International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Refereed Paper Proceedings

Sponsors

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Table of Contents

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Conference Chairs, Program Committee, and Editorial Team

Conference Co-Chairs

Federico Niccolini
University of Pisa, Italy
federico.niccolini@unipi.it

Meir Russ
University of Wisconsin - Green Bay, IL, USA
russm@uwgb.edu

KM2018 Conference Organizers and Coordinators

Shonda Brown
Middle Georgia State University, USA
Shonda.Brown@mga.edu

Nathan White
Central Washington University, USA
nathan.white@cwu.edu

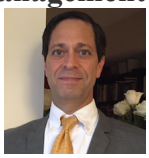
Michelle Ramim
Middle Georgia State University, USA
michelle.ramim@gmail.com

Boštjan Delak
Faculty of Information Studies, Slovenia
bostjan.delak@fis.unm.si

Online Journal of Applied Knowledge Management (OJAKM) - Editorial Board

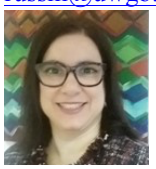
Meir Russ – OJAKM Editor-in-Chief
University of Wisconsin - Green Bay, IL, USA
russm@uwgb.edu

Alex Koohang – Director of Publications
Middle Georgia State University, USA
alex.koohang@mga.edu



Yair Levy – Senior Editor
Nova Southeastern University, FL, USA
levyy@nova.edu

Ewa Ziemba – Senior Editor
University of Economics in Katowice, Poland
ewa.ziemba@ue.katowice.pl



Carla Curado – OJAKM Associate Editor
ISEG - University of Lisbon, Portugal
ccurado@iseg.ulisboa.pt

Nitza Geri – OJAKM Associate Editor
The Open University of Israel, Israel
nitzage@openu.ac.il

Federico Niccolini – OJAKM Associate Editor
University of Pisa, Italy
federico.niccolini@unipi.it

Joanna Paliszkiewicz – OJAKM Associate Editor
Warsaw University of Life Sciences, Poland
joanna_paliszkiewicz@sggw.pl

OJAKM Vol 6, 2018 Special Issue on Knowledge Management: Research, Organization, and Applied Innovation Editors:

Meir Russ
University of Wisconsin - Green Bay, IL, USA
russm@uwgb.edu

Federico Niccolini
University of Pisa, Italy
federico.niccolini@unipi.it

Chiara Bartolacci
University of Pisa, Italy
chiara.bartolacci@live.it

KM2018 Program Committee Co-Chairs

Nitza Geri
The Open University of Israel, Israel
nitzage@openu.ac.il

Yair Levy
Nova Southeastern University, USA
levyy@nova.edu

Ewa Ziemba
University of Economics in Katowice, Poland
ewa.ziemba@ue.katowice.pl

KM2018 Program Committee Members

Nayel Al-Hawamdeh	Brunel University, United Kingdom
Azad Ali	Indiana University of Pennsylvania, USA
Paul Alpar	Philipps University at Marburg, Germany
Graziano Aretusi	Marine Protected Area "Torre del Cerrano", Italy
Shauna Beaudin	Southern New Hampshire University, USA
Dizza Beimel	Ruppin Academic Center, Israel
Ofir Ben Assuli	Ono Academic College, Israel
Ina Blau	The Open University of Israel, Israel
Marko Bohanec	University of Nova Gorica, Slovenia
Steve Bronsburg	Nova Southeastern University, USA
Shonda Brown	CIGNA Healthcare, USA
Melissa Carlton	Nova Southeastern University, USA
Nicola Castellano	University of Pisa, Italy
Vincenzo Cavaliere	University of Florence, Italy
Witold Chmielarz	Management Faculty of Warsaw University, Poland
Dimitar Christozov	American University of Bulgaria, Bulgaria
Anat Cohen	Tel-Aviv University, Israel
Carla Curado	ISEG - University of Lisbon, Portugal

Beata Czarnacka-Chrobot	Warsaw School of Economics, Poland
Bostjan Delak	Faculty of information studies, Novo Mesto, Slovenia
Helena Dudycz	Wroclaw University of Economics, Poland
Monika Eisenbardt	University of Economics in Katowice, Poland
Yoram Eshet-Alkalai	The Open University of Israel, Israel
Steven Furnell	Plymouth University, United Kingdom
Ruti Gafni	Tel-Aviv Yaffo Academic College, Israel
Marco Giannini	University of Pisa, Italy
John Girard	Middle Georgia State University, USA
Michal Golinski	Warsaw School of Economics, Poland
Jodi Goode	Nova Southeastern University, USA
Jose Luis Guerrero-Cusumano	Georgetown University, USA
Julita Haber	Fordham University, USA
Robert Hambly	Nova Southeastern University, USA
Meliha Handžic	International Burch University, Bosnia and Herzegovina
Wilnelia Hernandez	University of Turabo, Puerto Rico
Jeretta Horn Nord	Oklahoma State University, USA
Anat Hovav	Korea University, Korea
Angel Hueca	Nova Southeastern University, USA
Pedro Isaias	University of Queensland, Australia
Jurij Jaklic	University of Ljubljana, Slovenia
Dorota Jelonek	Czestochowa University of Technology, Poland
Oliver Jokisch	Leipzig University of Telecommunications, Germany
Frank Katz	Armstrong State University, USA
Deanna Klein	Minot State University, USA
Alex Koohang	Middle Georgia State University, USA
Gila Kurtz	HIT - Holon Institute of Technology, Israel
Myungjae Kwak	Middle Georgia State University, USA
Anat Lerner	The Open University of Israel, Israel
Zoran Levnajić	Faculty of information studies, Novo Mesto, Slovenia
Jay Liebowitz	Harrisburg University of Science and Technology, USA
Mike Lohle	University of Bridgeport, USA
Christiaan Maasdorp	Stellenbosch University, South Africa
Magdalena Mądra-Sawicka	Warsaw University of Life Sciences, Poland
Gianluigi Mangia	University of Naples Federico II, Italy
Eliel Melon	University of Puerto Rico, Puerto Rico
Krzysztof Michalik	University of Economics in Katowice, Poland
Iwona Miliszewska	University of Technology Sydney (UTS), Australia
Roisin Mullins	University of Wales Trinity Saint David, United Kingdom
Federico Niccolini	University of Pisa, Italy

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Exploring the effects of expertise and guidelines on small and medium enterprises (SMEs) cybersecurity practices

[Research-in-Progress]

Nowwaf Alsubaie, Central Washington University, Nowwaf.Alsubaie@cwu.edu

Nathan White, Central Washington University, Nathan.White@cwu.edu

Abstract

Securing information is a seemingly never-ending task, especially for small- to medium-sized enterprises (SMEs). Despite the abundance of cybersecurity guidelines, SMEs still experience difficulty in implementing and maintaining good cybersecurity practices. Additionally, a lack of cybersecurity expertise may also play a role in a SME's ability to properly secure their information systems. This proposed study will investigate how cybersecurity guidelines and expertise impact the cybersecurity of a SME. Data will be collected from SMEs in the Pacific Northwest of the United States.

Keywords: Cybersecurity guidelines, cybersecurity expertise, small and medium enterprises, and cybersecurity practices.

Introduction

In spite of nearly one-third of all cyberattacks targeting companies that employed less than 250 individuals, many small enterprises chose not to adopt additional cybersecurity measures, due to a low expectation of an attack (MacInnes, 2013). A successful cyberattack experienced by small- to medium-sized enterprises (SMEs) may result in financial and information losses, which in turn could discourage new and existing customers (GFI, 2010). SMEs neglecting information technology (IT) security by not monitoring, detecting, or responding to cyber threats breed an environment for placing the enterprise's monetary, brand, and customer value at risk (GFI, 2010). Prior literature found SMEs that invested in cybersecurity practices benefited in mitigating cyber threats (GFI, 2010). Cybersecurity practices are essential in order to avoid viruses and dodging spam especially, when concerning safety in smaller enterprises (GFI, 2010). SMEs that concern themselves with protecting customer data and personal information build relationships with their customers as well as gains customer's trust.

Confidence in SME's cybersecurity has significantly decreased due to the lack of IT expertise they are utilizing in their organizations (Manso, Rekleitis, Papazafeiropoulos, & Maritsas, 2015). IT expertise and cybersecurity are influential to the confidentiality and integrity of all information held by companies. Determining and implementing the correct as well as most efficient security guidelines for each situation is key to protecting the information within SMEs.

Cybersecurity guidelines properly executed by monitoring, detecting, and responding to all security incidents (Seals, 2017). An ill-prepared business typically has not focused on the appropriate security countermeasures for preventing breaches. Organizations reduced security vulnerabilities through the completion of a risk assessment and developed security policy (Dimopoulos, Furnell, Jennex, & Kritharas, 2004).

The following document discusses the problem being addressed by this research paper. Topics included are: How do security guidelines affect cybersecurity, how does cybersecurity expertise affect cybersecurity, and why have good cybersecurity? After addressing the previous questions, the document covers the methodology for measuring this research, and concludes with the effects that expertise and guidelines have on small and medium enterprises' cybersecurity skills.

Problem Statement

There are numerous advantages of implementing IT for SMEs, therefore, they are trying to adopt IT applications to support their business (Ghobakhloo, Hong, Sabouri, & Zulkifli, 2016). However, with the advantages brought by IT applications, there come cybersecurity risks from not only the applications themselves, but also the inexperience with cybersecurity practices that employees of SMEs may not be exposed to. Security reports from 2016 show that large amounts of breaches are from employees not following the organization's cybersecurity guidelines (McClimans, Fersht, Snowdon, Phelps, & LaSalle, 2016). The problem that this study addresses is the lack of cybersecurity guidelines and expertise in SMEs, which affects a SMEs' ability to institute sound cybersecurity practices and prevents SMEs from obtaining the value that cybersecurity provides (Manso et al., 2015).

Suitable Cybersecurity Guidelines

Security guidelines are strong recommendations and practices that set the standards for cybersecurity (Alshaikh, Maynard, Ahmad, & Chang, 2018; Leccisotti, 2015). Due to the variety of SMEs and the different needs SMEs have, one set of guidelines may not work from one SME to another. Therefore, it is important that each SME analyze threats to its network and apply guidelines relevant to its needs. In 2016, the Center for Internet Security published version 6.1 of the CIS Critical Security Controls for Effective Cyber Defense. Five examples of suitable cybersecurity guidelines include:

1. Deploy an automated asset inventory discovery tool and use it to build a preliminary inventory of systems connected to an organization's public and private network(s). Both active tools that scan through Internet Protocol version 4 (IPv4) or version 6 (IPv6) network address ranges and passive tools that identify hosts based on analyzing their traffic should be employed (Center for Internet Security, 2016).

2. If the organization is dynamically assigning addresses using dynamic host configuration protocol (DHCP), then deploy DHCP server logging and use this information to improve the asset inventory and help detect unknown systems (Center for Internet Security, 2016).
3. Ensure that all equipment acquisitions automatically update the inventory system as new, approved devices are connected to the network (Center for Internet Security, 2016).
4. Deploy network level authentication via 802.1x to limit and control which devices can be connected to the network. The 802.1x must be tied into the inventory data to determine authorized versus unauthorized systems (Center for Internet Security, 2016).
5. Use client certificates to validate and authenticate systems prior to connecting to the private network (Center for Internet Security, 2016).

How Do Security Guidelines Affect Cybersecurity Practice?

The attractiveness to attack an enterprise increases when cybersecurity procedures are not followed to discourage a cybercriminal (Leccisotti, 2015) . Identifying all possible threats, risks, and vulnerabilities for each given system remains vital in structuring a strong base for an information system (IS) to be secure (Paquet, 2012). Executing the appropriate preventative measures makes it possible for companies to protect private and confidential data that would otherwise be easy to access and exploit (Paquet, 2012). The standards for cybersecurity increase as new technological services emerge in SMEs. The emergence of new technological services poses threats to both cybersecurity and privacy (Manso et al., 2015). SMEs can better mitigate any predetermined or undetermined attack by following cybersecurity standards (Manso et al., 2015). Misinterpretation of the suitable security and privacy standards needed for each information system has come to be challenging in implementing the adequate security measures needed for each business (Manso et al., 2015). Identifying the appropriate practices necessary for protecting assets and the analysis of weaknesses in the ISs create the framework for the guidelines (Leccisotti, 2015). Thus, implementing all security guidelines encourages the benefits of cybersecurity practices to be fully realized by an enterprise (Leccisotti, 2015).

How Does Cybersecurity Expertise Affect Cybersecurity Practice?

Cybersecurity expertise plays a role in enterprise's defense against a cyberattack. For example, hacking, malware, and vulnerabilities are all security issues that enterprises face (Leccisotti, 2015). An enterprise can fail whenever an attack on its data occurs without cybersecurity-skilled employees (e.g., knowledge, experience, & ability) ISs management (Flood, 2018). Therefore, ISs management skilled in cybersecurity have the knowledge and ability to mitigate the diverse threats experienced by an enterprise (Flood, 2018). Therefore, getting outside advice and counseling from cybersecurity experts is the first step a SME should take in developing their cybersecurity model. The time-consuming nature of implementing standards is also a barrier faced by many SMEs. Given the limited, or non-existent, IT staff of most SMEs, it is not uncommon for SMEs to invest in activities that produce a more obvious return on investment

(Manso et al., 2015). SMEs may need to hire employees with technical and software expertise to satisfy all of the technical requirement standards (Carlton & Levy, 2017; Manso et al., 2015). To enforce strong cybersecurity, SMEs must utilize IT specialists that are capable of customizing and interpreting the cybersecurity standards that are the most relevant to each business (Carlton & Levy, 2017). Utilizing the proper security standards for each companies' technical, financial, and economic standings are essential for ensuring sufficient security safeguards (Manso et al., 2015). Detecting and evaluating security incidents accurately minimizes the damages inflicted by the security threats (Manso et al., 2015).

What Makes Good Cybersecurity?

In order for an organization to have what's considered close to adequate cybersecurity they will have to take multiple steps. The Ponemon Institute found over 77% of the successful attacks in 2016 were file-less and managed to bypass the existing security systems in place (Ponemon Institute, 2017). Due to the hype in security breaches and data exposure, the need for better cybersecurity is rapidly increasing. Companies that possess strong cybersecurity are protecting their consumers' data and information. For consumers to retain privacy, there has to be a system in place to prevent hacking and leaks (Manso et al., 2015). However, small companies are more at risk for these attacks because of their inadequate cybersecurity. The larger a company becomes, the more information it will have that needs to be protected. When a company properly secures its customer's data, the customers will experience less data loss and trust the company more (Manso et al., 2015). Having the right cybersecurity creates the opportunity for business growth and consumer loyalty to prosper. Investing in a strong security system is key to protecting data and ensuring a strong customer bond. Determining the privacy and information security risks that each organization is exposed to is the initial step in choosing the scope of which guidelines need to be completed in order to have a secure information system (Manso et al., 2015). Once the applicable standards for the framework of the security guidelines have been chosen, countermeasures must be exercised to ensure the integrity of the cybersecurity system stays in place (Leccisotti, 2015). Establishing a secure system protects various types of information, whether it be intellectual property, personal data, credentials, or commercial data (Leccisotti, 2015).

Methodology

This study is a descriptive study that describes the effect of cybersecurity guidelines and cybersecurity expertise on a SMEs ability to secure their ISs. The study will use a survey methodology and will be administered to SMEs in the Pacific Northwest of the United States. A survey methodology was chosen to gather the quantitative information of cybersecurity guidelines and cybersecurity expertise in SMEs. The main research question that this study addressed is: Does the lack of cybersecurity guidelines and expertise in SMEs which affect a SMEs' ability to institute sound cybersecurity practices and prevents SMEs from obtaining the

value that cybersecurity provides? This proposed research will address the following hypotheses that are depicted in Figure 1:

H1: A SMEs' knowledge of cybersecurity guidelines will significantly impact the SMEs' cybersecurity practices.

H2: The cybersecurity expertise within a SME will significantly impact the SMEs' cybersecurity practices.

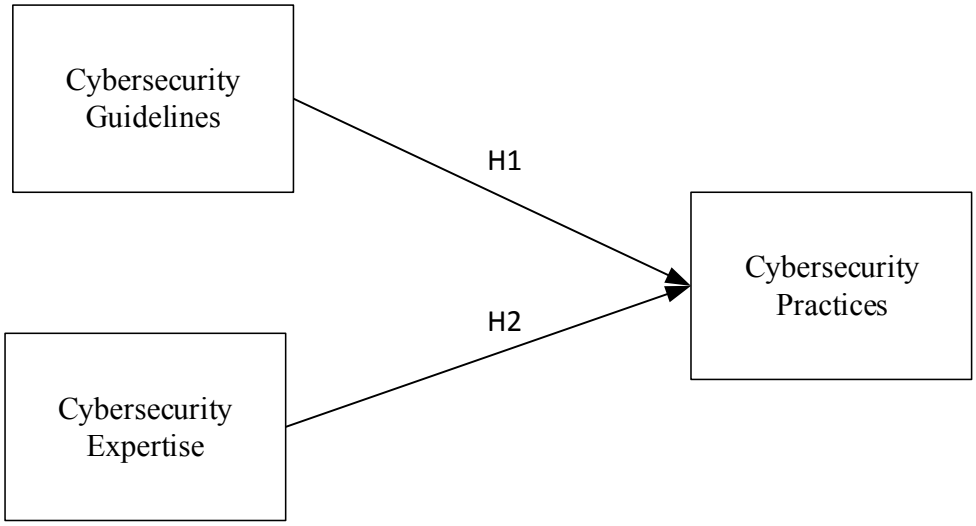


Figure 1: Conceptual research model for investigating the relationships of cybersecurity guidelines and expertise on the ability of a SME to secure their information systems

After a review of valid literature, the instrument selected to measure the use of cybersecurity guidelines was adopted from Dimopoulos et al. (2004). This instrument measures a SMEs use of cybersecurity guidelines in protecting their information systems. The items used to measure the cybersecurity expertise within a SME came from Manso et al. (2015). These items measure what cybersecurity expertise a SME has and how that expertise is utilized. Additionally, measures related to demographics of a SME and their experience with cyberattacks were taken from the SBA Office of Advocacy (2017). These items explore the nature of the cyberattacks that a SME may have experienced. Additionally, these items also include questions relating to the size, business sector, and revenue of the SME.

