to it-praca.pl (2015), for the majority of candidates knowledge is required of programming languages such as.NET, Java, C ++. For employers, it seems to be as important as the ability to use newer technologies. Any practical skills are welcome, eg.: The ability to implement management systems, working with databases, testing software or knowledge of programming network applications.

9.4.2. The Needs of the Labour Market in Selected Countries

In the EU, as in Poland, the shortage of IT specialists in Europe will increase systematically. It is assumed that the rate is increasing from 365 thousand in 2014 to 755 thousand in 2020 [9](see Figure 9.2).

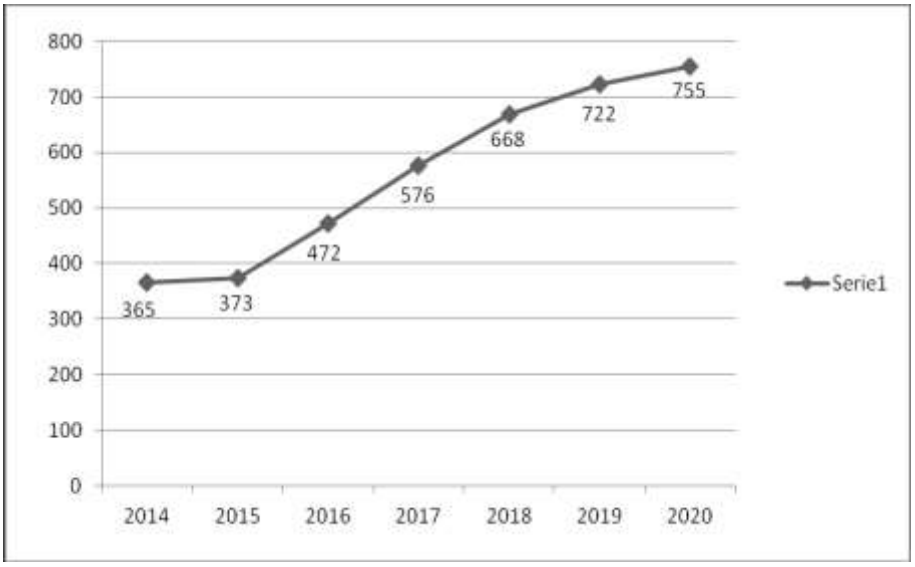

Figure 9.2. The forecasted shortage of ICT professionals in Europe for years 2014-2020 (in thousands)
Source: [9]

New Zealand

Growing digitalisation and the growing use of ICT across the world is generating employment growth across a range of skill-sets, including software engineering and development, business informatics, project managers, marketers, sales, administrators and business analysts. The situation depends on the country. For example, in New Zealand, there is a problem to find graduates who have IT skills. IT jobs on the lists include [21]:

- business analyst,
- developer programmer,
- software engineer,
- project manager,
- security specialist,

- software tester,
- telecommunications network engineer,
- database administrator,
- QA engineer.

Lithuania

The demand for specialists in Business Informatics is rapidly growing in Lithuania, EU and the rest of the world given the expansion of business associated with the services and products of the knowledge society and an extensive transfer of business services into e-space. It attaches an enormous importance to the creation of information systems, their integrity, interoperability and safety requirements. If there is an insufficient number of professionals in informatics who have been trained in the areas of business development, then, in the long run, its evolution would slow down, and the strategic niches of business and possibilities in e-space would not be used to their full potential both in Lithuania and EU.

The Scientific Commission for Business Informatics has assessed the new initiatives that propose speciality fields in which specialists in Business Informatics can be trained and indicates that the specialists that are primarily needed are the following:

- System analysts,
- Business analysts,
- Managers of information technologies,
- Architects of information systems,
- Creators of financial account services,
- Specialists that implement electronic services in the internet environment,
- Designers of informational infrastructure at business companies.

The main career applications of specialists qualified in Business Informatics are the design of ICT infrastructure, its effective installation and creation in business processes. If the specialists effectively apply the theoretical knowledge related to e-business solutions and technologies, strategies for development of e-services and e-business; conduct the research in innovations, marketing, entrepreneurship and market dynamics, they will be able to consult and practically develop business in e-space and to solve emerging problems related to application and research [5].