The first section of the survey questions the SMEs use of guidelines. This section serves the purpose of addressing the analysis of the first hypothesis. The following questions will be asked, with the answers ranging from Strongly Disagree to Strongly Agree on a seven-point Likert scale:

How strongly do you agree or disagree with the following statements related to the cybersecurity guidelines, policies, and practices in your business?

1. Your business has adequate cybersecurity guidelines.

2. Your business has an adequate responsibility structure for cybersecurity.
3. Your business has an adequate cybersecurity risk assessment policy.
4. Your business performs adequate cybersecurity risk assessments.
5. Your business has a formal documented cybersecurity policy that your employees must follow.
6. Your business has adequate data safeguard guidelines.
7. Your business has implemented the specific requirements from a cybersecurity standard such as PCI, NIST, or CIS CSC.
8. Your business has adequate privacy policies.

The second section of the survey will be used to gauge the SMEs cybersecurity expertise. The answers for the following questions also range from Strongly Disagree to Strongly Agree on a seven-point Likert scale. The section of the survey asks the following questions:

> How strongly do you agree or disagree with the following statements regarding the expertise of the individual or individuals who perform the cybersecurity functions for your business?
>
> 1. There is at least one person specifically assigned to be responsible for cybersecurity in your business.
> 2. The personnel who perform the cybersecurity functions for your business have adequate qualifications.
> 3. Your business has outsources all its cybersecurity functions.
> 4. My business' information systems are secure.

The third section of the survey will assess the SMEs' experience with cyberattacks. The following questions will be asked:

1. What is the main reason your organization has implemented cybersecurity standards?
2. Has your business been the victim of a cyberattack (i.e. computer virus, malware/spyware, website hack, credit card or banking hack, ransomware, or Trojan horse, etc.)?
3. What was the nature of the most recent cyberattack?
4. When did the most recent cyberattack occur?
5. On average, how long did it take to resolve cyberattacks?
6. How have cyberattacks impacted your business?
7. Approximately how much have cyberattacks cost your business?

The final section of the survey asks the SMEs about their demographics and financial information. The purpose of these questions is to be able to quantify the data in a meaningful manner regarding the characteristics of the SME:

1. How many people does your business employ?
2. What industry is your business in?
3. What was the total payroll for your most recent fiscal year?
4. What were your gross sales or revenues for your most recent fiscal year?

Next Steps

We are currently in the process of gathering data from SMEs in the Pacific Northwest. After we have gathered the data, we will analyze the data using the partial least squares structural equation modeling method per Hair, Hult, Ringle, and Sarstedt (2014). The results of that analysis will help guide our future research. The next likely step will be a qualitative study that will focus on the barriers SMEs face with acquiring the needed cybersecurity expertise that is necessary to successfully implement cybersecureity guidelines.

References

Alshaikh, M., Maynard, S. B., Ahmad, A., & Chang, S. (2018). An exploratory study of current information security training and awareness practices in organizations. *Proceedings of the 51st Hawaii International Conference on System Sciences,* Big Island, Hawaii, pp. 5085–5094.

Carlton, M., & Levy, Y. (2017). Cybersecurity skills: Foundational theory and the cornerstone of advanced persistent threats (APTs) mitigation. *Online Journal of Applied Knowledge Management*, *5*(2), 16–28.

Center for Internet Security. (2016). *The critical security controls for effective cyber defense*.

Dimopoulos, V., Furnell, S., Jennex, M., & Kritharas, I. (2004). Approaches to IT security in small and medium enterprises. *Proceedings of the 2nd Australian Information Security Management Conference(AISM),* Perth, Australia, pp. 73–82.

Flood, G. (2018). Telecoms and network technologies for SMEs: Need IT expertise? Then managing matters. Retrieved from https://www.computerweekly.com/feature/Telecoms-and-network-technologies-for-SMEs-Need-IT-expertise-Then-managing-matters

GFI. (2010). *Security threats: A guide for small and medium enterprises*.

Ghobakhloo, M., Hong, T. S., Sabouri, M. S., & Zulkifli, N. (2016). Strategies for successful information technology adoption in small and medium-sized enterprises. *Information*, *3*(1), 36–67.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Thousand Oaks, CA: Sage.

Leccisotti, F. Z. (2015). *Guidelines for IT security in SMEs*.

MacInnes, B. (2013). SMEs often lack effective IT security. Retrieved from http://www.computerweekly.com/microscope/feature/SMEs-often-lack-effective-IT-security?vgnextfmt=print

Manso, C. G., Rekleitis, E., Papazafeiropoulos, F., & Maritsas, V. (2015). *Information security and privacy standards for SMEs*. *European Union Agency for Network and Information*

Security.

McClimans, F., Fersht, P., Snowdon, J., Phelps, B., & LaSalle, R. (2016). *The state of cybersecurity and digital trust 2016: Identifying cybersecurity gaps to rethink state of the art*.

Paquet, C. (2012). Network security concepts and policies. In *Implementing Cisco IOS network security (IINS 640-554) foundation learning guide, 2nd ed.* (pp. 1–84). Retrieved from http://www.ciscopress.com/articles/article.asp?p=1998559&seqNum=3

Ponemon Institute. (2017). *The 2017 state of endpoint security risk*.

SBA Office of Advocacy. (2017). *2017 small business profiles for the states and territories: Washington State*.

Seals, T. (2017). Majority of SMEs lack confidence in security postures. Retrieved from https://www.infosecurity-magazine.com/news/majority-of-smes-lack-confidence/

Authors' Biographies

Nowwaf Alsubaie is an international student studying abroad at Central Washington University pursuing a degree in Information Technology and Administrative Management with specializations in both Cybersecurity and Network Administration. Prior to becoming a student at Central Washington University.

Dr. Nathan White is an Associate Professor at Central Washington University in the Information Technology and Administrative Management Department where he teaches networking, cybersecurity, and database courses at the undergraduate and graduate levels. He obtained his Ph.D. in Information Systems from Nova Southeastern University. He has also earned an undergraduate degree in computer science from the University of Maryland, a Master of Business Administration degree from St. Mary's University, and a Master of Science in Computer Information Systems degree from Southern Illinois University-Edwardsville. Prior to joining the faculty at Central Washington University, he was a member of the faculty of the Computing Division at McKendree University. Dr. White is also a retired officer of the United States Air Force, where he served for 21 years. After retiring from the Air Force and prior to entering academia, he was an Associate Vice President in the IT department of a Fortune 500 financial services company.

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Process improvement in a graduate practicum to create a favorable learning environment for knowledge transfer

[Research-in-Progress]

Stephen E. Bronsburg, Nova Southeastern University, USA, bronsbur@nova.edu

Harold E. Wiggin, Nova Southeastern University, USA, wigginh@nova.edu

Arif M. Rana, Nova Southeastern University, USA, arif.rana@nova.edu

Abstract

A successful graduate student level practicum in biomedical informatics must not only fulfill academic requirements and student goals, but also the demands of the dynamic and fast-paced healthcare and technology industries. The processes involved preparing, guiding and mentoring students through a practicum experience allowing them to take full advantage of the learning opportunity can be particularly challenging. Academia is in the position to embrace knowledge management principles that create, share, apply and manage information and ultimately knowledge. This project applied selected process management tools to map, develop and provide continuous feedback to improve the Nova Southeastern University, Dr. Kiran C. Patel College of Osteopathic Medicine, Department of Health Informatics, Biomedical Informatics Program student practicum course. Process tools used in this project included: the Supplier Input Process Output Customer Requirements (SIPOC-R), interviews and focus groups, an "As Is" process map and swim lane map, and the study-plan-do-study-act (SPDSA) model, which will be used as the student practicum overall template. The project is now at a stage to begin tracking and collecting data, which will facilitate ongoing continuous feedback and improvement.

Keywords: Knowledge, Learning, Practicum, Process Improvement.

Introduction

The purpose of this paper is to apply process improvement to the graduate practicum course at Nova Southeastern University, Dr. Kiran C. Patel College of Osteopathic Medicine (NSU-KPCOM), Biomedical Informatics Program (BIP). The BIP requires students to complete a core practicum experience focused in one or more areas of application, evaluation, implementation or research. A well-trained informatician needs to possess knowledge in technology, healthcare and business management (Hersh, 2010). A student practicum builds on skills learned in the classroom and challenges the student to go further while mentoring and fostering them as they gain confidence and expand their knowledge and skill base. The student practicum encompasses complex processes including a systematic approach based on addressing valid customer requirements and strong stakeholder collaboration. A successful practicum experience enhances accuracy, completeness and speed of data captured. This data formulates meaningful information

that is appropriately applicable. This process creates a transfer of knowledge reducing errors and administrative cycle time. Process mapping, data collection and analysis increase understanding of how information and knowledge flows and is transferred in an organization. There is limited academic research implementing process improvement in higher education (Li, Ely, & Laux, 2017). Academia is in a unique position to embrace knowledge management principles that create, share, apply and manage information, which ultimately forms knowledge. Specifically, this project applies process improvement tools to improve the student practicum and the practicum site overall experience.

Summer term of 2017 found the NSU BIP with a new department chair and graduate program director whose emphasis was on developing a more skills-based education and moving towards a program that is in alinement with the competencies set by the American Medical Informatics Association (AMIA). Developing curriculum in computer related disciplines in specialized studies is challenging (Parker et al., 2017). This new direction had the program focusing on incorporating more skills based education into the existing curriculum, which included incorporating programming in R, Structured Query Language (SQL), and analytics. In collaboration with AMIA, the Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM, 2018) has standards and criteria for accreditation. Curriculum content and learning objectives now match the accreditation standards, renewed mission and vision statements. We started the practicum improvement initiative by revisiting the renewed mission and vision statements. Our specific purpose of our mission statement emphasized providing "…students with an interdisciplinary, skills-based education in biomedical informatics. These graduates will enable healthcare organizations to maximize the capture and utilization of data to improve patient safety and care and to reduce healthcare expenditures." Our vision states that the "program is to graduate students who have acquired the necessary knowledge, skills, and attitudes needed to be successful in future informatics careers. Graduates will be highly sought after and actively recruited by healthcare organizations". The core curriculum and practicum now emphasize skills building as reflected in both the renewed mission and vision statements.

Process Management Tools

Individual student and practicum site interviews as well as focus groups uncovered stakeholder needs. Data gathered from the interviews and focus groups identified and define practicum issues including: students who registered for the practicum without sufficient coursework completed; onboarding process complexities and delays; the length of time to complete the practicum; and lack of student skills matching practicum site needs.

This in-progress research project utilized several tools such as the Supplier Input Process Output Customer Requirements (SIPOC-R) (see Table 1 SIPOC-R Identification of Processes). SIPOC-R requires brainstorming with customers that are familiar with the process and can explain linkages recorded in a flowchart format (Pyzdek & Keller, 2014). Suppliers identified included students, faculty and community partners. Inputs included practicum approval form, faculty

competencies and core course requirements such as knowledge, skills and attitudes. Processes identified were the onboarding process, program preparation of students, and site selection. Outputs included meeting accreditation standards, learning objectives using Bloom's Taxonomy, and accurate and completeness of the student practicum deliverables. Community partner objectives to be meet included the project's accurate completion. Student outputs were to pass the course, complete the practicum and gain knowledge in a timely manner. Customers identified were the university, faculty, students and community partners.

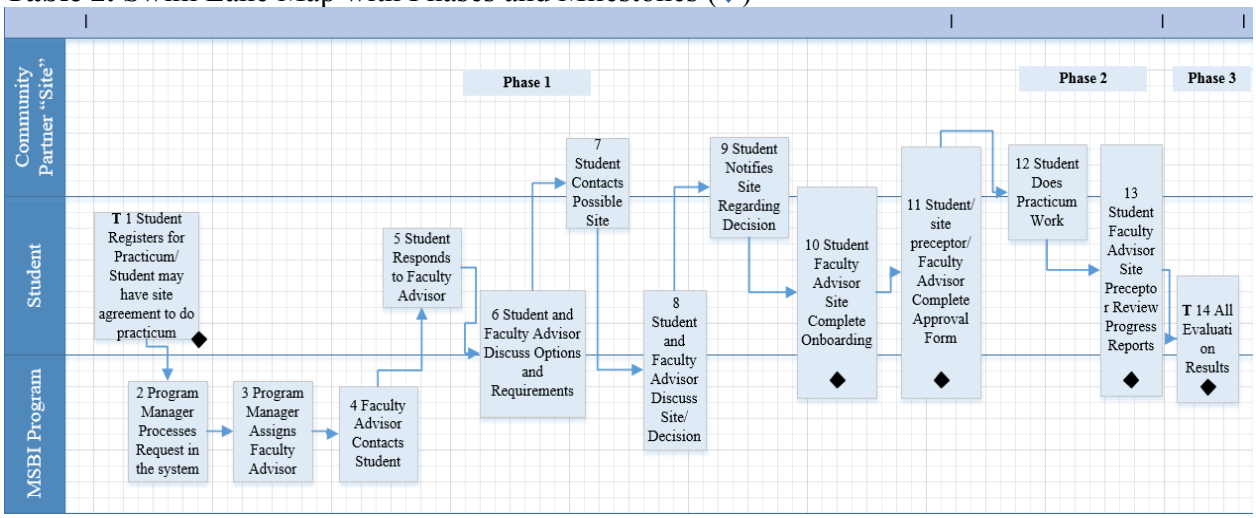
Table 1. SIPOC-R Identification of Processes

1. Suppliers	2. Inputs	3. Process	4. Outputs	5. Customers
Community Partners -Site Preceptor -Faculty Advisor ***University*** -Faculty Advisor	***Practicum Forms*** -Complete -Accurate -On time ***University*** -Guidance Accurate -Student Participation Professional	***Student prepared to start practicum*** -Complete MI5200 Survey Course ***Site selection*** -Student Match ***Complete accurate pre documents*** -Onboard -HIPAA Approval Form	-Pass Practicum -Timeliness -Accuracy -Complete Work -Knowledge Transfer -Strengthen Community Partnerships	-Community Partner -Site Preceptor -Student -University

After determining stakeholder needs the next step was to create an "As Is" flow chart, which was the base for a more in-depth analysis; the swim lane map. The "As Is" flow chart was a baseline walk-through of the existing practicum process (a snapshot), which identified some obvious issues that were later resolved using simple Kaizens (change for the better). Kaizens are simple fixes adhering to a standard and aimed at improving cycle time and eliminating waste (Pyzdek & Keller, 2014). The 'As Is" flow chart highlighted problematic areas which included selecting sites, the onboarding process and the structure of the practicum project. There were no prior systematic process steps in place for the practicum. One Kaizen created a policy mandating that students must complete all core course before registering for the practicum thus, ensuring that students have the basic knowledge, skills and attitudes needed for these projects. The onboarding process is unique for each community partner, and it was decided to have each faculty advisor take on this responsibility and work with the student to accomplish what was required. Another Kaizen implemented was modifying and creating courses with in-demand skills as identified by community partners such as healthcare analytics, lean six sigma, basic programing in SQL and R, and descriptive and inferential statistics. Once the as-is swim lane map was created and Kaizens were completed, a should-be swim lane map was created and major phases and milestones were added (see Table 2 Swim Lane Map with Phases and Milestones).

The development of the blueprint for the practicum project used the methodology: Study, Plan, Do, Study, and Act (SPDSA) based on the familiar healthcare PDSA model that drives quality (Taylor et al., 2013). The first step of the SPDSA (see Figure 1) is Study. This step is the preparation stage of the practicum. The student, faculty and site preceptor need to ask questions: Does the practicum site have a problem that would be appropriate for a student to work on? Does the student have the interest and necessary skills? Is there an Affiliation Agreement with the community organization and is there an onboarding process? Can an appropriate project charter be completed and approved? In addition, the student can create a project plan to organize activities. It is important to select the right project so that resources are not wasted. A selection matrix tool capturing appropriate project criteria was developed and proposed (see Table 3). Table 3 Proposed Project Selection Matrix is a project-rating tool. This tool consists of several important, pre-selected weighted items. Total scores for each item gives the student, faculty, and site preceptor a better view of project fit analysis. Consider some of the following questions. Does the project address a strategic need? Do you have available staff? Will the project be completed in an acceptable period?

Table 2. Swim Lane Map with Phases and Milestones (◆)



The next step is Plan. Planning begins the project and includes mapping the system and/or relevant process(es). Identify all valid customer requirements. Create a breakthrough equation. The breakthrough equation looks to identify and manage critical inputs (Xs), which have a significant

Table 3. Proposed Project Selection Matrix

Rating Items	Weights (e.g)	Scores for Projects Being Rated (Use a 1- 5 Scale & Multiply Items by Weights)		
		Totals		
		Project 1	Project 2	Project 3
1. Are customers (internal/external) dissatisfied or defecting?	3			
2. Is there a serious problem (Y)?	4			
3. Arethe related Xdata available or collectable?	5			
4. Is the solution known?	3			
5. Are the expected benefits significant enough?	3			
6. Is the project aligned with department or company goals?	3			
7. Can the project be completed within 6 months or less?	3			
8. Considering the risk, is there a good probability of success?	2			
9. Will the solution likely involve a significant cost?	4			
10. Is the ability to make change largely in our control?	4			
Totals				

impact on the output(s) (Y). Managing variation in process (X) helps produce better outcomes (Y). Next, identify all current measures for (X's). Explore the quality of the measurement system. Project plans identify and spell out the tasks, who is responsible, beginning and end dates, as well as status and comments.