Ukraine

According to the database analysis of vacancies hh.ua, the Ukrainian labour market is most in need of web-developers. Also, the majority of work proposals are related to the design, marking up and the creation of mobile applications. The lion's share of mobile applications are created based on iOS and Android, so the first thing employers are looking for is professionals to develop by these operating systems.

The top three programming languages, stated in the requirements for specialists are Java, C# and PHP. Most employers indicate in the vacancies a knowledge of HTML. Python is also quite commonly in the job description. Most often, applicants require a thorough knowledge of one programming language. As shown by a review of salaries, the most highly paid on the market are Java-programmers.

One of the main requirements that push employers to IT-specialists is an obligatory knowledge of English language at the level of upper-intermediate and above. As experts explain, hh.ua, it is not only the specifics of working in IT but also the fact that more than 80% of all outsourcing Ukrainian IT-companies operate in foreign markets.

It is worth presenting the most popular job positions related to Business Informatics [4]:

1. Junior CRM Developer. Jobs available for candidates with incomplete higher education. However, the requirement is the ability to program in C #, JavaScript, C / C ++, .NET, and knowledge of English at the intermediate level and above.
2. Portal Administrator – web-developer. Consider applicants with a minimum of experience, but confident knowledge of JavaScript, HTML, CSS and the ability to understand someone else's code.
3. Python Server Programmer. The main tasks of the expert will be programming the game logic server-side mobile games as well as refactoring and optimisation of the existing code.
4. Intermediate Javascript Developer. Requirements: good knowledge of Javascript, HTML5/CSS3, PHP, ASP.NET, SQL. Also, a requirement is good written and oral English skills. The level of remuneration varies from 1 900 to 2 500 USD.

5. PHP Programmer. Remote work, free schedule. From applicants excellent knowledge of PHP, Yii2, Mysql is required; confident knowledge of JavaScript, JQuery, Bootstrap; Basic knowledge of UNIX. The big plus is a knowledge of AngularJS. Income: from 700 to 800 USD.
6. Developer of Android/iOS mobile applications. Responsibilities: development of mobile applications on the Android/iOS-based; interaction with other developers; front end/back end programming: test and run the application.
7. Junior WEB/PHP Developer. Minimum experience. The main requirements are higher education, knowledge of PHP 5.3+, JavaScript SQL and at least one of the current PHP-frameworks.
8. Mobile App Technical Support. Experience is not mandatory, but higher technical education, ability to work with Android and, iOS, good written and spoken English are mandatory requirements for the future employee.
9. Web-designer. Requires knowledge of Adobe Photoshop and Adobe Illustrator. The tasks that will face a candidate: design landing pages, the creation of banners (static and Flash) and development of design sites. The salary of 15 000 UAH.
10. Assistant SEO Specialist/Link Builder. The main requirements: basic knowledge of SEO principles, English at Upper-intermediate level, the ability to work with large data sets, as well as the ability to make decisions.

9.4.3. The Forecast for the Needs of the Labour Market Concerning Informatics and Business Informatics

A forecast has been prepared on the Computerworld Forecast report 2016 showing the employment market of IT professionals. Shortly it is expected that the most sought after experts in IT will be architecture and software developers. A group that does not have to worry about a job in 2017 is project management specialists possessing the ability to use software such as Microsoft SharePoint, Excel and Access. A more and more essential group of specialists will also be business analysts, able to transform digital data into information, which will then be possible to use for a business decision. This group should have skills and knowledge related to relevant issues such as Big Data, Business Informatics, Cloud Computing. Another group is developers of mobile applications due to the increasing presence on the market of these applications. Nowadays Polish companies have trouble finding appropriate candidates who

possess these kinds of skills. Demand for specialists in the field of database administration and security of IT infrastructure will be maintained at a fairly significant level, as in previous years. This demand results from the growth of cyber crime [18], [7].

Figure 9.3. Types of skills, which the labour market will need in 2017
Source: own elaboration based on [7]

Figure 9.3 does not include new technologies that shortly will generate huge demand for specialists in Business Informatics. According to the authors, these technologies can certainly already include Green Computing and Green Internet of Things.

Green IoT is related to two aspects [10]. The first one concerns developing energy efficient computing solutions, communications protocols, and network architecture for interconnecting the real world. The second aspect is related to IoT technologies to decrease pollution and carbon emissions and enhance energy efficiency [10]. It is predicted that many devices shortly will have extra sensory and communication devices that will communicate with each other. The energy-efficient methods and information processes adopted by IoT will reduce the use of energy. Ecology systems, solutions and procedures will be used in companies, public institutions and individuals regardless of the type

of activity. The level of application of these solutions will depend on many factors. In the authors' opinions, ICT Ecosystem will consist of two sub-systems GC and Green IoT. Its implementation may be difficult, given certain limitations. It is important that the system should be controlled by well-educated people. Among them will be a specialist of Business Informatics. Implementing and developing GC and Green IoT is unique technology and still in experimental stages [24].

In this section of the chapter, it is worth mentioning that in the future, even more than now, the area of Business Informatics will have to deal with an employee's market. Further development of new technologies and the emergence of new currently existing solutions will further increase the demand for IT professionals. The analysis shows that over the years the labour market demand in this area is maintained at a very high level.Acquiring talent in the competitive IT market is a big challenge for a company, which requires above-average commitment and a custom approach to the recruitment process. This is because the IT industry deals primarily with passive candidates. Graduates with unique practical skills usually already have an attractive job and are often so satisfied with it that they do not seek alternatives.

Soft skills

The demand for soft skills can not also be forgotten. To succeed in a company certainly even the ability to work in a group, under time pressure as well as a creative and independent approach to solving problems will be needed.

Employers are usually impressed by candidates who have a degree, but that, in many cases, is just the bare minimum that students need when competing for a job after graduation. Many employers are looking for candidates who have skills that help them get things done in the workplace, but managers who hire report they do not see these skills from many job applicants [19].

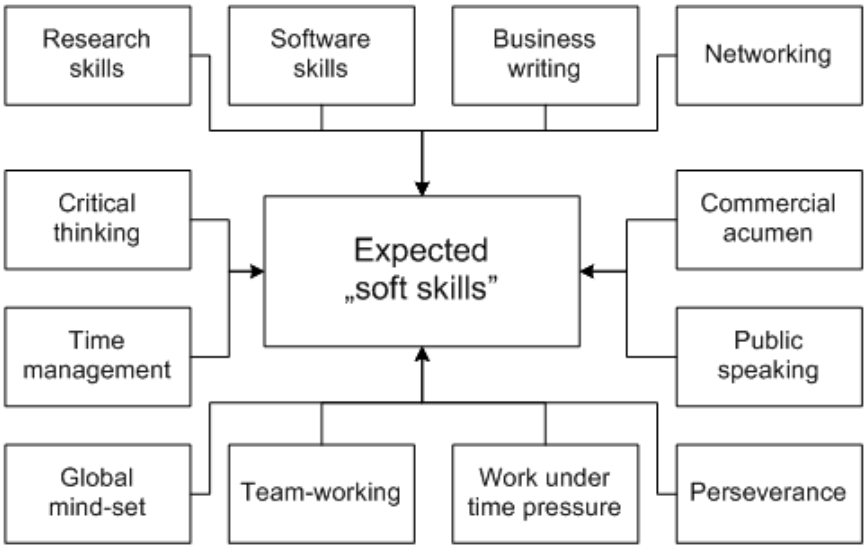

Figure 9.4. Types of skills
Source: own elaboration based on [19], [8], [20]

According to Oliver Donoghue [8] nowadays the number of students now attending university is high. For this reason, a graduate needs to find ways to separate themselves from the pack when they finally graduate and enter the labour market. Unless students have obtained unique skill and knowledge, there are likely to be numerous other people with similar skills and qualifications entering the job market at the same time [8]. Therefore apart from professional preparation it is necessary to possess "soft skills" such as:

- **Commercial acumen.** It's crucial to not only have knowledge of social media or finance if that's what your job entails but also the wider goals of the organisation and how you could contribute to meeting them. Anyone who can develop these skills and identify potential opportunities is likely to thrive [8]. Knowing where your industry is going will help you decide what other areas of knowledge are important for you to focus on [20].
- **Perseverance**. During work, the graduate will have to face many problems. To solve them it is necessary to be resistant to stress and unpredictable situations [8]. Great employees don't passively wait for the boss to tell them what to do. They figure out solutions on their own [20].