Edward Deming, the high-quality expert, coined the phrase "In god we trust, all others bring data". This is a focus of the Do step. The student is now collecting and analyzing new data, identifying any process waste, analyzing existing and new data, and identify the problem's (Y) root causes. Root causes are the most basic reason causing an undesirable condition or problem. If eliminated or corrected, it would have prevented the problem from existing or occurring. Root Cause Analysis refers to the process of identifying and eliminating those so-called causal factors. It is about finding the real cause of the problem and dealing with it rather than simply continuing to deal with the symptoms. Students will measure to obtain data to assess the performance of processes against customer requirements, to identify variation (relative strengths and weaknesses) in your processes, and to drive improvement-obtain information for process management, improvement, or design/redesign.

The second Study step focuses on the overall project. Research best practices ideas that could resolve the issue the practicum is addressing. The student will identify and test workable solutions

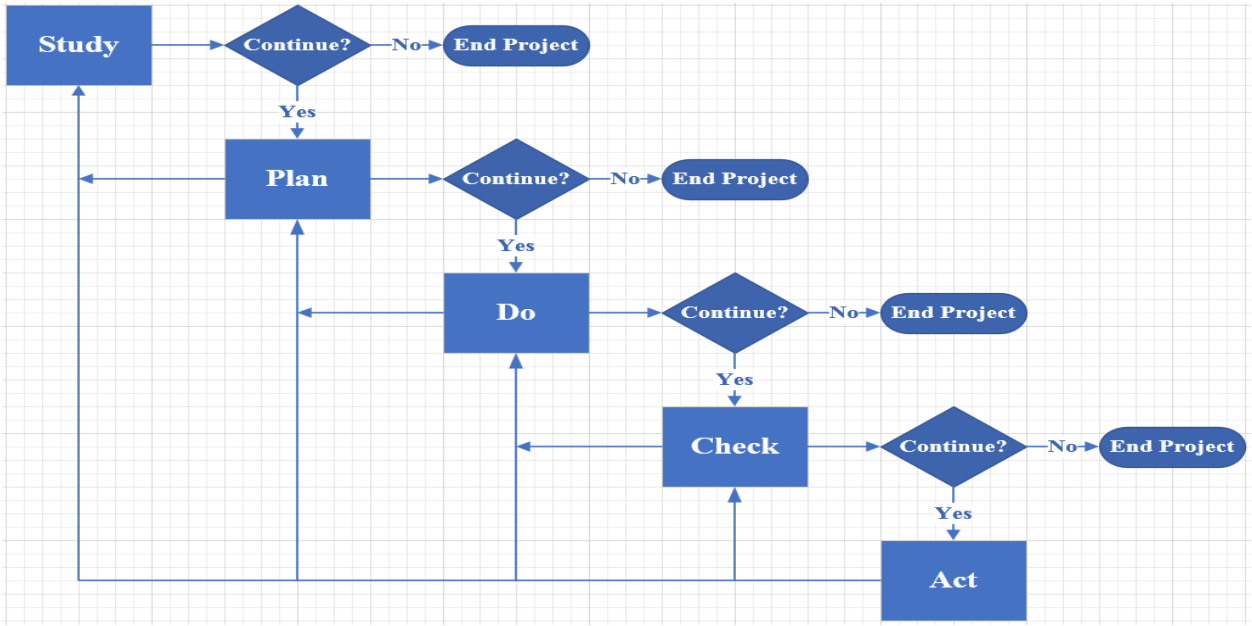


Figure 1. SPDSA Model

to the problem. The student will review findings with the site preceptor and team. Solutions include standardization making sure that essential elements of a process are performed consistently in the best-known way. Changes would be made only when data shows that a new alternative is better. Documentation is key so making sure documentation is up to date encourages ongoing use of standardized methods.

The last step is Act. Here students, faculty and the community site may elect to accept or reject the student practicum recommended changes. A new standard may need to be develop. The goal is to implement the changes throughout the system with plans for maintenance and continuous improvement. Each step of the SPDSA is contingent on how much time is available for the student and the community organization (see Figure 1). The SPDSA Model shows each of the steps. The SPDSA Process Tool (see Table 4) displays process tools for each step of the SPDSA. The project is now at a stage to begin tracking and collecting time and quality data tied to the completion of phases and milestones. This information will facilitate ongoing continuous improvement. Table 5 Proposed Data Collection Instrument captures time measurements and student progress through the practicum experience. Phase I (not shown on Table 5) begins when the student is approximately

Table 4. SPDSA Process Tool

	Study (Prepare)	Plan (Baseline)	Do (Root cause)	Study (Solutions)	Act (Implement)
Charter	X				X
Project Plan	X				X
Customer Requirements		X			
Breakthrough Equation		X			
Process Maps		X			
Data Audits and Collection		X	X		X
Histograms		X		X	
Run and Control Charts		X	X	X	X
Pareto Charts		X	X		
Box Plots			X	X	X
Waste Analysis			X	X	X
FMEA			X	X	X
Fishbone and Five Ways			X		
Lean Tools				X	X
Solution Selection Matrix				X	

Approximately one term out of eligibility to register for the practicum. The BIP office needs to contact eligible students and get the process started during Phase I. Faculty need to meet with the student and determine the "best- fit" project for a student. This includes identifying student skills,

Table 5. Proposed Data Collection Instrument

Student ID	Practicum Start/Finish	Faculty Advisor	Phase II										Phase III	
			Study Start/Finish	Time Months	**Plan** Start/Finish	Time Months	**Do** Start/Finish	Time Months	**Check** Start/Finish	Time Months	**Act** Start/Finish	Time Months	Practicum Sign Off Start/Finish	Time Months
171	W 2018/F 2018	John	9/17-10/17	1	10/17-12/17	2	12/17-1/18	1	1/18-2/18	1	3/18-			
172	S 2017/W 2018	Mary	2/18-2/18	1	2/18-									
173	W 2018/F 2018	John	1/18-2/18	1	2/18-3/18	1	2/18-							
174	F 2017/S 2018	Beth												
175	S 2017/W 2018	Sue	1/18-1/18	1	1/18-2/18	1	2/18-							
176	F 2017/S 2018	John												
177	F 2017/S 2018	Sue												
178	F 2017/S 2018	Tom	1/18-2/18	1	2/18-2/18	1	2/18-							
179	F 2017/S 2018	Beth	2/18-2/18	1	2/18-									
180	W 2018/F 2018	Beth												
181	W 2018/F 2018	Sue												
182	W 2018/F 2018	Tom												
183	W 2018/F 2018	John												
184	W 2018/F 2018	John	1/18-1/18	1	2/18-									
185	W 2018/F 2018	Mary	1/18-1/18	1	2/18-2/18	1	2/18-							

potential plans, and community organization where a student can do a project. Other significant factors are the affiliation agreement, if there is a required onboarding process, and the students' practicum interest.

Phases II and III capture time (in months) from start to finish for each step SPDSA (see Table 5). The entire student practicum is on a whiteboard in the Practicum Course Director's office allowing faculty to access to all of the student practicums and their progress. Student names are de-identified. This chart uses "stop light" colors as a visual reference on status. Green indicates to faculty that the practicum is on target and time. Yellow indicates caution and there may be some issues dragging on the project. Red indicates an alert for faculty that there is a definite problem because the project is taking too much time. The Practicum Course Director is responsible for updating the chart on a weekly basis.

Acknowledgement

This work is an ongoing improvement project conducted by the authors. This project received no financial support. We wish to thank the governing body of the International Institute for Applied Knowledge Management and their Conference for providing a platform for researchers and scientist to collaborate and highlight their work.

References

Commission on Accreditation for Health Informatics and Information Management Education, (2018). CAHIIM Accreditation. *Commission on Accreditation for Health Informatics and Information Management Education.* Retrieved from: http://www.cahiim.org/accreditation/accreditation.html

Hersh, W. (2010). The health information technology workforce: Estimates of demands and a framework for requirements. *Applied Clinical Informatics, 1*, 197-212

Li, N., Ely, S., & Laux, C. (2017). How to use lean six sigma to improve service processes in higher education: A case study. *4th international Conference on Lean Six Sigma for Higher Education*, pp. 129-145.

Parker, K. R., Srinivasan, S. S., Houghton, R. F., Kordzadeh, N., Bozan, K., Ottaway, T. & Davey, B. (2017). Health informatics program design and outcomes: learning from an earlier offering at a mid-level university. *Education and Information Technologies, 22*(4),1497-1513.

Pyzdek, T. & Keller, P. (2014). *Six sigma handbook (4th ed.).* New York, NY: McGraw-Hill Education.

Taylor, M. J., McNicolas, C., Nicolay, C., Darzi, A., Bell, D., & Reed, J. E. (2013). Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Quality and Safety,* 1-9. Doi:10.1136/bmjqs-2013-001862

Author Biographies

Dr. Stephen E. Bronsburg is an Assistant Professor, Academic Advisor and Practicum Course Director at Nova Southeastern University Dr. Kiran C. Patel College of Osteopathic Medicine (NSU-KPCOM), Department of Health Informatics, Biomedical Informatics Program, Fort Lauderdale, Florida, USA. He is a board member for the South Florida Health Care Information and Management Systems Society. He has conducted and collaborated on health information technology research projects with health professionals and students such as developing Avatars to teach addiction counseling skills to physicians, developed and implemented a phone application to address addiction, and incorporating mobile health technology interventions addressing chronic disease and addiction. He has delivered presentations and peer reviewed journal publications in these areas. Dr. Bronsburg recently submitted a National Institute of Health grant, which incorporates mobile health technologies to facilitate change behaviors promoting increased physical activity, improving chronic disease self-management skills, and fostering patient-provider relations.

Dr. Harold E. Wiggin is a Certified Six Sigma Master Black Belt who has been involved in government and agency organizational and process improvement activities for over 30 years. He was Director of Planning and Quality Improvement for the Broward County Children's Services Council and Regional Manager of Performance and Planning for the Florida Department of Children and Families. He received the 2015 Golden Apple Award for excellence in teaching Lean Six Sigma for Health Care courses at NSU-KPCOM and he is working to develop a quality improvement track at the medical college. Recent consulting activities have included projects addressing hospital boarding, revenue cycle management, community care (case management) for Medicaid patients, and high reliability organization training. Dr. Wiggin provides these services through his company, SH&L Quality Consulting, Inc. and he is a Principal in the Sterling Academy. Dr. Wiggin also co-authored "The Lean Management Systems Handbook" (CRC Press, 2014).

Dr. Arif M. Rana is an Associate Professor of Biomedical Informatics, Medical Education, and Public Health. He is Department Chair and Director of the Biomedical Informatics Program at NSU-KPCOM. Since his arrival at NSU-KPCOM, he has taught a wide array of courses, including Databases in Health Care, Clinical Decision Support Systems, and Introduction to Information and Communication Technologies in Health Care. In addition, he is well versed in curriculum development and instructional design and has substantial knowledge of programming languages, including C/C++, Perl scripting, SQL, PHP as well as experience in database applications.

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Proposal of evaluation criteria for editors of ontologies created to represent knowledge in information systems

[Research-in-Progress]

Helena Dudycz, Wroclaw University of Economics, helena.dudycz@ue.wroc.pl

Abstract

One way to represent knowledge of experts in information systems is an ontology. Constructing ontology always denotes analysis and organizing knowledge concerning specific field noted in formalized structure. There can be noticed an increasing interest in using ontology, whose goal is to illustrate the model of a specific field, in information systems. There is an increasing number of both, open source and commercial software, whose aim is to support the process of creating ontology. In this paper, we discuss the suggestion of 11 criteria to evaluate ontology editors. For each of them, we present a rating scale. The proposed list of criteria may be used to conduct research and evaluation of ontology editors with the use of scoring methods.

Keywords: Ontology, ontology editor, multi-criteria evaluation, knowledge representation.

Introduction

Ontology in computer science is a kind of model describing in a formal way a specific area of the field. One of the main goals of creating an ontology is sharing the accumulated knowledge. Initially, ontology in computer science was developed for data on the Internet. Currently, its applications are wider, based also on ontology's capabilities to represent specific knowledge (including for the purpose of its exchange) and to establish a flexible platform for integrating information and elements from various information systems. There is a growing interest in software that supports the creation of an ontology model for specific areas. It is important that their functionality significantly facilitates this process and supports the work of teams (including experts) specialising in various fields of knowledge, e.g. in the area of economics and finance.

On the information technology (IT) market, there is an increasing number of programs for ontology, both open source and commercial, with a variety of functionalities. An extensive list of programs for building, developing and integrating ontologies is presented in Bergmann (2010), and *Ontology Tools* (2010). The problem is choosing the best program to save the created ontology as a form of knowledge representation in the IT system.

On the basis of literature search, analysis of the functionality of selected editors to record the created ontologies and to conduct research related to the creation of ontologies for specific areas of analysis of economic and financial indicators, basic criteria were identified that are relevant to choosing the editor to record the developed ontology. The first proposal of these criteria is

presented in Dudycz (2015). In this research, we used inductive approach, that is inference was done based on conducted experiments (e.g. the created ontology for the representation of business knowledge in IT system) and analysis of ontology editors described in literature.

This paper focuses on presenting proposals for evaluation criteria of the editors for recording the conceptual model of ontology developed for a selected area. These criteria can be used to analyse these programs, including using scoring methods (is described e.g Mackey & Gass, 2015). The structure of this paper is as follows: in the next section, the ontology is briefly characterised as a method of knowledge representation in the IT system; subsequently, there are presented proposals for evaluation criteria for ontology editors. This paper closes with a summary.

Ontology as a Method of Knowledge Representation

One of the ways to represent knowledge in IT systems is the ontological approach. In the IT context, the term ontology appeared in 1967 in the works of Mealy (1967), which deals with data modelling. In the literature, there are many interpretations of the term "ontology", including a philosophical discipline, informal conceptualization of the system, formal semantic description, specification of conceptualization, conceptual representation of the system via logical calculations, determination (meta-level) of logical theory. This issue is described in more detail in the paper (Almeida & Barbarosa, 2009).

There are numerous definitions of ontologies in the literature, yet there is no one commonly recognized in computer science. The most frequently used definition is the general explanation of ontology formulated by Gruber (1993), which described it as a formal specification of the conceptual layer. Thus, it is a formal conceptualization of a specific field (Godard, Andres, & Ono, 2004), regarding the model described by concepts and the relations existing between these concepts. Ontology can also be described as a graph of ordered semantic terms, where the nodes are distinguished concepts, while the relations existing between them are arcs. In addition to defining terms and relations between them, we can also specify: instance concepts, functions used, and logical expressions. According to Smith (2003), ontology should ensure the ultimate and comprehensive classification of subjects in all areas of existence (p. 155). This means that ontology in IT is a kind of model describing a specific area of the field in a formalized way. Constructing ontology always denotes analysis and organizing knowledge concerning specific field noted in formalized structure. The ontology can be used to create, for example, the necessary knowledge models in analytical tools. A more extensive review of definitions of ontologies was presented, among others, in the following publications by Arp, Smith, and Spear (2015), Grand and Soto (2010), as well as Smith (2010).

A dozen or so methods have been developed to indicate the ontology building procedure (more widely described, among others, by: Dudycz & Korczak, 2015; Gomez-Perez, Corcho, & Fernandez-Lopez, 2004; Noy, & McGuinness, 2005). The very process of its creation is not an easy task and often requires the involvement of teams with several people. It is a time-consuming process, mainly due to its multistep nature, regardless of the method used. Building an ontology

means always analysing and organising knowledge about a specific field recorded in a formalised structure. It can be written in an informal way (expressed in natural language), semi-formal (expressed in a formalised language) and formal (also described using statements and proofs). In the literature, due to this criterion, the following types of ontology are distinguished: highly informal, structured informal, semi-formal and rigorously formal (Casellas, 2011). Ontologies which possess a more formal form require the use of appropriate language to create them. The standards recognised by the World Wide Web Consortium (W3C), which is an international community that develops open standards to ensure long-term growth of the World Wide Web (WWW). It include:

1) Resource Description Framework (RDF) – it is an extension of XML; it was created as a metadata encoding standard;
2) RDF Schema (RDFS) – it is an extension of RDF; it makes it possible to categorise and prioritise, describing the classes of individual resources;
3) Web Ontology Language (OWL) – it is an extension of RDF with semantics based on descriptive logic; it allows to define complex relationships between classes and their properties, instance classes, properties of data types, and attributes.

Languages recognised by the W3C as a standard enable the recording of knowledge and its verification. In order to use their capabilities, it is necessary to employ tools for creating and editing ontologies. There are created numerous solutions to support ontology building and management, which can be broadly divided into (e.g.: Alatrish, 2013; Bergmann, 2010; Corcho, Fernandez-Lopez, & Gomez-Perez, 2003; *Ontology tools*, 2010; Mizoguchi & Kozaki, 2010):

- Ontology editors (for examples: Hozo, Neon Toolkit);
- Inference engines (for examples: Fact ++, Pellet, RacerPro, Hermit, KAON2);
- Mapping ontologies (for examples: the Alignment API, GOMMA, Optima);
- Ontology visualization /analysis (for examples: Graphviz, igraph, OWL2Prefuse);
- Comprehensive ontology Tools (for examples: Ontopia, Protégé, SWOOP, Wandora).