- **Networking**. At present many graduates leave university without being able to communicate on a business level with people of varying degrees of seniority. It may sound obvious, but it's a professional skill that a surprising number of people simply don't possess. When you take the time to develop positive relationships with customers, vendors, the people you speak to frequently who work at other companies, etc., you'll find that they'll present you with opportunities organically and vice versa [20].
- **Team-working.** Every job requires some degree of collaboration, so employers are looking for workers who know how to work well with other people.A surprisingly large number of graduates won't be able to work effectively with others. Being able to work in a team is a vital professional skill to develop, as organisations look to utilise more fluid operational methods [8].If you work in a team, you will learn a lot from each other, and great relationships will form [20].
- **Global mind-set**. As a result of globalisation, it's important to possess an international outlook and not to think of commercial opportunities as being limited by borders [8]. It's always been useful to be multilingual, and it's no longer just the obvious languages that are in demand.
- **Time management**. Although students can learn how to manage their time on their own if they're disciplined enough, there are also courses they can take to get more proficient at this skill. In time management courses, students can learn how to set effective goals, fight the urge to procrastinate and prioritise all the tasks on their plate [19].
- **Critical thinking**. A graduate who developed critical thinking skills can collect information and evaluate it to make the best decisions. It is an important skill to learn as it can help them solve problems in creative ways and work toward innovative approaches to a variety of tasks [19].
- **Public speaking**. Speaking in front of a group is almost an inevitability in many university courses as well as in the workplace so honing public speaking skills can be extremely beneficial. Public speaking skills can help a graduate learn to organise their thoughts, create effective arguments and voice their opinions in an effective way [19].
- **Research**. Research skills are an essential for a graduate, as there's a professional need to be able to collect information for some assignments, as well as evaluate the veracity of the information they find [19].

- **Software skills**. Manciagli said that although many students have some of the essential software skills, they will use at any position they land, most don't have all of them. But, she warned, students not fluent in basic programs like Microsoft Word, Excel and PowerPoint will be at a real disadvantage when they look for a job. Additionally, students can also find a variety of free online courses designed to help them build their proficiency in these programs [19].
- **Business writing**. Business writing skills are so important that a graduate has to possess them to compete for any job. When they land the job, workers must be able to demonstrate business writing skills - such as drafting reports, professional emails, or memos - to do their job well. Although some students may mistakenly believe that if they're entering certain fields, like science and technology professions, they don't need to focus so much on the written word, having business writing skills can make a big difference in how they progress in their careers [19].

9.4.4. Graduate Profile in Business Informatics Field

The demand for professionals in the field of Informatics and Business Informatics as presented above is constantly growing. Multidisciplinary Business Informatics makes it difficult to propose a graduate profile. This problem consists in the uniformity of the possible solution. The result of the preceding statement is that the world of science has so far failed to establish a common understanding of the concept of business informatics. Consequently, it is difficult to expect an unequivocal statement as to what kind of competences a graduate of BI should have. For this reason, we need to use the connections with the industry. It is, therefore, necessary to determine what skills are expected by business practice. This issue is also ambiguous. It results from the large scope of the economy where graduates of Business Informatics work. As an example, we can say that, apart from the IT industry, they are working in the health sector and public administration.

So, the place of the BI field in the scientific world is important for the students too. The question is what kind of skills the student should acquire being a BI graduate. This problem should be treated from the labour market perspective. The discussion about the position of the discipline hasn't only got academic importance. For graduates, skills obtained as a result of the education

process set up their future on the labour market. For every college student should realise a curriculum predetermined and approved by the university. A well-designed program is prepared on the one hand based on market analysis and the other the needs of the student. This approach enables the identification of the program as a key element of education. The flexibility of the curriculum allows for constant adaptation of content programmed to change dynamically. The curriculum should be flexible. It's a result of the changes occurring rapidly in the world and local economies. Universities using surveys and maintaining a solid relationship with its graduates within graduate clubs should constantly monitor the quality and effects of teaching. The process of data collection from graduates should be anonymous.

If students have graduated in Business Informatics they can obtain: high salaries, high placement rate, exciting and challenging fields, opportunities to grow as technology evolves, hands-on problem solving, chances to be innovative, global opportunities, great chance for promotion, opportunities to continue learning [15].

Approximately five majors, directly or indirectly related to IT, were ranked as the most popular ones in the group of the ten majors in demand, which might account for the increased interest in studying Business Informatics. First place on the list of the most commonly chosen majors is Informatics, whose popularity has increased the most (following data of the Polish Ministry of Science and Higher Education and the Central Statistical Office in Poland). Many Universities and schools noticed the demand for the specialists. Therefore they have started or are planning to open studies in BI and DW, however, they face the problem of a lack of methods and tools. Within the European field, the strategy Europe 2020 and the Agenda for Modernizing Higher Education assume the intensification of actions in the area of improving the quality of the education process and developing ICT and popularising the Open Educational Resources.

Business Informatics combines the areas of business knowledge, knowledge of management and social skills as well as the business use of information technology. Figure 9.5 shows in more detail some key competencies in these areas given the knowledge and skills required as well as the typical job titles held by business information specialists.

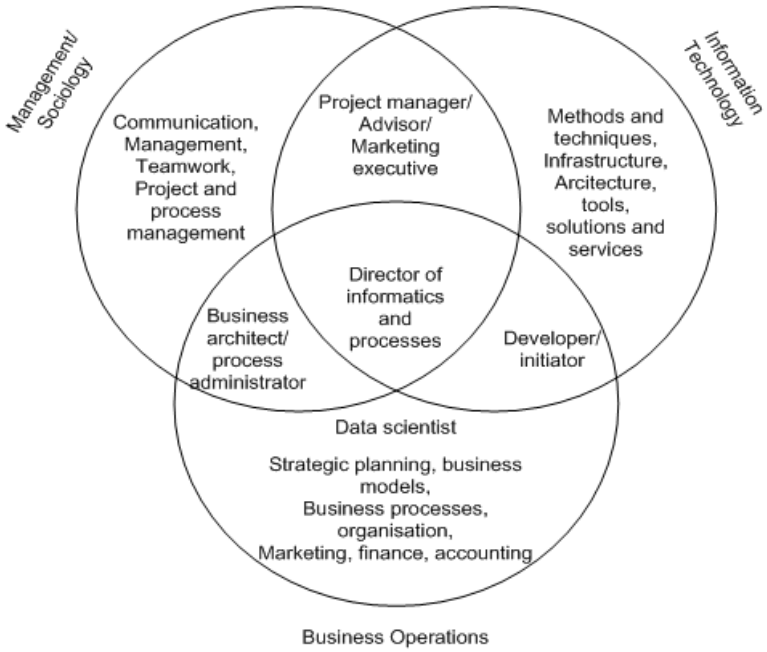

Figure 9.5. Key competencies in Business Informatics
Source: [25]

The idea to implement a Bachelors or Masters Studies in Business Informatics always should be preceded by recognizing profound market needs and skills such as the ability to work as part of a team, analytical skills, an aptitude for Information Technology, communication skills (oral and written), creativity, problem-solving skills, the ability to work in a changing environment, the ability to work under pressure [15].

A typical Business Informatics graduate is obliged to have a lot of different skills. This branch integrates information technology, people and business. It means that a graduate has to examine the information needs of an organisa-

tion's management at each level of decision making (operational, tactical, strategic). His role is to create and introduce processes, procedures, and routines that provide correctly detailed reports in an adequate manner. A graduate has to know a computer-based system that provides managers with the tools to organise, evaluate and efficiently manage departments within an organisation. A management information system can include software that helps in decision making, data resources such as databases, the hardware resources of a system, decision support systems, people management and project management applications, and any computerised processes that enable the department to run efficiently[3]. The aim of this activity is to give top managers feedback about their results. So, the collection of information management methods using software and hardware automation supports the quality and efficiency of business operations and human decision making. There are many examples of MIS [23]:

- Decision Support Systems,
- Enterprise Resource Planning (ERP),
- Supply Chain Management,
- Customer Relationship Management (CRM),
- Project Management,
- Executive Information Systems (EIS).