The development of tools supporting the creation of ontologies is necessary due to the growing interest in the use of ontologies in various information systems. There are run, among others, advanced works related to the use of ontologies to develop a model for representing economic knowledge in information and analytical systems dedicated to economic as well as financial analysis (Aruldoss, Maladhy, & Venkatesan, 2011; Cheng, Lu, & Sheu, 2009; Korczak, Dudycz, & Dyczkowski, 2017). This is due to the advantages of ontologies, which are: easier understanding of the recorded model, gives the opportunity to discuss with other experts or specialists in the field of its conceptualisation, higher efficiency of preparation and use of knowledge expressed in this way; the ease of sharing such recorded knowledge by various applications and the reuse of knowledge components created in this way in other systems.

Proposal of Evaluation Criteria for Ontology Editors

One of the ways to represent knowledge in IT systems is the approach where ontology is created for a specific purpose, and should, therefore, be recorded in the most adequate way to be able to accomplish its tasks. The advantages of many ontology building tools should be their intelligibility and friendliness. To use them, there should be no need for fluency in IT solutions, which will allow them to be directly used by experts in a given field. The number of available ontology editors shows a significant development of work related to ontology as part of information technology.

There are more and more editors that improve the creation of ontologies, both open source and commercial solutions. In the literature on the subject, one can find papers in which the authors carry out a wide analysis of the available tools for building ontologies. Among them, there are works which provide general characteristics of selected solutions (Denny, 2002), describe a lot of products (Bergmann, 2010), compare some of ontology editors (Alatrish, 2013), and works which analyse them according to the proposed synthetic measure (Mizoguchi & Kozaki, 2010). Mizoguchi and Kozaki (2010) focused on analysis and comparison of environments of comprehensive ontology tools due to the following criteria: methodological support, collaboration support, ontological theory, standards compliance, ontology/model server, evaluation methodology, refinement support, friendly GUI, architecture, extensibility.

While conducting scientific research related to the creation of ontologies for the analysis of economic and financial indicators as a representation of knowledge in the IT system, there was simultaneously conducted research on ontology editors. The premise of this research was the question: how to choose an ontology editor, and which is the best solution in creating an ontology in a specific project? The research regarding the selection of the ontology editor was conducted according to the following procedure. First, a literature review was carried out touncover papers that describ ontology editors, their basic tasks, and functionalities. Second, open source software (including TM4L, Ontopia, Protégé) were selected and tested, carrying out research projects (Dudycz, 2010; Korczak, Dudycz, & Dyczkowski, 2013; Dudycz, Korczak, Nita, & Oleksyk, 2016), in which one of the elements was the proposal to use an ontological approach to knowledge representation in the IT system. Third, factors that can influence the choice of the ontology editor were identified. Fourth, criteria for the ontology editor evaluation and rating scale were developed.

As a result of the compleation from the conducted work, the following criteria were identified (see also: Dudycz, 2015), which are important in the selection of the ontology editor:

1. Ontology coding language – decides about the possibility of using the recorded ontology in various systems operating on different platforms. The preferred editor is a solution allowing to record the created ontology in languages compliant with the W3C standard (including OWL, RDF, EDRS). The following rating scale is proposed: 1 point – coding in languages defined by the provider (not belonging to the W3C standard); 2 points – coding in one of the

languages compliant with the W3C standard; 3 points – coding in more than one of the languages compliant with the W3C standard.

2. Multi-modularity – indicates the possibility of extending the functionality of the editor by including any type of additional modules (e.g. inference mechanisms), for example in the form of a plug-in. The preferred editor is one which can be extended with new functionalities and which contains many modules. The following rating scale is proposed: 0 points – no possibility of attaching additional modules, and 1 point – a possibility to attach additional modules.
3. Form of access – defines the possibility of using the editor: locally or online. In the case of online access, it is possible to read and edit the created ontology anywhere (provided that there is access to the Internet). Such functionality is important when the ontology is created by a team of people in different places or when it is required to be verified by additional experts in a given field. The preferred solution allows for online work. The following rating scale is proposed: 1 point – local access, and 2 points – online access.
4. Group work – allows for cooperation of several people, often specialists in various fields, in the creation of ontologies. The preferred editor is one which has functionalities supporting group work. The following rating scale is proposed: 0 points – no such function, and 1 point – there is such a function.
5. User interface – facilitates ontology building where the participation of experts (e.g. from economic knowledge) is desirable, including people who often do not have programming or IT proficiency. The preferred editor is a solution with a graphical interface that is more intuitive than the character-based one, a choice which can improve the efficiency of recording the ontology created in the editor. The following rating scale is proposed: 1 point – character interface, and 2 points – graphical interface.
6. Ontology visualisation – allows to display the ontology in the form of a graph. This is an important functionality both during the creation of ontology and its use, especially by the so-called non-technical people (e.g. experts in a given field of economic knowledge). The preferred editor is a solution that allows to visualise ontologies. The following rating scale is proposed: 0 points – no such function, and 1 point – there is such a function.
7. Import/export – indicates the possibility of loading an already created ontology in another tool, as well as saving it in a format that allows for its use in other IT solutions. The preferred editor allows to save the created ontology in the W3C standard, but there should be also taken into account those programs that allow to save the ontology in the form of files with widely used extensions such as MSOffice or html. The following rating scale is proposed:1 point – saving in the format defined for a given editor (not belonging to the W3C standard); 2 points – saving also in the format of files with popular extensions (e.g. MS Office), and 3 points – saving in the format compliant with the W3C standard.
8. Export the graphic form to a file – allows to save the visualisation of the created ontology (graph) in one of the standard formats of graphic files (e.g. jpg). The preferred editor is a solution which has such functionality. The following rating scale is proposed: 0 points – no such function, and 1 point – there is such a function.

9. Integration – allows to combine already built ontologies or their selected fragments, which facilitates the creation of extensive ontologies. The preferred editor is a solution which allows the integration of existing ontologies. The following rating scale is proposed: 0 points – no such function, and 1 point – there is such a function.
10. Software upgrade – ensures the stability of use of a given editor and the information systems built with it. Therefore, when choosing an editor, one should pay attention whether new updates appear, as well as to aspects such as: whether a given program has passed the testing phase and how long it has existed on the market. The preferred editor is constantly being developed and adapted to the applicable standards. In the case of this criterion, it is important whether the software is updated in the context of constantly changing software and hardware conditions (e.g. subsequent versions of operating systems). As an example, we can use TM4L (Topic Maps for e-learning), which consists of two tools, i.e. TM Editor and TM Viewer. It is an ontology-editing software for use in accordance with the concept map standard. The well-functioning program has virtually ceased to exist because several years ago it was not updated due to the change of the MS Windows operating system. The following rating scale is proposed: 0 points – no ongoing update of the program, and 1 point – the program is being updated on an ongoing basis.
11. Cost of software – in this respect, two groups of editors can be considered, i.e. commercial or open source solutions. Assuming only the financial aspect, interpreted as the cost of obtaining a given editor, the preferred solution is open source software. The following rating scale is proposed: 1 point – for a commercial license, and 2 points – for an open-source license.

The last two criteria require a brief explanation. The first one (#10) concerns software updates. This criterion, although placed almost at the end of the presented list, is a key parameter determining the choice of the editor. This means that analysis and evaluation should be carried out only on this software which is being constantly updated. In the case of using the scoring point method, where the significance coefficient is assigned to the criteria, this item should be given the highest weight. When choosing an ontology editor, one should mainly focus on its timeliness and if it supports standard writing languages supported by W3C. This is crucial, especially when the created ontology is edited and used in numerous programming environments. This criterion was included in this list in order to propose a relatively complete spectrum allowing multicriteria evaluation of existing ontology editors, as well as enabling the selection of the best solution. The aspect of software updates is very often overlooked in the literature in the characteristics of this type of tools.

The second criterion (#11) that requires a comment is the cost of the software. Analysing this parameter, which not only takes into account the cost of obtaining (purchasing a license) an editor for ontology, but also aspects of maintaining and developing an information system based on this tool, the presented rating scale may be different. If the ontology editor is to be used in projects run by micro, small and medium enterprises to record economic knowledge on even the analysis of economic indicators assessing their company, the most important factor may be the

cost of acquiring this software, and, therefore, the preferred solution is open source. In this situation, the rating scale consists of only two options. In the case of research works, both open source and commercial programs, which are free of charge for scientific purposes, are important. Thus, the rating scale may contain three options: 1 point – for a commercial license; 2 points – for a commercial and open source license for research works, and 3 points – for an open-source license. However, for large enterprises and IT companies, both commercial tools and open source software, which they can develop themselves, may be the preferred solution. In this case, the rating scale may contain only two options, but with a reversed score than suggested in this paper.

The proposed list of criteria, together with the rating scale, can be used to perform a comparative assessment of editors, based on scoring methods (with or without using weights). In the case of the scoring method without using weights, the best solution to create ontologies will be the software which receives the largest sum of points obtained from the analysed programs. However, when using the scoring method with weights, each criterion, next to the points scale, is assigned a significance coefficient (so-called weight, the developed significance coefficients determine the so-called vector of valuation preferences for the features of the required software), which indicates its importance in the context of the assessment.

In that case, the best program for saving the created ontology will be the software that will receive the largest sum of ratios of the points obtained within the given criterion, multiplied by its weight. When using the scoring method with weights, the obtained results can be analysed in a multifaceted manner, i.e. not only the obtained final sum, but also partial evaluations of each criterion. The presented criteria proposal is not a closed list, but it covers the most important issues when choosing an ontology editor to represent knowledge in IT systems.

Conclusions

Literature indicates about 185 different ontology tools (*Ontology tools*, 2010). Among them, there are editors, inference mechanisms, mechanisms for ontology management, and those for their integration. The variety of tools for creating ontologies and their characteristics in various publications (e.g.: Alatrish, 2013; Kapoor1 & Sharma, 2010), as well as research related to building an ontology of economic and financial knowledge for use in dedicated management systems (Korczak et al., 2013; Dudycz et al., 2016), prompted an attempt to determine the criteria for their assessment. It aims to facilitate the analysis and selection of the most adequate solution for the developed ontology.

There are works in the literature such as, for example, Mizoguchi and Kozaki (2010), that propose a synthetic measure containing, among others, the following criteria: methodological support, ontological theory, ontology/model server, evaluation methodology, architecture, extensibility. These criteria allow to compare environments of comprehensive ontology tools. The criteria of analysis and choice of ontology editors proposed in this paper focus on the evaluation of tools regardless of used ontology building method.

The selection of an ontology editor suitable for a given project influences the efficiency of developing an ontology for a selected area and its subsequent application. With a multitude of proposals, it is difficult and there is a risk of choosing an inadequate solution. Therefore, this paper proposes criteria that should facilitate the analysis of available ontology editors, compare them with one another in order to select the right software. These criteria should help to choose the best solution in creating ontologies in the implemented project.

Performing a comparative assessment of ontology editors for representation in the implementation of a specific IT system, when we already have a defined set of criteria and the scale of their evaluation, does not require a lot of work anymore. In that case, the application of the scoring method is already relatively simple and it is easy to interpret the obtained results. The criteria of analysis of ontology editors proposed in the literature, as well as in this article, is the basis for further research in this area.

References

Alatrish, E. (2013). Comparison some of ontology editors. *Management Information Systems*, *8*(2), 18-24.

Almeida, M. B., & Barbarosa, R. R. (2009). Ontologies in knowledge management support: A case study. *Journal of the American Society for Information Science and Technology*, *10*(60), 2032-2047.

Arp, R., Smith, B., & Spear, A. D. (2015). *Building ontologies with basic formal ontology*. Cambridge, MA: MIT Press.

Aruldoss, M., Maladhy, D., & Venkatesan, P. V. (2011). A framework for business intelligence application using ontological classification. *International Journal of Engineering Science and Technology*, *3*(2), 1213–1221.

Bergmann, M. (2010). *The sweet compedium of ontology building tools*. Retrieved from http://www.mkbergman.com/862/the-sweet-compendium-of-ontology-building-tools/

Casellas, N. (2011). *Legal ontology engineering: methodologies, modelling trends, and the ontology of professional judicial knowledge*. Berlin, Germany: Springer Science & Business Media.

Cheng, A., Y.-C., Lu, & Sheu, C. (2009). An ontology-based business intelligence application in financial knowledge management system. *Expert Systems with Applications*, *36*(*2*), 3614–3622.

Corcho, O., Fernandez-Lopez, M., & Gomez-Perez, A. (2003). Methodologies, tools and languages for building ontologies. Where is their meeting point? *Data & Knowledge Engineering*, *46*, 41–64. doi:10.1016/S0169-023X(02)00195-7

Dudycz, H. (2015). Kryteria oceny edytorów ontologii. *Problemy Zarządzania*, *13*(2), 78-87. doi: 10.7172/1644-9584.52.6

Dudycz, H. (2010). Topic map for notation of ontology of return on investment indicator. *Applied Technologies and Innovations*, *3*(3), 1-14.

Dudycz, H., & Korczak, J. (2015). Process of Ontology Design for Business Intelligence System. In: Ziemba E. (Ed.) *Information Technology for Management. Federated Conference on Computer Science and Information Systems, ISM 2015 and AITM 2015*, Lecture Notes in Business Information Processing, Springer, *243*, 17-28. doi:10.1007/978-3-319-30528-8_2

Dudycz, H., Korczak, J., Nita, B., & Oleksyk, P. (2016). Attempt to extend knowledge of Decision Support Systems for small and medium-sized enterprises. In Ganzha, M., Maciaszek, L., & Paprzycki, M. (Eds.), *Proceedings of the 2016 Federated Conference on Computer Science and Information Systems*, Annals of Computer Science and Information Systems, *8*, 1263-1271. doi:10.15439/2016F181

Godard, J., Andres, F., & Ono, K. (2004). ASPICO: Advanced scientific portal for international cooperation on digital cultural content. *Journal Information Theories & Applications*, *11*(2), 103-112.

Gomez-Perez, A., Corcho, O., & Fernandez-Lopez, M. (2004). *Ontological engineering: with examples from the areas of knowledge management, e-commerce and the semantic web*. London, UK: Springer-Verlag.

Grand, B. L., & Soto, M. (2010). Topic maps, RDF graphs, and ontologies visualization. In: Geroimenko, V. & Chen, C. (Eds.), *Visualizing the Semantic Web. XML-Based Internet and Information Visualization*, Springer-Verlag London, 59-79.

Gruber, T. R. (1993). *Toward principles for the design of ontologies used for knowledge sharing*. Technical Report KSL, Knowledge Systems Laboratory, Stanford University. Retrieved from http://tomgruber.org/writing/onto-design.pdf

Kapoor1, B., & Sharma, S. (2010). A comparative study ontology building tools for semantic Web applications. *International journal of Web & Semantic Technology*, *1*(3), 1-13. doi: 10.5121/ijwest.2010.1301

Korczak, J., Dudycz, H., & Dyczkowski, M. (2013). Design of financial knowledge in dashboard for SME managers. In Ganzha, M., Maciaszek, L., & Paprzycki, M. (Eds.), *Proceedings of the 2013 Federated Conference on Computer Science and Information Systems*, Annals of Computer Science and Information Systems, *1*, 1263-1271.

Korczak, J., Dudycz, H., Nita, B., Oleksyk, P. (2017). Towards Process-Oriented Ontology for Financial Analysis. In Ganzha, M., Maciaszek, L., & Paprzycki, M. (Eds.), *Proceedings of the 2013 Federated Conference on Computer Science and Information Systems*, Annals of Computer Science and Information Systems, *11*, 981-987. doi:10.15439/2017F181

Mackey, A., & Gass, S., M. (2015). *Second language research: Methodology and design,* routledge. New York, NY: Routledge.

Mealy, G. H. (1967). Another look at data. In *Proceedings of the Fall Joint Computer Conference*, Anaheim, California, pp. 525-534.

Mizoguchi, R., & Kozaki, K. (2010). Ontology engineering environments. In Staab, S., & Studer, R. (Eds.), *Handbook on Ontologies*. Berlin, Germany: Springer Science & Business Media.

Noy, F. N., McGuinness, D. L. (2005). *Ontology development 101: A guide to creating your first ontology*. Retrieved from http://www.ksl.stanford.edu/people/dlm/papers/ontology101/ontology101-noy-mcguinness.html

Ontology Tools (2010). Retrieved from http://wiki.opensemanticframework.org/index.php/Ontology_Tools

Smith, B. (2010). *Ontology and information systems.* Retrieved from http://ontology.buffalo.edu/ontology%28PIC%29.pdf

Smith, B. (2003). *Blackwell guide to the philosophy of computing and information*. Oxford, UK: Blackwell.

Sunitha, A. (2012). A Survey on ontology reasoners and comparison. *International Journal of Computer Applications*, *57*(17), 33-39.

Author's Biography

Helena Dudycz, Ph.D. is an Associate Professor at Wrocław University of Economics in Institute of Business Informatics. She earned her Ph.D. and Post Ph.D. in Management, with a major focus on management information systems. Her current research focuses on information systems and technologies for business, especially: information visualization, ontology of economic and financial knowledge, business intelligence and visual data exploration. She is the author and co-author of over 150 publications.