A typical BI graduate has to know a Business information system. From this point of view, he must be able to use methods forecasting, planning, control, coordination, decision making and operational activities in an organisation. These skills focus on the five basic resources of people, hardware, software, communications and data. People resources include the users and developers of an information system and those who help maintain and operate the system such as IS managers and technical support staff. Hardware resources include computer and other items such as printers. Software resources refer to computer programs known as a software and associated instruction manuals. Communications resources include networks and the hardware and software needed to support them. Data resources cover the data that an organisation has access to such as computer databases and paper files [11]. Establishing effective communication channels are very useful for making timely, and accurate decisions and in turn contribute to organisational productivity and competitiveness. This paradigm shift leads to global outsourcing, strategic alliances and partnerships to be competitive regarding price, quality, flexibility, dependability, responsiveness.

International Journal of Business Information Systems (IJBIS) highlights new strategies, techniques, tools and technologies for developing suitable BIS.

Moreover, it is assumed that a graduate of Business Informatics will possess the skills to [2]):

- understand the key concepts of the functional areas in business,
- create a clear view of the information system role in the business organisation,
- understand the basic informatics tools used in the business context and their design and development requirements,
- identify and effectively use appropriate informatics tools and information systems for business applications and decision making,
- customise user-level software for business needs in economics, social, ethical and legal conditions,
- Apply adequate financial, economic skills in business management,
- Create, evaluate and assess a range of best practices in various business areas,
- Conduct project management activities in various business aspects,
- Adopt and use informatics-based solutions for business,
- Function effectively as an individual and as a member of a team,
- Recognise the need for and engagement in life-long learning,
- Promote ethical and professional behaviour.

A BI graduate has to be familiar with problem-solving models, techniques and approaches; critical judgment and creativity concepts and techniques; management standards; codes of professional standards, legal and regulatory principles. The principal aim of BI teaching is to provide students with basic knowledge of computer science in the areas of management and business. In addition to general economic knowledge, studies should provide graduates with practical skills to use tools for the purpose of supporting business processes. Students have to learn, among other things, the methods and techniques of analysis and design of information systems, database technology, business applications, as well as the basics of e-business, project management, hardware and software solutions. The problems solved by students as parts of case studies will permit them to gain analytical skills, flexibility and self-fulfilment of tasks by a computer. It should be noted that taking into account the trends in education and international standards, including the Association for Computing

Machinery (ACM), the best solution, depending on the financing at the University, is emphasis on individual learning and adapting to the current needs of the market with the introduction of individual choice in a large group of subjects. In the contemporary world, knowledge of foreign languages is a strong asset for students. In multicultural Europe knowledge of languages provides a competitive advantage over other participants in the labour market.

The graduate will have the ability to analyse and synthesise business problems, to adapt to changing conditions, to solve the problems of implementing information and communication technology (ICT), to work in the project team, to communicate, as well as to learn and update knowledge. These powers give him knowledge of computer science, management, accounting, finance, quantitative methods, economics. They will be therefore able to solve business problems using tools using modern information technologies; They will be able to design, program and deploy business applications. Studies allow you to master two foreign languages, including English professionally in the field of information technology in business. As part of the study, lectures in English will be organised, conducted by foreign experts participating in the parallel operated English study "Business Informatics".

The business part of the studies will acquaint a graduate with organisational theory and business models; the systems approach; evaluation of business performance; functional business areas, like marketing, human resources, logistics and manufacturing. The communication and teamwork studies will help understand and apply the issues of motivation, encouragement, negotiating and facilitating, and operation in a global, culturally diverse environment. Building a team, team decision making, operating in a virtual team environment are the next exit characteristics of a BI graduate.

The computing part of the studies will develop potential in collecting, summarising and interpreting data; computer systems hardware and software; networking and telecommunications; operating systems management; personal use of information technology and information systems; Web page and Web architecture design and development, etc.