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Definition of a framework for acquiring and acquisition sub-processes in a collective knowledge processing in the integrated management information system

[Research-in-Progress]

Marcin Hernes, Wrocław University of Economics, Poland, marcin.hernes@ue.wroc.pl

Ngoc Thanh Nguyen, Wrocław University of Science and Technology, Poland, ngoc-thanh.nguyen@pwr.edu.pl

Abstract

Efficient operation of the integrated management information systems (IMIS), especially multi-agent systems, is related to their ability to automatically process collective knowledge. On the basis of this knowledge the decision-making process is realized in the business organizations. This paper presents issues related to framework for acquiring and acquisition sub-processes in a collective knowledge of business organization processing in IMIS. The main novelty of the developed framework is coverage all the areas of the operation of an organization. Additionally, the inter-area knowledge for automatic strategic level decision making has been taken into consideration. The main improvements of this framework are that it allows for processing of the whole collective knowledge of business organization and it can be directly implemented in IMIS.

Keywords: Collective knowledge, business organization, integrated management information systems, and multi-agent systems.

Introduction

Information Technology (IT) innovations are currently used in the knowledge management processes, especially the integrated management information systems (IMIS) which, among other things, enable fast processing and automatic analysis of information, as well as to generate knowledge by automatically reasoning on the basis of results of such analysis (Hester, 2011). Increasingly, they also permit the understanding of the actual meaning of the observed economic phenomena and processes occurring in the business environment (Joshi, 2013). This capability can be achieved through the use of the intelligent cognitive agent architecture in the construction of the IMIS (Hernes, 2014). Because this type of system is more often made up of many software agents, which autonomously process knowledge, its functioning is similar to the group (collective) decision making processes by humans (Moskaliuk, Kimmerle, & Cress, 2012). One example of collective knowledge is experts' opinion about a predicted currency trading. Some experts may argue that the exchange rate of a currency will raise others that it will decrease, and still others that it will remain unchanged. In addition, expert opinions include reasons for such

predictions. Therefore, processing of collective knowledge and making decisions on the basis of the type of knowledge (automatically) realized by IMIS, are the areas of issues of the Collective Intelligence, which deals with methods for building an intelligence on the basis of a set (collective) of independent intelligences (Maleszka & Nguyen, 2015; MIT Center for Collective Intelligence, 2015). Dixon (2011) noted that the need for leveraging collective knowledge arises when organizations have to function in an increasingly difficult and complex conditions, such as turbulent environments and the reality of Big Data. However, it appears that existing papers do not consist of tools for collective knowledge processing, which can be implemented in multi-agent IMIS. On one hand, there are many different approaches related with particular functional areas (e.g. manufacturing, Customer Relationships Management (RCM), finance), but it is very difficult to integrate them, and it is insufficient to take decisions on a strategic level. On the other hand, the research papers and practical applications, related to IMIS development, take the issue of collective knowledge as a supplement to these systems (often collective knowledge is processed manually by users), while it should be treated as a very important element, as a tool for supporting Big Data problems. In addition, because the decision-making process in business organizations is realized in the conditions of a very turbulent environment with the aim of being competitive, decisions must be taken quickly, and on the basis of valuable knowledge.

The important research problem is, however, developing a framework for acquiring and acquisition of a collective knowledge of business organization in IMIS. It would enable a complete automation of the process of collective knowledge management from different functional areas of organization (e.g. manufacturing, logistics, CRM). Nowadays, it is a very important issue, because the decision-making process in business organizations is realized in the conditions of a very turbulent environment. In order to achieve competitiveness, decisions must be taken quickly and on the basis of valuable knowledge. Moreover, the collective knowledge related to particular functional areas (as the basis for operational & tactical level decisions) is insufficient to take decisions on the strategic level.

Thus, the IMIS should not only allow for a collective knowledge management near to real time as well as for acquiring and acquisition of the best valuable knowledge (from the point of view of the organization) in particular functional areas. However, it also should allow for the creation and management of the inter-area knowledge (the knowledge created on the basis of particular areas of knowledge; such knowledge is used for taking strategic decisions). The discussed framework should be implemented in IMIS, therefore, it is required to develop a formal framework. In particular, this framework would allow, in further works, for the development detailed methods for collective knowledge acquiring, acquisition, frameworks, as well as methods for the integration and evaluation of collective knowledge in IMIS. It appears that such type of framework either has not yet been developed or received limited attention in the subject literature. Taking into account the above issues, the aim of this paper is to develop a formal framework of acquiring and acquisition of the collective knowledge of business organization in the multiagent cognitive IMIS. In addition, the contribution of this paper is to systematize collective knowledge processing issues.

This framework is a part of a conception of management of collective knowledge of a business organization in a multi-agent cognitive IMIS, suggested in this paper, based on three stages: acquiring and acquisition of collective knowledge, integration of collective knowledge, and evaluation of collective knowledge (details are shown in the section 3). The collective knowledge is considered to be knowledge determined on the basis of knowledge states given by collectives' members (experts or agents). All these stages have a significant impact on the use of collective knowledge in the decision-making process.

This paper has been divided into four parts. First, there is a review of the literature in the field of collective knowledge management and IMIS; next, a conception of collective knowledge processing is described; in the third part, the framework of acquiring and acquisition of collective knowledge is developed. The fourth part of paper presents practical implementation and integration issues; the research experiment related to this framework is described in the last part of this paper.

Related Works

Knowledge of a business organization applies to various functional areas. These areas are reflected in the architecture of IMIS. The conception of such a class of systems is presented in the work of Plikynas (2008) and Bytniewski (2015). They suggested building an IMIS that could integrate information systems related to the different decision areas of enterprise, such, as: fixed assets, logistics and supply chain management (SCM), manufacturing management, human resources management, financial and accounting (and investment), controlling, CRM – including environment scanning, business intelligence (analyses & forecasting), e-Business. Although the functional areas are reflected in various IMIS's architectures, the common feature of all IMISs is necessary to use knowledge related to all sub-systems (inter-area knowledge) in order to make strategic level decisions.

The aspect of knowledge acquiring and acquisition is considered in various ways. Cairo and Guardati (2012) stated that knowledge acquisition is nowadays "a cognitive process that involves both dynamic modeling and knowledge generation activities" (p. 8108). This approach is also considered by Breuker (2013), however, it is not strictly related to collective knowledge. Moreover, acquiring and acquisition of knowledge are often considered separately for particular functional area, while these processes should be also considered in relation to all areas in order to achieve automatic strategic level decision making. For example, Gebus and Leiviskä (2009) presented a model for knowledge acquisition on an electronic assembly line, while Cheah, Kim, Kim, and Yang (2011) described a knowledge acquisition related to designing a product. These studies are related to manufacturing areas. Santoro Borges, and Pino (2010) instead, suggested a method of acquiring knowledge on business processes on the basis of stakeholders' stories. It is mainly related to customer relationship management, human resource management and logistics areas.

A Conception of Collective Knowledge Processing

This section describes the acquiring and acquisition of a collective knowledge, the integration of a collective knowledge, and the evaluation of a collective knowledge stages. Figure 1 presents an acquiring and acquisition of a collective knowledge.

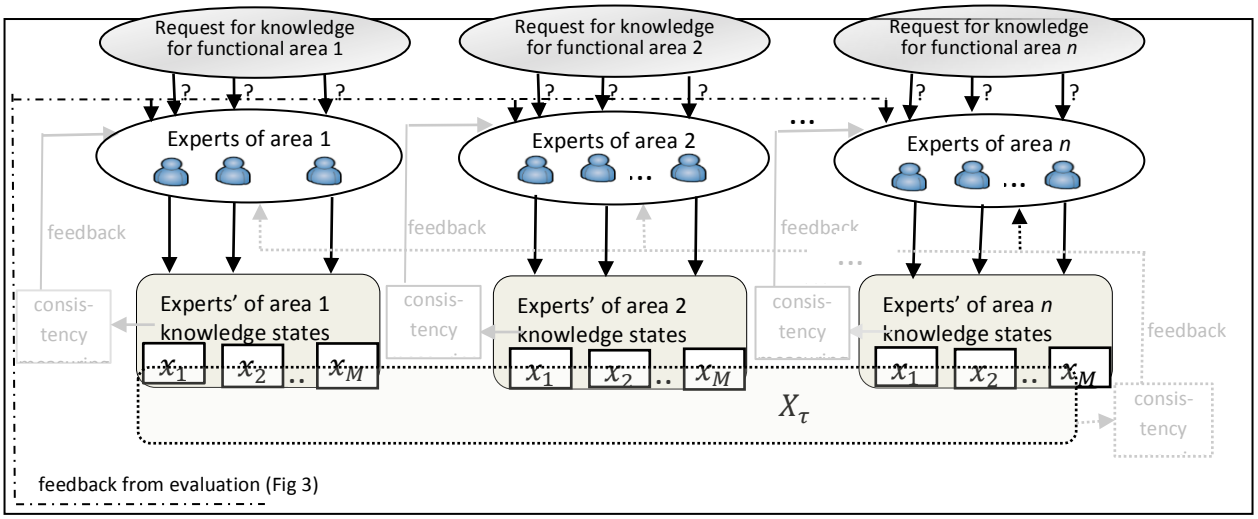


Figure 1. Acquiring and acquisition of a collective knowledge of business organization

At all the functional areas of business organization, experts' knowledge about business processes realization in particular areas is often needed. This knowledge is related to the decision-making process. More often, not one, but many experts are asked for opinions. A group of experts is often called a collective. Experts' opinions can be acquired from different kinds of sources, for example, from humans, software agents, or web pages. A set of experts' opinions is called experts' knowledge states and they are represented by using knowledge structures, which differ depending on a particular functional area. Since experts' opinions may differ (because for example, they may use different decision-making methods or different information sources to create their opinions) it is necessary to measure the level of consistency of experts' knowledge states. The feedback of consistency measuring is send to experts. If level of consistency is to low, experts may change their opinions. On the basis of particular areas of experts' knowledge states, the inter-area knowledge is created. This knowledge is needed to execute business processes across functional areas. Particular areas of experts' knowledge and inter-area knowledge are called collective knowledge of business organization. Figure 2 presents integration of knowledge. Determining particular areas and inter-area collectives knowledge (as a whole) is implemented by knowledge integration using consensus methods. First, the experts' knowledge states of particular areas and inter-area (called profiles) are examined for susceptibility to consensus (Nguyen, 2009).

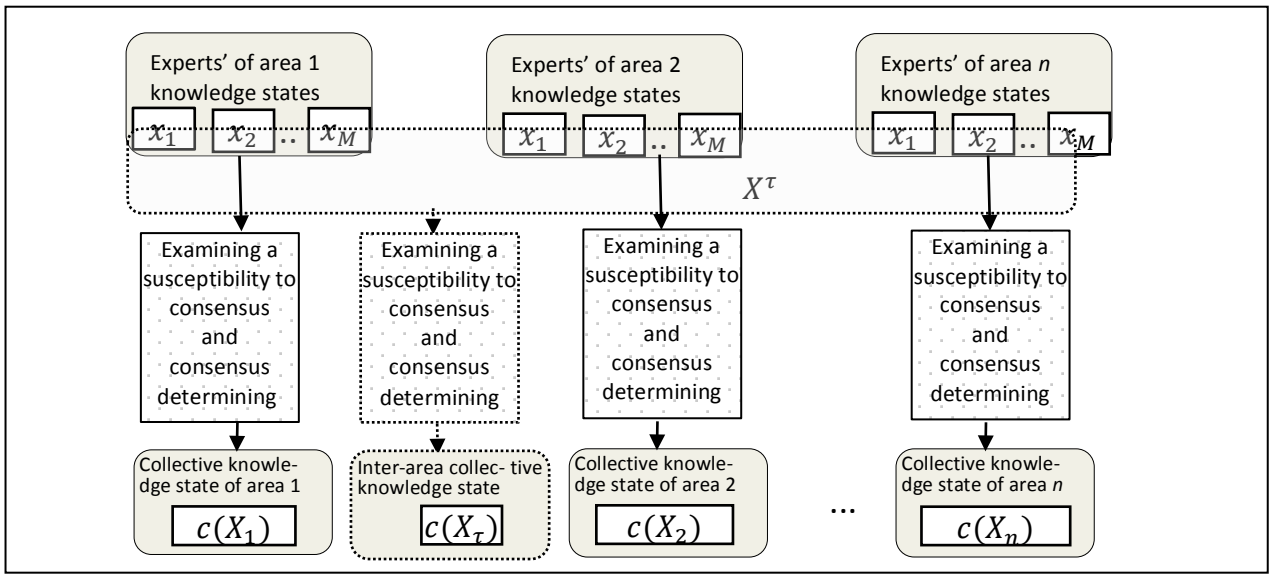


Figure 2. Integration of a collective knowledge of business organization.

The results of consensus algorithms are called collective knowledge states (of a particular area and inter-area). On the basis of these knowledge states decisions are taken. Very important issue is an evaluation of individual expert's and collectives' knowledge states (Figure 3).

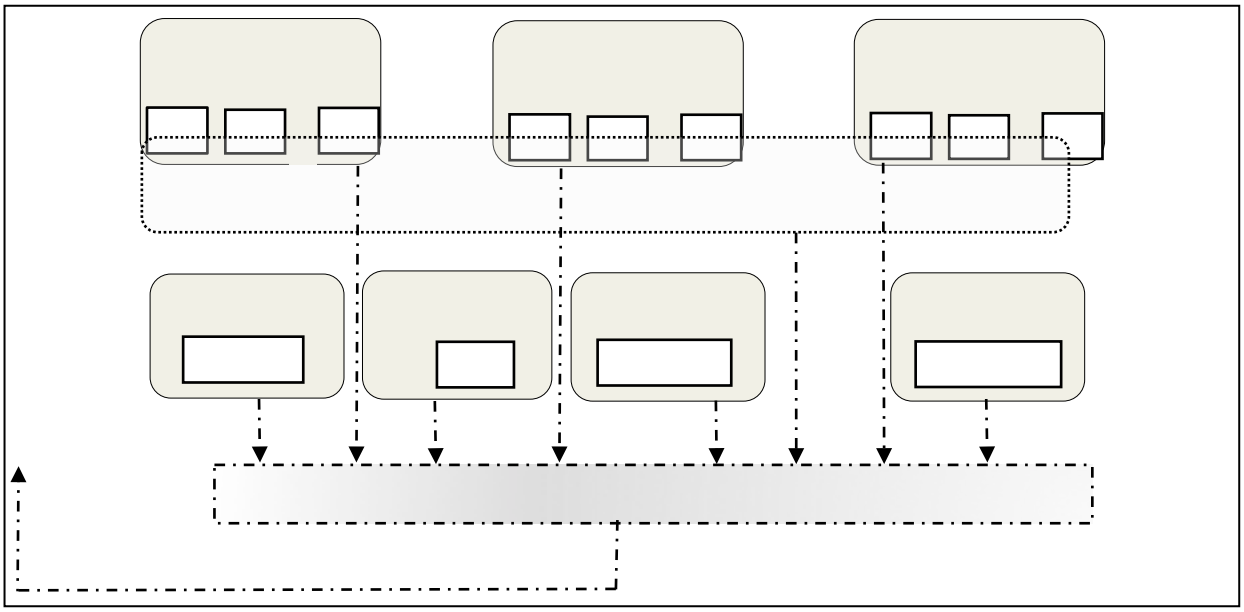


Figure 3. Evaluation of a collective knowledge of business organization.

If profiles are susceptible to consensus, the consensus is determined (using different consensus determining algorithms for particular areas knowledge structures). This evaluation can be realized, for example, by calculating a distance between collective knowledge states determined by consensus algorithm and real state of knowledge or by using decision results evaluation functions. The results of evaluation are sent as feedback to the experts. The subject of this article studies the issues related mainly to acquiring and acquisition of collective knowledge of business organization (figure 1). Selected issues related with knowledge integration, evaluation and definition of knowledge structures are also discussed (they will be presented in a wider scope in further papers).

The Framework For Acquiring And Acquisition of Collective Knowledge

In order to define a framework of acquiring and acquisition of collective knowledge in the multi-agent cognitive IMIS it was assumed that expert's knowledge (expert is a human or intelligent cognitive software agent) applies to the particular area of organization functioning, because there are no situations in which one expert has an in-depth knowledge of all areas of the organization functioning. Let us assume, according (Maleszka, Nguyen 2015), that U denotes a set of objects representing the potential elements of knowledge referring to a concrete real world. The elements of U can represent, for example, logic expressions, tuples, ontologies, etc. In business organization these are, for example, knowledge structures representing different areas of enterprise functioning. Symbol 2^U denotes the powerset of U that is the set of all subsets of U. By $\Pi_k(U)$ we denote the set of all k-element subsets (with repetitions) of set U for $k \in N$ (N is the set of natural numbers), and let

$$\Pi(U) = \square_k(U)$$

Thus, $\Pi(U)$ is the set of all non-empty finite subsets with repetitions of set U. A set $X \in \Pi(\mathrm{U})$ can represent the knowledge of a collective where each element $x \in X$ represents knowledge of a collective member. Note that X is a multi-set. We also call X a collective knowledge profile, or a profile in short. Therefore, the profile is a set of the knowledge structures on the one area of enterprise functioning. Set U can contain elements which are inconsistent with each other. Two elements $x, y \in U$ are inconsistent if they represent two states of knowledge, which cannot take place simultaneously in the real world to which U refers. A set $Z \subseteq U$ is called inconsistent if all the knowledge states represented by its elements cannot take place in the real world to which U refers, simultaneously, and Z is minimal in the sense that any proper subset of Z does not have this property. Set $Z \subseteq U$ is called consistent if any its subset is not inconsistent.

Each X which belongs to $\Pi(U)$ is called a *collective*. The definition of macrostructure of the set U is given below (Maleszka, Nguyen 2015):

Definition 1

The macrostructure of the set U is some distance function $\delta : U \times U \rightarrow [0,1]$ which is nonnegative, reflexive, symmetrical and transitive.

Also function (named *Aug*) which determines the "additional" elements arising in a collective was defined. This function has the following signature:

$$Aug: 2^U \rightarrow 2^U.$$

Because functioning of each business organization is performed in different areas and the experts' (the members' of a collective) opinions are related to that particular area, then the functional area of business organization must be defined. This definition is based on resources of business organization i.e. goods or services available to individuals and businesses used to produce valuable consumer products or services. Thus, the functional area of business organization is defined as follows:

Definition 2

Let sets of resources of business organization $O = \{o_1, o_2, \ldots, o_n\}$ and attributes of these objects $A = \{a_1, a_2, \ldots, a_s\}$ and values of these attributes $V = \{v_1, v_2, \ldots, v_t\}$ are given.

The functional area of business organization is called a sequence:

$$F =< noa, O, A, V, E, P >$$

where: noa – a name of area, E – set of activities, P – set of business processes.

The activity is defined as follows:

Definition 3

An activity $e \in E$ is called a function having following signature:

$$e : O \times A \times V \rightarrow O \times A \times V.$$

Thus, the activity involves transformation of one tuple objects, attributes and values into another. The activities are performed by humans, machines or devices, and they are elements of business processes. The functioning of a business organization in particular areas lies in the implementation of the business processes. A business process is a set of interrelated activities, defined as follows:

Definition 4

Let $E = \{e_1, e_2, \ldots, e_n\}$ be a finite set of activities. A relation $\rho \subseteq E \times E$ is called a business process if and only if:

1. $\forall e_x \in E. \langle e_x, e_x \rangle \notin \rho,$
2. $\forall e_x, e_y \in E. \langle e_x, e_y \rangle \in \rho \Rightarrow \langle e_y, e_x \rangle \notin \rho,$

3. $\forall e_x, e_y, e_z \in E.(\langle e_x, e_y \rangle \in \rho \wedge \langle e_y, e_z \rangle \in \rho) \Rightarrow \langle e_x, e_z \rangle \in \rho,$

Thus, the business process is a partial order of set *E*.

Experts form opinions related to a particular area, and their knowledge is represented by the elements of knowledge referring to a concrete real world – functional area (the elements of set *U*) by using following function:

Definition 5

Let set $FAR = \{F_1, F, \ldots, F_n\}$ *of functional areas of organization is given (n –the number of functional areas). By a knowledge representation of set FAR we call a function:*

$$\kappa : FAR \rightarrow U .$$

Taking into consideration presented definitions, the definition of a collective knowledge of business organization in the IMIS is following:

Definition 6

Let set FAR and set $CKA = \{X_1, X_2, \ldots, X_n\}$ *of the collectives of particular areas are given (where* X_1 *denotes the collective of functional area* F_1*,* X_2 *denotes the collective of functional area* F_2*, ...,* X_n *denotes the collective of functional area* F_n*).*

A collective knowledge of business organization in the IMIS is a following sequence:

$$CKBO = \langle \{X_1 \cup X_2 \cup \ldots \cup X_n\}, \tau \rangle, where:$$

CKBO – a collective knowledge of business organization,

τ *- function of inter-collective (inter-area) knowledge having a signature:* $\tau : \prod(CKA) \rightarrow 2^U$ *, where* $\prod(CKA)$ *is the set of all non-empty finite subsets with repetitions of set CKA*

Function τ satisfies the following conditions $(X_p, X_q \in CKA)$:

1) $\tau(X_p, X_p) = \emptyset$ - function τ is related only to different areas' collectives.
2) $\tau(X_p, X_q) \neq \emptyset$ - always there is the inter-collective knowledge between different areas.
3) $\tau(X_p, X_q) \neq X_p \wedge \tau(X_p, X_q) \neq X_q$ - the inter-area knowledge differs from the knowledge of particular collectives.
4) If X_p or X_q is inconsistent then $\tau(X_p, X_q) = X_\tau$ - if the knowledge of at least one of collectives is inconsistent then function τ creates a new collective X_τ.

The τ function differs from function *Aug* (which determine additional knowledge of collective). Since *Aug* function creates new knowledge related to particular areas of organization functioning, that is a particular collective, a τ function generates knowledge related to different areas on the basis of knowledge of particular collectives (that is on the basis of knowledge of

collective members and on the basis of knowledge determined by *Aug* related to particular collectives). The τ function is also not the same as the integration function, because it did not generate a representation of collectives' knowledge, while knowledge determined using τ function can be inconsistent; therefore, it may require integration of this knowledge.

Essential problem is related to knowledge conflicts in IMIS. They are the result of incoherence or contradiction between sets of knowledge generated by individual agents. Incoherence represents a scenario when one agent confirms or negates the occurrence of a given object's property or attribute in a given timeframe while another agent has no information on the matter at hand or chooses to withhold it. Contradiction, on the other hand, refers to a scenario when one agent confirms the occurrence of such attribute in a given timeframe while another agent reports its absence (Nguyen, 2009). Therefore, knowledge conflicts are generated when the same real world object is assigned with different attributes or when different values are assigned to the same attribute by two or more agents. A very important issue is also the consistency of collective knowledge of a business organization. In knowledge-based systems the notion of consistency of knowledge is most often understood as a situation in which a knowledge base does not contain contradictions. A certain level of inconsistency is required because it allows for a broader look at the organization's environment and the realization of business processes. However, if the level of inconsistency is too large it is very difficult to take proper decision. The work (Nguyen, 2009) defines the postulates for consistency functions and the consistency function for particular profiles. The defined framework allows for acquiring and acquisition of collective knowledge of a business organization in IMIS and also allows for elaborating methods of integrating this knowledge in order to make effective automatic realization of decision making processes.. It should also be emphasized, that nowadays becomes necessary not only to register by IMIS the values of economy events attributes in different areas but also to automatically analyze their meaning. It is important to interpret these events in the context of decisions-making, and realizing unexpected information management needs. Therefore, and "automatic" integration needs semantic natural language processing, which is still an open research problem.

Conclusions

Collective knowledge becomes increasingly important in business organization management. It is mainly related to Big Data issues - collection of data sets so large and complex that it becomes difficult to process using traditional data processing applications. It becomes necessary to use new solutions in order to process collective knowledge of business organizations. It this paper it has been suggested to use an IMIS with cognitive agents for this purpose. The developed framework is preliminary results of research. The works on developing theorems and algorithms related to acquiring and acquisition of collective knowledge are under implementation. Further research will also focus on the development the models of collective knowledge integration and knowledge evaluation related to remained functional areas. Also, implementation of these models in a prototype of the Cognitive Integrated Management Information System is planned.

References

Breuker J. (2013). A cognitive science perspective on knowledge acquisition. *International Journal of Human-Computer Studies, 71*(2), 177-183.

Bytniewski, A. (ed) (2015). *Architecture of integrated management information system*, Wydawnictwo AE we Wrocławiu, Wrocław (in Polish).

Cairo O., & Guardati S. (2012): The KAMET II methodology: Knowledge acquisition, knowledge modeling and knowledge generation. *Expert System with Application, 39*(9), 8108-8114.

Cheah, W. P., Kim Y. S., Kim K.-Y., & H. J. Yang (2011). Systematic causal knowledge acquisition using FCM constructor for product design decision support. *Expert Systems with Applications, 38*(12), 15316-15331.

Cress U., Held C., & Kimmerle J. (2013). The collective knowledge of social tags: Direct and indirect influences on navigation, learning, and information processing, *Computers & Education, 60*(1), 59-73.

Dixon, N. (2011). How to make use of your organization's collective knowledge – accessing the knowledge of the whole organization - Part I. Retrieved from: http://www.nancydixonblog.com/2011/01/how-to-make-use-of-your-organizations-collective-knowledge-accessing-the-knowledge-of-the-whole-orga.html

Gebus, S, & Leiviskä K., (2009). Knowledge acquisition for decision support systems on an electronic assembly line. *Expert System with Application, 36*(1), 93-101.

Hernes, M. (2014). A cognitive integrated management support system for enterprises. In D. Hwang, J. J. Jung, & N. T. Nguyen (Eds.), *Computational Collective Intelligence. Technologies and Applications* (pp. 252-261). Lecture Notes in Artificial Intelligence, Springer-Verlag.

Hester, A. J. (2011). A comparative analysis of the usage and infusion of wiki and non-wiki-based knowledge management systems. *Inforation Technology and Management, 12*(4), 335-355.

Joshi, G. (2013). *Management information systems*. New Delhi: Oxford University Press.

Maleszka M., & Nguyen N. T. (2015). Integration computing and collective intelligence. *Expert Systems with Applications, 42*(1), 358-378.

Nguyen, N. T. (2009). Processing inconsistency of knowledge in determining knowledge of collective. *Cybernetics and Systems: An International Journal, 40*(8), 670-688.

MIT Center for Collective Intelligence. http://cci.mit.edu/.

Moskaliuk, J., Kimmerle, J., & Cress, U. (2012). Collaborative knowledge building with wikis: The impact of redundancy and polarity. *Computers & Education, 58*(4), 1049–1057.

Plikynas, D. (2011). Multiagent based global enterprise resource planning: Conceptual view. *WSEAS Transactions on Business and Economics, 5*(6),31-123.

Santoro, F. M., Borges M. R. S., & Pino J. A. (2010). Acquiring knowledge on business processes from stakeholders' stories. *Advanced Engineering Informatics, 24*(2), 138-148.

Authors' Biographies

Marcin Hernes is a researcher in Wroclaw University of Economics. He is the author and co-author of over 100 papers published in national and international publishing houses. Moreover, he is a participant of scientific national and international conferences, a lecturer of the issues that concern distributed decision support systems, conflicts in multi-agent systems, the methods of consensus, negotiation and cooperation, the systems of deductive and temporary data bases, and the systems of coordination and visualization. Marcin Hernes is a practitioner (of many years) in the scope of management systems, coordination and automation of production processes, digital systems of measurement, systems of distributed data bases, and multi-agent decision support systems. Apart from that, he is the author of several dozen computer applications that function in industrial enterprises or state-owned institutions.

Ngoc Thanh Nguyen is a full professor of Wroclaw University of Science and Technology, and the Head of Information Systems Department in the Faculty of Computer Science and Management. He is the author or co-author of 5 monographs and more than 350 journal papers and conference papers. Prof. Nguyen serves as Editor-in-Chief of International Journal of Information and Telecommunication (Taylor & Francis), Transactions on Computational Collective Intelligence (Springer) and Vietnam Journal of Computer Science (Springer). He is also an Associate Editor of several prestigious international journals. He was a General Chair or Program Chair of more than 40 international conferences.

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Antecedents of performance, learning and innovation in exporting operations: A conceptual framework

[Research-in-Progress]

Joanna Santiago, ISEG – Lisbon School of Economics and Management, ULisboa, Portugal, joannas@iseg.ulisboa.pt

Abstract

The rapid growth of exporting has focused the attention of marketing researchers on the factors associated with export performance. However, although numerous studies have attempted to identify factors that are correlated with exporting success, much debate still remains as it concerns the organizational learning and innovation. This study examined the internal and external forces as the antecedents of export performance, product innovation performance, and learning consequences. This study suggests also the potential moderating impact of the export marketing strategy. It offers a broad-spectrum view and synthesizes important streams of research to propose a conceptual model of the antecedents of performance, learning and innovation in exporting operations. Methodological suggestions for applying the model and measuring it in substantive research are offered and its importance for practitioners is emphasized.

Keywords: Export performance, organizational innovation, organizational learning.

Introduction

One of the fundamental questions in the study of organizations is 'Why do some firms perform better than others?' (Morgan, Zou, Vorhies, & Katsikeas, 2003; Camisón & Villar-López, 2014). Evidently, this subject developed into the broad-spectrum question for this study. Although, a large number of studies have previously attempted to identify factors that are correlated with exporting success (Zou, Taylor, & Osland, 1998; Katskikeas, Leonidu, & Morgan, 2000; Alotaibi & Zhang, 2017), much controversy still exists about the relationship between performance and organizational learning and innovation. Despite of the increasingly recognized importance of organizational learning and innovation (Morgan, Kaleka, & Katsikeas, 2000; Camisón & Villar-López, 2014), limited attention was given in the export marketing literature to emphasized their role, which is a significant gap (Vargo, Wieland, & Akaka, 2015; Hurley & Hult, 1998). Consequently, in this research, we aim to understand the environmental and organizational factors that drive the outcomes of performance, learning and innovation of an exporting firm.

Theoretical Background

The three broad theoretical approaches, the resource-based view (RBV), the structure-conduct-performance (SCP) paradigm, and the contingency perspective (CP) dominate explanations of firm performance. Furthermore, the evolution of the resource-based view of the firm led researchers to the concept of dynamic capabilities, which we try not to omit in our study. Additionally, over the past decades a new school of thought labeled the knowledge-based view of the firm (KBV) has emerged (Morgan, Zou, Vorhies, & Katsikeas, 2003; Horisch, Johnson, & Schaltegger, 2014). Correspondingly with the theoretical advances, this study integrates the structure-conduct-performance paradigm and resource-based view, into a cohesive theoretical model of the antecedents of organizational outcomes: export performance, learning and innovation. We also intend to extend our understanding of the contingency perspective and knowledge-based view of the firm (KBV) applied to an exporting context. Figure 1 presents the interplay of the theoretical views in support of our conceptual framework.

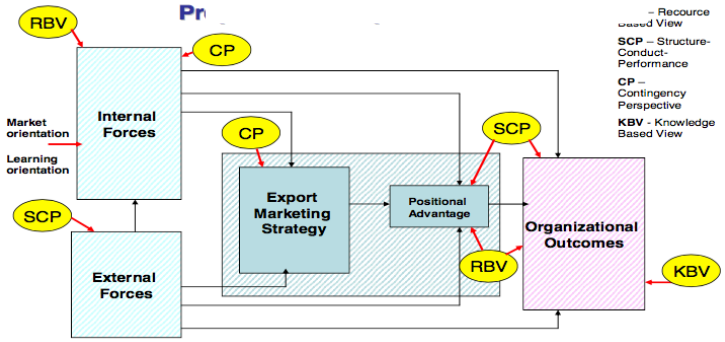


Figure 1. Theoretical Background

Based on the analyzed theoretical views, the present study tends to explore the interplay between internal forces, external forces to the firm and the export marketing strategy, which serve to determine the positional advantage and the outcomes of organizational performance.

Model Development

To illustrate the key relationships in our study, and link them with respective theoretical background, we propose a conceptual framework of the antecedents of performance, learning and innovation in exporting operations (Figure 2). Thus, the internal forces are represented by the constructs of firm's capabilities, resources, market orientation, organizational learning and innovation. In the same way the external forces are represented by the constructs of export market competitive intensity and industry competitive intensity. The export marketing strategy corresponds to marketing mix adaptation, accordingly represented by the '4Ps' variables, and the competitive strategy construct. Finally, the organizational outcomes are represented by the constructs of export performance, product innovation performance and the learning

consequences. All the constructs are operationalized through multiple-item scales validated by previous research.

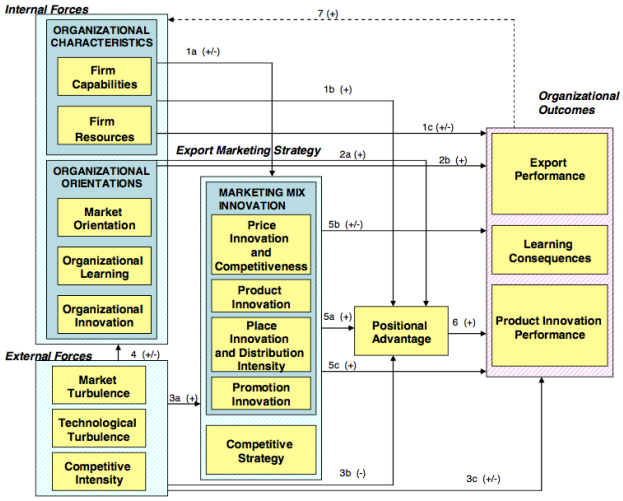


Figure 2. Conceptual Model

Research Hypotheses

To explain the effects of capabilities and resources on export marketing strategy we draw upon the RBV, which is essentially an 'inside-out' approach to developing successful strategy. Traditional strategy models such as Porter's (1980) five forces model, focus on the company's external competitive environment. In contrast, the resource-based perspective highlights the need for a fit between the external market context in which a company operates and its internal capabilities. The RBV posits that marketing strategies are planned patterns of resource and capability deployments that support choices about how the firm will compete for target customers and achieve its goals (Aulakh, Kotabe, & Teegen, 2000). Accordingly, resources are emphasized as central to understanding firm performance (Amit & Shoemaker, 1993). Heterogeneity in the resources and capabilities explains variations in firm export strategies and performance (Makadok, 2001). The RBV is grounded in the perspective that a firm's internal environment, in terms of its resources and capabilities, is more critical to the determination of strategic action than is the external environment. The RBV suggests that firm's unique resources and capabilities provide the basis for a strategy. The strategy chosen should allow the firm to best exploit its core competencies relative to opportunities in the external environment. Consequently, we postulate that:

H1a: Export marketing strategy may be positively or negatively influenced by the firm's available resources and capabilities.