Business and management involve many economic activities such as accounting, agribusiness and auditing. It also comprises all the managerial areas that fall under the auspices of business administration such as commerce, mar-

keting, logistics and supply chain management, public administration, or human resource management.

Business colleges and schools typically offer highly specialised study programmes in business and management. Examples include internationally recognised degrees such as Master of Business Administration (MBA) or Executive Master of Business Administration (EMBA), which usually require some work experience. Other courses include Masters in Management (MiM) and a wide range of specialisations in retail management, business intelligence and analytics, corporate communication, taxation or technology management.

Programmes focus on theoretical knowledge, but also on real-case examples, seminar debates and the development of practical skills. Graduates acquire an in-depth understanding of business challenges and issues, learn to use effective leadership methods and to apply economic principles in various work settings.

Graduates in one of the business and management disciplines may pursue careers as entrepreneurs, forensic accountants, project managers, bankers, international business specialists, and more.

9.5. Summary

As the education sector is changing very often, graduates are facing competition to ensure their employability in business, industry and administration. The purpose of this study is to aid universities in preparing their graduates with sufficient skills to enter the job market in the field of Business Informatics.

There is nothing worse than well-educated graduates who cannot find employment. Therefore, universities must be responsible for the preparation of such curricula for graduates to live up to expectations in the labour market. This study seems to be very important because it contains a fairly detailed analysis of the needs of the labour market and the expected profile of the graduates. Use of the findings may result in the adjustment of the necessary curricula to bring the knowledge and skills of students to the real needs of employers. In the case of graduates of the Business Informatics specialisation and Management Information System, we have to deal with an employee's market. Therefore there are no problems for graduates to find a job. However, you should think over whether employers' expectations are met. Time should also be kept for analysis and re-

search, including information technology, which only occurs or may occur in the future.

This chapter has focussed on necessary professional skills which graduates should possess. Nonetheless, it turned out that "soft skills" are very important as well. Thus the research contains a list of appropriate skills which are welcome in the labour market.

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Affiliations

Paweł Stępień
Faculty of Economics and Management, University of Szczecin
macuser@wneiz.pl

Ireneusz Miciuła
Faculty of Economics and Management, University of Szczecin
irekmic@wp.pl

Habib Shabazigigasar
Department of Agricultural Economics, Sayyed Jamaleddin Asadabadi University (SJAU), Hamedan, Iran
habib_susa@yahoo.com

Akram Abbasifar
Economic Office of Consumer and Producer Protection Organization, Tehran, Iran
zahir_1379@yahoo.com

Zohreh Abbasifar
Saderat Bank Iran LPC, Tehran, Iran
absifar3503@yahoo.com

Jerzy S. Zieliński
Department of Computer Science, University of Lodz
jzielinski@wzmail.uni.lodz.pl

Joanna Paliszkiewicz
Warsaw University of Life Sciences (SGGW)
joanna_paliszkiewicz@sggw.pl

Jerzy Gołuchowski
University of Economics in Katowice
jerzy.goluchowski@ue.katowice.pl

Rafik Nafkha
Faculty of Applied Informatics and Mathematics, Warsaw University of Life Sciences
rafik_nafkha@sggw.pl

Marta R. Jabłońska
Department of Computer Science In Economics, Faculty of Economics and Sociology, University of Lodz
mjablonska@uni.lodz.pl

Marcin W. Mastalerz
Institute of IT in Management, Faculty of Economics and Management, University of Szczecin
mwmastalerz@gmail.com

Hossein Noori
Sayyed Jamaleddin Asadabadi University (SJAU)
hossein-noori2003@gmail.com

Mohammad Soleimani
Sayyed Jamaleddin Asadabadi University (SJAU)
mohammad_soleimany85@yahoo.com

Dariusz Zając
Jan Wyżykowski University, Polkowice

Małgorzata Nycz
Wrocław University of Economics
malgorzata.nycz@ue.wroc.pl

Zdzisław Pólkowski
Jan Wyżykowski University, Polkowice

Scientific Council
of the Polish Information Processing Society
Solec St. 38/103
00-394 Warsaw, Poland
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