In the context of this study, positional advantage pertains to the relative superiority of the export venture's value offered to customers in the target export market and the cost of delivering this

realized value (Day & Wensley, 1988; Porter, 1985). Basing on the contingency perspective, Hansen and Wernerfelt (1989) found that the external market factors independently explain variance in performance, but that internal factors can explain it 'twice as well'. Consequently, we expect that outcome levels result from firm's internal forces. According to this view, a company's competitive advantage derives from its ability to assemble and exploit an appropriate combination of resources. Positional advantage is achieved by continuously developing existing and creating new resources and capabilities in response to rapidly changing market conditions. The literature argues that firm resources and capabilities can be important factors in achieving positional advantage and superior firm performance only if they posses certain characteristics (Barney, 1991). The RBV main prescription holds that only resources and capabilities that are valuable, rare, inimitable and non-substitutable are capable of generating positional advantage which affords the accrual of superior performance. Consequently, consistent with RBV and dynamic capabilities perspective, both the resources and the capabilities available to the firm have an impact on positional advantage in its target market (Collis, 1991; Day & Wensley, 1988). Therefore, we postulate that internal forces influence the organizational outcomes:

H1b: There is a relationship between the resources and capabilities available to the export venture and its positional advantage.

H1c: There is a relationship between the resources and capabilities available to the export venture and its export performance and organizational outcomes of learning and innovation.

Considering the internal forces, the RBV literature describes resources and capabilities in terms of various special characteristics. Additionally, drawing on KBV we turn attention to other internal forces, such as organizational orientations, for success. Strategic orientations engaged by firms have been broadly debated in prior research and have led to conclusions that cover a wide range of their effects on performance (Hakala, 2011). Firms, whose cultures emphasize market, learning and innovation orientations, when other resources and capabilities are available, tend to develop positional advantage and achieve superior performance (Menon et al., 1999). Also, the firm's capability to learn and innovate, as well as available resources will have an impact on future organizational outcomes. Because "a market orientation essentially involves doing something new or different in response to market conditions, it may be viewed as a form of innovative behavior" (Jaworski & Kohli, 1993, p. 56). In their subsequent work, Jaworski and Kohli (1996) suggested that market orientation is an antecedent of innovation and they regard innovation as an outcome of market orientation. As mentioned before, Slater and Narver (1995) took a somewhat different approach to responsiveness to markets by introducing the concept of organizational learning. They suggest that without the ability to use and act on information (applied learning), market orientation would not have a positive effect on performance; that is, market orientation promotes organizational learning, and afterwards the organization's ability to learn enhances performance. We assume that the organizational characteristics influence the use of learning processes. The inclusion of organizational learning and the generation of new behaviors, as central factors in models of market orientation, bring forward the fact that market orientation requires the adoption of new behaviors (innovation). Contrarily to learning,

innovation has been inappropriately absent in models of market orientation. In the few existing studies where the innovation construct is present (Deshpande, Farley, & Webster, 1993; Menon & Varadarajan, 1992) the market orientation construct is related to both organizational culture and innovativeness. In the only empirical work, to our knowledge, that has examined innovation and customer orientation, Deshpande et al. (1993) found that market and entrepreneurial-oriented cultures outperformed those that were more internally or hierarchically oriented and suggested that the "fundamental question is whether customer orientation, as it relates to corporate culture and in concert with organizational innovativeness, has a measurable impact on business performance" (p. 24). Many studies confirm the positive relationship between MO and firm performance (Ellis, 2007; Kirca, Jayachandran, & Bearden, 2005). Also, in the marketing literature, it is claimed that firms need to adopt a market-oriented posture, to enable them to become more responsive to changes in consumer needs and wants (Murray, Gao, & Kotabe, 2011). Hence, our hypotheses regarding the relation between market orientation, organizational learning and innovation are stated as follows:

H2a: There is a relationship between the organization's market orientation, organizational learning and innovation and its positional advantage.

H2b: There is a relationship between the organization's market orientation, organizational learning and innovation and its export performance.

H2c: There is a relationship between the organization's market orientation, organizational learning and innovation and its export marketing strategy.

Conditions in foreign markets pose both opportunities and threats for exporters. Export marketing strategy must be formulated to match a firm's strengths with market opportunities and to neutralize the firm's strategic weaknesses or overcome market threats as export marketing strategy is conditioned by the export market characteristics (Cavusgil, Zou, & Naidu, 1993; Cooper & Kleinschmidt, 1985). In this study, we focus on three external forces of particular relevance: export market turbulence, technological turbulence and competitive intensity. A firm responds to its environment by developing a marketing mix and a competitive strategy. Traditionally, when exporting, the firm is faced with the decision of either adapting or standardizing its local market marketing mix to the foreign market (Cavusgil, Zou, & Naidu 1993). Product adaptation, promotion adaptation, and competitive pricing strategies have been described as the means by which firms' offerings adapt to or fit the idiosyncrasies of foreign markets (Douglas & Craig, 1989). These strategies can be interpreted as the means by which a firm achieves coalignment with its internal and external forces. At this point we propose:

H3a: There is a relationship between the external forces of export market turbulence, technological turbulence and competitive intensity and export marketing strategy.

A fundamental premise in SCP theory is that the structural forces that determine competitive intensity in a market have a strong impact on firm's positional advantage and performance. While SCP theory posits that the level of competitive intensity is an essential determinant of market attractiveness (Porter, 1980; 1985), the RBV theory treats competitive intensity as a less significant issue. Nonetheless, RBV theory posits that rivals' willingness and ability to imitate a

firm's strategy or to use substitute resources and capabilities to deliver an equal value proposition determine the extent to which a firm's positional advantage may be successful (Barney, 1991). As the environment generates constraints for all the players in an industry, it is most likely that only the 'fit' firms (Itami & Roehl, 1987) will be in an advantageous competitive position and achieve above-normal performance. Accordingly, we hypothesize:

> *H3b: There is a relationship between the external forces such as export market turbulence, technological turbulence and export market competitive intensity and the firm's positional advantage.*

Earlier research on the impact of external forces on export performance presents mixed findings. On the one hand, firms that export to developing countries have better performance than do firms exporting to developed countries, because of the lack of competition in less developed countries. On the other hand, there is a negative relationship between exporting to less developed countries and export success, because of the economic instability associated with those countries. Beamish, Craig, and McLellan's (1993) results complicate the picture even further; they found a positive relationship between less developed countries and export profit performance among Canadian exporters, and a non-significant relationship among British exporters. In light of these mixed results, we hypothesize that:

> *H3c: There is a relationship between the external forces and the export performance, learning and innovation consequences.*

The contingency perspective assumes the importance of particular *internal* and *external factors* (Jain, 1989; Zou & Cavusgil, 1996). Internal environment of the firm consists of the inherent strengths and weaknesses of the firm, whereas external environment offers both opportunities and threats. Some companies experience a mismatch between their internal and external forces. With formal planning and resource commitment, uncertainty is reduced, and marketing strategy can be implemented effectively (Aaby & Slater, 1989), leading to better performance. As organizations are dependent on their environments for resources, we suggest:

> *H4: Depending on the nature of the external forces of export market and industry competitive intensity, they might have positive or negative impact on firm's internal forces.*

In contrast to previous exporting studies that postulate direct links from product, industry, and export market characteristics to export performance (Cooper & Klainschmidt, 1985; Madsen, 1987). Cavusgil and Zou (1994) proposed that these links are mediated by export marketing strategy and highlight the central role of marketing strategy in determining performance. This study follows their proposal as the export marketing strategy must be present to achieve the coalignment with environment. The particular theoretical perspective adopted here is the principle of strategy-environment alignment (Porter, 1980), which states that the "fit" between strategy and its context – whether it is the external environment or organizational characteristics – has significant positive implications for firm performance. The principle has its roots in the SCP framework if industrial organization and rests on two premises: (1) organizations are

dependent on their environments for resources and (2) organizations can manage this dependence by developing and maintaining strategies. In today's global economy, strategic decisions, such as a choice of competitive strategy for market entry, may be more complex since cultural traits influence managerial perceptions and actions. The objective in setting competitive strategy is to seek a position in which these five forces do the firm the most good or cause it the least harm (Porter, 1980). To overcome these competitive forces and succeed in the long term, management can select from several competitive strategies: cost leadership, differentiation, or focus. The link between marketing strategy and performance has been investigated as part of a stream of exporting literature involved with explaining the success or failure of a firm's exporting activities. In international marketing, with the exception of the standardization versus adaptation debate (Douglas & Craig, 1989), it is often considerate if the strategy is enough competitive to meet the market requirements. Although a large body of research asserts export performance as a main organizational outcome, few studies considered the role of learning and innovation consequences on exporting operations as organizational outcomes. Nonetheless, the literature on international marketing brings into sharp focus two distinct goal orientations: learning and performance. We focus our attention not only on export performance but also on learning and innovation as important organizational outcomes. Export marketing strategies are planned patterns of resource and capability deployments that support choices about how the venture will compete for target customers and achieve its desired goals (Aulakh, Kotabe, & Teegen, 2000). Consequently, export marketing strategy mediate the relationship between an export firm's available resources and capabilities and its positional advantage. Therefore, we can postulate that:

H5a: There is a relationship between export marketing strategy and the positional advantage of the export venture.

In the international marketing context, a handful of studies (Cavusgil & Zou, 1994; Lages & Montgomery, 2004) have suggested that export performance is influenced by export marketing strategy. As the firms are dependent on their environments for resources and can manage this dependence by developing and maintaining strategies, the following is proposed:

H5b: There is a relationship between export marketing strategy and the export performance.

Marketing strategy can improve a firm's current expertise and require the development of new knowledge and skills. Learning and innovation are simultaneously influencing and being influenced by marketing strategy, and as such they can be viewed as equally antecedents and consequences of strategy. Because of its external focus, marketing is well positioned to appreciate the benefits of market-driven learning and to lead the market-oriented values that constitute the culture of the learning organization. Marketing strategy should be learning and innovation-driven as both focus on understanding and effectively satisfying the customers' needs through new products, new services, and new ways of doing business (Day, 1994). Consequences of organizational learning might materialize in new insights and better understanding of the strategy, whereas the consequences of innovation help in new product

development and future innovativeness. The extent to which organizations are able to learn from marketing strategy history will affect their ability to maintain a steady progress in the long-term learning that continually builds from the past. If exporters pursue the adaptation strategy to compete on a local-by-local basis (Porter, 1986; Prahalad & Doz, 1987), it is expected that they have higher need for learning, innovating, knowledge and international experience. Pursuing the goal of profit maximization and performance improvement, firms following the adaptation strategy may be more inclined to gain new product-market information. Thus,

H5c: There is a relationship between the export marketing strategy and firms' learning and innovation consequences.

The SCP paradigm posits that firm performance is determined by the firm's ability to achieve and sustain positional advantages through the efficient and affective execution of planned marketing strategy (Porter, 1980; 1985). Positional advantage is a direct antecedent of export performance because the relative superiority of a venture's value offering determines target customers' buying behavior (Piercy, Kaleka, & Katsikeas, 1998) and the outcomes of this behavior for the export venture (Cavusgil & Zou, 1994). Morgan et al. (2004) pointed out that export venture performance is strongly related to its positional advantage in the marketplace. Therefore:

H6: Positional advantage of export venture has a direct positive impact on export performance.

RBV theory indicates that some of the economic outcomes of positional advantages will be reinvested to acquire or to develop available resources and capabilities (Hamel & Prahalad, 1994). In the same vein, marketing theory indicates that strategic outcomes, such as relationships with customers and channel members, often become "market-based assets" that add to the firm's existing resource stock (Srivastava, Shervani, & Fahey, 1998). RBV and dynamic capabilities theories also indicate that because of learning effects, many resources and most capabilities are enhanced by use (Grant, 1996). For example, export market knowledge and relationship-building capabilities are likely enhanced as a result of the experiential learning that is associated with their use in planning, executing, and monitoring the outcomes of competitive strategy decisions (Day, 1994; Morgan et al., 2003). Therefore, we suggest:

H7: Learning and innovation have a positive impact on internal forces.

Methodology

Data Collection

Data collection done via e-mail survey instrument and to a lesser extent through in-depth personal interviews, acquired from a respondent directly responsible for export activities. The instrument incorporated a variety of multi-item measures and indicators of the conceptual framework. We tend to use *multi-item scales* rather than single-item scales in order to increase

reliability and decrease the measurement error. Moreover, it allows for better capturing of the complexity of export marketing (Lages & Lages 2003) using a seven-point Likert scales to measure most of the constructs. We also use, to some extent, the semantic differential scale which measures respondents' reactions to stimulus words and concepts in terms of ratings on bipolar scales, defined with contrasting adjectives at each end.

Sample

As manufactured exports account for the bulk of total world export trade, we intend to empirically assess the conceptual framework among manufacturing exporters. Since exporting is a stage of internationalization that is particularly appropriate for small and medium-sized business, and the overwhelming majority of global export trade is in manufacturing, the target population will consist of manufacturing firms ranging in size from 50 to 250 employees and with the turnover of 10-50 million € (EU recommendation 2003/361). The target population for this research will include the firms registered in the Catalogue of Polish Exporters, provided by the Polish Chamber of Commerce. The Polish Chamber of Commerce is the largest economic self-government institution in Poland, which groups above 130 business organizations encompassing approximately 300 thousand of Polish enterprises.

Unit of Analysis

The vast majority of the studies assess export performance at the firm level, which can be explained by the greater willingness of respondents to disclose information at this broad level. However, we lean to adopt a single export venture unit of analysis. This approach of a single product or product line exported to a single foreign market will enable to associate the results more precisely. The selection of the unit of analysis is important for the correct operationalization of export performance since a study at the firm level seeks success determinants describing the overall export activity of a firm whereas a study at the venture level focuses on performance determinants of a particular product/market combination. For instance, when studying individual export ventures, firm level export performance analysis is inappropriate because of the heterogeneity of the firm's operations. Using measures such as export profitability, overall export sales and overall export performance at the firm level ignores the difference between the venture and the firm level. Therefore, the assumed level of analysis has major implications on the implementation of operational measures of export performance.

Conclusions

Since exporting has become increasingly important sector in world trade, it is incumbent to develop and test theory that relates specifically to the exporting operations. A paramount task in the export marketing literature is to clarify what influences the strategy of marketing mix innovation and reassess the relationship between strategy and organizational outcomes. This study, when completed, will contribute to the body of knowledge by extending the view on the antecedents of export marketing strategy and export performance with a particular role played by organizational learning and innovation. While the existing frameworks do not link the

organizational learning and innovation with the strategy and performance and usually have in sight only the intra-organizational aspects, we view it broadly as intra- and inter-organizational levels. The matter of this study is relevant for exporting companies, as the internal and external forces with the attentiveness to learning and innovation, export marketing strategy decisions, positional advantage and the aim at superior organizational performance are all challenges constantly faced by those companies.

References

Aaby, N. E. & Slater, S. F. (1989). Management influences on export performance: A review of the empirical literature 1978-88. *International Marketing Review, 6*(4), 7-26.

Alotaibi, M. B. G, & Zhang, Y. (2017). The relationship between export market orientation and export performance: An empirical study. *Applied Economics, 49*(23), 2253-2258.

Amit, R., & Schoemaker, P. J. H. (1993). Strategic assets and organisational rent. *Strategic Management Journal*, 14, 33-46.

Aulakh, P.S., Kotabe, M., & Teegen, H. (2000). Export strategies and performance of firms from emerging economies: Evidence from Brazil, Chile, & Mexico. *The Academy of Management Journal, 43*(3), 342-361.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99-120.

Beamish, P. W., Craig, R., & McLellan, K. (1993). The performance characteristics of Canadian versus UK exporters in small and medium sized firms, *Management International Review, 33*(2), 121-137.

Camisón, C., & Villar-López, A. (2014). Organizational innovation as an enabler of technological innovation capabilities and firm performance. *Journal of Business Research, 67*(1), 2891-2902.

Cavusgil, S. T. Zou, S., & Naidu, G. M. (1993). Product and promotion adaptation in export ventures: An empirical investigation. *Journal of International Business Studies, 24*(3), 479-506.

Collis, D. J. (1991). A resource-based analysis of global competition: The case of the bearings industry. *Strategic Management Journal, 12*(Special Issue, Summer), 49-68.

Cooper, R. G., & Kleinschmidt, E. J. (1985). The impact of export strategy on export sales performance. *Journal of International Business Studies, 16*, 37-55.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing, 58*(10), 37-52.

Day, G.S., & Wensley, R. (1988). Assessing advantage: A framework for diagnosing competitive superiority. *Journal of Marketing, 52*(4), 1-20.

Deshpande, R., Farley, J. U., & Webster, F. E. Jr. (1993). Corporate culture, customer orientation, and innovativeness in Japanese firms: A quadrad analysis. *Journal of Marketing, 57*(1), 23-37.

Douglas, S. P., & Craig, C. S. (1989). Evolution of global marketing strategy: Scale, scope and synergy. *Columbia Journal of World Business, 22*(4), 19-30.

Ellis, R. (2007). *Entropy, large deviations, and statistical mechanics*. New York, NY: Springer.

Grant, R. (1996). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration,. *Organization Science, 7*(4), 375-387.

Hakala, H. (2011). Strategic orientations in management literature: Three approaches to understanding the interaction between market, technology, entrepreneurial and learning orientations. *International Journal of Management Reviews, 13*(2), 199-217.

Hamel, G., & Prahalad, C. K. (1994) *Competing for the future*. Boston: MA: Harvard Business School Press.

Hansen, G. S., & Wernerfelt, B. (1989). Determinants of firm performance: Relative importance of economic and organizational factors. *Strategic Management Journal, 10*, 399-411.

Horisch, J., Johnson, M. P., & Schaltegger, S. (2014). Implementation of sustainability management and company size: A knowledge-based view. *Business Strategy and the Environment, 24*(8). doi:10.1002/bse.1844.

Hurley, R. F., & Hult, T. M. (1998). Innovation, market orientation, and organizational learning: An integration and empirical examination. *Journal of Marketing, 62*(7), 42-54.

Itami, H., & Roehl, T. (1987). *Mobilizing invisible assets*. Cambridge, MA: Harvard University Press.

Jain, S. C. (1989). Standardization of international marketing strategy: Some research hypotheses. *Journal of Marketing*, *53*(1), 70-79.

Jaworski, B. J., & Kohli, A. K. (1993). Market orientation: Antecedents and consequences. *Journal of Marketing, 57*(6), 53-70.

Jaworski, B. J., & Kohli, A. K. (1996). Market orientation: Review, refinement, and roadmap. *Journal of Market-Focused Management, 1*(2), 119–135.

Katsikeas, C. S, Leonidou, L. C., & Morgan, N. A. (2000). Firm-level export performance assessment: Review, evaluation, and development. *Journal of the Academy of Marketing Science, 28*(4), 493-511.

Kirca, A. H., Jayachandran, S., & Bearden, W. O. (2005). Market orientation: A meta-analytic review and assessment of its antecedents and impact on performance. *Journal of Marketing, 69*(2), 24-41.

Lages, L. F., & Lages, C. R. (2003). The MIXADAPT scale: A measure of marketing mix adaptation to the foreign market. *FEUNL Working Paper* No. 429.

Lages, L. F., & Montgomery, D. B. (2004). Export performance as an antecedent of export commitment and marketing strategy adaptation: Evidence from small and medium-sized exporters. *European Journal of Marketing, 38*(9/10), 1186-1214.

Madsen, T. K. (1987). Empirical export performance studies: A review of conceptualizations and findings. *Advances in International Marketing*, Greenwich, CT: JAI Press, 177-198.

Makadok, R. (2001). Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Management Journal, 22*(5), 387-401.

Menon, A., Bharadwaj, S. G., Adidam, P. T., & Edison, S. W. (1999). Antecedents and consequences of marketing strategy making: Amodel and a test. *Journal of Marketing, 63*(2), 18-40.

Menon, A., Varadarajan, & Rajan P. (1992). A model of marketing knowledge use within firms. *Journal of Marketing, 56*(10), 53-71.

Morgan, N. A., Zou, S., Vorhies, D. W., & Katsikeas C. S. (2003). Experiential and informational knowledge, architectural marketing capabilities, and the adaptive performance of export ventures. *Decision Sciences, 34*(2), 287-321.

Morgan, N. A., Kaleka, A., & Katsikeas, C. S. (2004). Antecendents of export venture performance: A theoretical model and empirical assessment. *Journal of Marketing, 68*(1), 90-108.

Murray, J. Y., Gao, G. Y., & Kotabe, M. (2011). Market orientation and performance of export ventures: The process through marketing capabilities and competitive advantages. *Journal of the Academy of Marketing Science, 39*(2), 252-269.

Piercy, N., Kaleka, A., & Katsikeas, C. S. (1998). Sources of competitive advantage in high performing exporting companies. *Journal of World Business, 33*(4), 378–392.

Porter, M. E. (1980). *Competitive strategy: Techniques foranalyzing industries and competitors.* New York, NY: Free Press.

Porter, M. E. (1985). *Competitive advantage*. New York, NY: Free Press.

Porter, M. E. (1986). Changing patterns of international competition. *California Management Review, 31*(Winter), 29-41.

Prahalad, C. K., & Doz, Y. (1987). *The multinational mission: Balancing local demand and global vision*. New York, NY: Free Press.

Srivastava, R. K., Shervani, T. A., & Fahey, L. (1998). Market-based assets and shareholder value: A framework for analysis. *Journal of Marketing, 62*(2), 2-18.

Vargo, S. L., Wieland, H., & Akaka, M. A. (2015). Innovation through institutionalization: A service ecosystems perspective. *Industrial Marketing Management, 44*(1), 63-72.

Zou, S., & Cavusgil, S. T. (1996). Global strategy: A review and an integrated conceptual framework. *European Journal of Marketing, 30*(1), 52-69.

Zou, S., Taylor, C. R., & Osland, G. E. (1998). The EXPERF scale: A cross-national generalized export performance measure. *Journal of International Marketing, 6*(3), 37-58.

Author's Biography

Joanna K. Santiago joined Universidade de Lisboa, ISEG - School of Economics and Management as invited lecturer in September 2014. Her research focuses on brand management, customer-based perspective of brand equity and international marketing strategies.

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Knowledge management in the academic environment in Poland: A pilot study

[Complete Research]

Małgorzata Cieciora, Polish-Japanese Academy of Information Technology, Faculty of Information Management, Poland, Malgorzata.Cieciora@pja.edu.pl

Abstract

The purpose of this paper was to present an introductory, test analysis on effective ways of obtaining various types of useful knowledge, factors conducive to, and hampering sharing knowledge with academic colleagues. Moreover, the aim was to outline the type of knowledge management strategy that should be implemented in institutions of higher education in Poland. A sample of academic employees' opinions was gathered and analyzed. Results as well as discussion and implications are presented. The main conclusion of this study is that research and teaching staff are eager to acquire and share knowledge, while the main challenge for the academic authorities is to implement the personalization strategy of knowledge management and develop an organizational culture that would focus on cooperation as well as mutual trust and reward knowledge sharing. A further, more comprehensive research into the matter will be worth conducting.

Keywords: Knowledge, knowledge management, knowledge sharing, higher education, personalization strategy.

Introduction

Knowledge management is currently one of the most important issues in the theory and practice of management as in the era of Knowledge-Based Economy the development of an organization depends, to a large extent, on the skillful acquisition and use of relevant data, information, and knowledge. It has been a subject of many research (Brooking, 1999; Davenport & Prusak, 1998; Drucker, 1993; Gold, Malhotra, & Segars, 2001; Koohang, Paliszkiewicz, & Gołuchowski, 2017; Leonard, 1995; Liebowitz, 2008, 2012; Nonaka & Takeuchi, 2000; Paliszkiewicz, 2007; Shveiby, 1987; Stacey, 2000; Teece, 2009; Tiwana, 2002; Von Krogh, Ichijo, & Nonaka, 2000; Wiig, 1994). Definitions, theories, models or techniques related to knowledge management are created not only by academic scientists but also by commercial companies, which stresses the importance of this resource for economic success. An interesting question to ask would concern, therefore, the role of knowledge management in organizations by definition intended to create, cultivate and disseminate knowledge, namely institutions of higher education.

The aim of this article was to conduct a short, pilot analysis for further, more comprehensive research on the characteristics and effectiveness of various organizational solutions and tools of

knowledge management in the academic environment in Poland. The information and conclusions derived from the analysis were supposed to serve as a tool to plan the direction and form of further studies. The research questions were: which ways of obtaining various types of useful knowledge are most effective in the academic environment in Poland? What are the factors conducive to and hampering sharing knowledge with academic colleagues? Which knowledge management strategy should be implemented at the university? First, a synthetic review of the literature on knowledge management is presented. Next, results of pilot surveys on selected aspects of knowledge management at universities in Poland conducted among a sample of academic instructors and researchers are presented and discussed. Finally, conclusions and a summary of the analysis are presented.

Literature Review

The Concepts of "Knowledge" and "Knowledge Management"

In the literature on the subject, one can find many definitions of both the notion of "knowledge" and the notion of "knowledge management". This subject was already of interest to ancient philosophers - according to Plato and his followers, knowledge is "justified true belief"; it can be obtained through deductive reasoning, thanks to mental processes, and not (often deceptive) senses. It is worth mentioning here that one of the most eminent students of Plato, Aristotle, did not agree with this type of reasoning and emphasized the role of empiricism in cognition (Fazlagić, 2005, p. 27). As far as more contemporary definitions are concerned, according to Koźmiński (2004), for example, knowledge is "a resource of information organized in a special way: corresponding to the intentions of its creators and users" (p. 94). It is worth noting here that many types of knowledge have been proposed. Nonaka and Takeuchi (2000), for example, divided knowledge into explicit knowledge and tacit knowledge. Explicit knowledge can be expressed in words and numbers, it is easily communicated and disseminated in the form of hard data, scientific formulas, codified procedures or universal principles. Tacit knowledge, on the other hand, is highly individual and difficult to formalize, which makes it difficult to convey (Nonaka & Takeuchi, 2000, p. 25).

As far as the concept of knowledge management is concerned, it is worth emphasizing here that Paliszkiewicz (2007) acknowledged two basic approaches - the first one treats knowledge as slightly more extensive information management, and focuses on information systems. The second one, emphasizes the human aspect of generating and transferring knowledge, thus, focusing on human resource management in the context of knowledge management (Paliszkiewicz, 2007, pp. 36 - 37).

Knowledge Management Strategies

There are many definitions and typologies regarding knowledge management strategies in the literature on the subject. To put it briefly, a knowledge management strategy is, according to the definition presented by Paliszkiewicz (2007), "the way in which an enterprise intends to acquire

knowledge and then use it to implement its competition strategy" (p. 39). The two basic, most frequently used knowledge management strategies applied by companies are the codification strategy and the personalization strategy (Hansen, Nohria, & Tierney, 1999, p. 109). The codification strategy consists in gathering information and knowledge in extended computer bases to which employees have access. Companies using this strategy focus on investing in information technology (IT) and telecommunications systems, allowing for efficient remote access of employees to the codified experiences of colleagues from around the world; employees are encouraged to use the ready-made patterns and solutions created on this basis. The personalization strategy, on the other hand, consists in creating opportunities for contact between people and direct transfer of knowledge they possess (Scheepers, Venkitachalam, & Gibbs, 2004, p. 204). Contrary to the codification strategy, employees are encouraged to create new, individual solutions to the problems encountered, information systems are treated only as a tool to support interpersonal communication and the knowledge management process itself is based on its codification and transfer of knowledge (in particular of tacit knowledge) in direct interpersonal contacts. Companies should decide on the choice one of the described strategies as the leading one, and the second one as complementary, preferably in the proportions of 80:20. One should not try to apply both strategies at the same time to the same extent, though, as they require different business models, different personnel and different ways of motivating (Paliszkiewicz, 2007, pp. 40-44).

Research Results

Results of Pilot Surveys on Selected Aspects of Knowledge Management Conducted Among Research and Teaching Staff at Universities in Poland

Description of the Pilot Surveys

Survey instruments concerning selected aspects of knowledge management at Polish universities were sent electronically between December 7, 2017 and January 15, 2018 to research and teaching staff members at universities in Poland. The survey questions were designed in this study to examine opinions of academic workers on usefulness of various types of knowledge at the university, factors conducive to and barriers to sharing the knowledge.

The sample was convenient. As it was supposed to be a pilot survey, this study used one key criterion to select respondents: they had to be active academic teachers and researchers. The respondents invited to participate in the research were currently employed in a few Polish institutions of higher education: Polish-Japanese Academy of Information Technology in Warsaw, Warsaw School of Economics, Warsaw University of Life Sciences, Poznan University of Economics, and SWPS University of Social Sciences and Humanities.

The survey instrument was set via Google Form and was sent to 72 individuals, while 30 participants were obtained, which recpresents 41.7% response rate. An equal number of men and

women participated in the survey, more than half of them were in the 40 - 50 age range (24% were over 50 years old, 12% of respondents represented age groups: up to 30 & 30-40). Almost 60% of the respondents had a doctoral degree, about 23% - a master's degree, 15% - a habilitated doctor and 3.8% - a full professor. No bachelor or engineer (only) completed the survey. Most respondents were employed as assistant professors (52%) and associate or full professors (20%); the others were teaching assistants (12%), teachers (8%), senior lecturers (4%) and "external teachers" (4%). The vast majority of respondents (over 60%) had over 10 years of work experience as in research and teaching work; less than 20% were people with work experience in the range of 1-5 years, about 15% - 5-10 years, and 3.8% - less than a year. In order to ensure anonymity of a small, pilot sample of the survey, the respondents did not have to reveal any sensitive data, such as more detailed information concerning their current employer. As far as categorizing the answers and drawing conclusions from the survey is concerned (e.g. defining some factors as "most useful" or "most efficient", etc.), it was done on the basis of frequency of the answers.

Usefulness of Particular Types of Knowledge for Efficient Work and Career Progress at the University

The first question regarded the degree (on a scale of 1-5, where 5, i.e. "very important" was the highest degree) of usefulness of particular types of knowledge for efficient work and career progress at the university (as a research & teaching employee). As it is shown in Table 1, the substantive knowledge needed for teaching classes was definitely chosen as the most important type; other types of knowledge received more differentiated responses.

The term *substantive* knowledge means "the subject matter" knowledge and the *methodological* knowledge is the knowledge of ways or methods of doing something (in this case methods of teaching or conducting scientific research).

Table 1. Usefulness of Various Types of Knowledge at the University for a Research and Teaching Enployee in Percentages

	Substantive knowledge needed for teaching classes	**Substantive knowledge needed for scientific research**	**Methodological knowledge needed to teach classes**	**Methodological knowledge needed to conduct scientific research**
Very important	84.6 %	65.4 %	46.2 %	34.6 %
Fairly important	15.4 %	26.9 %	30.8 %	42.3 %
Important	-	7.7%	15.4 %	15.4 %
Slightly important	-	-	7.7 %	3.8 %
Not very important	-	-	-	3.8 %

Next, questions concerned the most effective ways of acquiring/deepening the above-mentioned types of knowledge in the academic workplace as well as the factors supporting and barriers to sharing these types of knowledge with other employees.

The Most Effective Ways to Acquire Knowledge in the Academic Work Environment

As far as the most effective ways to acquire all the above-mentioned types of knowledge in the academic work environment are concerned, respondents stressed the importance of the following sources and methods (they appeared as answers in all the categories of knowledge):

- Self-study, participation in conferences and trainings, faculty seminars;
- Scientific publications, academic textbooks, professional literature in the library and information systems of the university, materials in electronic form, Internet resources, knowledge of specialist literature and the latest trends, professional/business experience, research and teaching,
- Exchange of experience, knowledge of more experienced colleagues/mentors, cooperation with other specialists in a given field, contact with faculty members of other similar universities, Erasmus+ trips, foreign and domestic conferences abroad;

The respondents also came up with suggestions concerning particular types of knowledge (See Table 2).

Table 2. The Most Effective Ways of Acquiring/Deepening Knowledge in the Academic Workplace, Broken into Knowledge Category

Substantive knowledge needed for teaching classes	**Substantive knowledge needed for scientific research**	**Methodological knowledge needed to teach classes**	**Methodological knowledge needed to conduct scientific research**
- Participation in classes conducted by experienced teachers.	- Being active, showing initiative and independence in the search for solutions - Participation in research and implementation projects focused on solving real problems	- Well-designed teaching materials - Training in teaching methodology, conscientious preparation for classes.	- Websites of the Ministry of Science and Higher Education - Use of the support of a dedicated university unit - Gaining the experience by writing many applications.

Factors Conducive to Sharing of Particular Types of Knowledge in the Academic Work Environment

As far as factors conducive to sharing of particular types of knowledge with other employees in the academic work environment are concerned, respondents listed the following as conducive to sharing all of the types of knowledge:

- IT infrastructure (access to the database of scientific publications, academic textbooks), good working conditions (heated, air-conditioned & well-lit rooms with good computer & Internet infrastructure);
- Working in teams (on scientific projects, development of course scripts and curricula, sharing teaching materials etc.), support of the superiors, good cooperation with others within organizational units, structured exchange of knowledge (seminars);

- The atmosphere of cooperation and trust, employing friendly and helpful people, cooperation with the environment, remuneration for sharing knowledge, focus on effects, openness, good personal contacts, time to learn.

Favorable factors that the respondents suggested as specific to sharing particular types of knowledge are presented in Table 3.

Table 3. Factors Conducive to Sharing of Particular Types of Knowledge in the Academic Workplace

Substantive knowledge needed for teaching classes	**Substantive knowledge needed for scientific research**	**Methodological knowledge needed to teach classes**	**Methodological knowledge needed to conduct scientific research**
- Conducting classes by many teachers who use the same materials - A good repository of didactic materials - Diversification of teachers conducting one sort of courses	- Thematic seminars, regular seminars and other planned research activities that do not interfere with teaching duties, organization of staff meetings - Good attitude of authorities towards scientific development of employees - Well-functioning and continually updated source databases	- Solving everyday problems - Organization of trainings in the organizational unit, aimed at exchanging experiences - Presentation of knowledge acquired by employees at external trainings/workshops etc. in which they participated to colleagues	- Discussing negative reviews together

Main Barriers to Sharing Knowledge in the Academic Work Environment

In opinions of respondents main barriers to sharing all types of knowledge in the academic work environment comprise:

- Lack of time for conversation/discussion, overload of duties, weak informal ties between employees, lack of training, lack of training that focuses on what would be really useful;
- Lack of a motivational system of rewarding and evaluating employees, reluctance of the university authorities to finance conference attendance, lack of feeling bonds with the organization, lack of commitment, fear of competition from other teachers, lack of willingness to cooperate, competition, ambition, laziness, professional jealousy, conviction that knowledge loses value when it becomes common, fear of lack of reciprocity;
- Lack of awareness that one should share knowledge, lack of trust in the quality of the knowledge to be acquired, too narrow specialization of teachers;
- Lack of uniform technical and organizational support for gathering didactic materials;
- Very high costs of acquiring commercial, specialist knowledge by the employees on their own - high staff turnover, insecurity, lack of motivation and benefits from sharing

knowledge, lack of any profits for having "valuable" knowledge, atmosphere of uncertainty, fear;
- Organizational culture focused on achieving goals at any price, even by unethical methods.

Some other barriers typical of particular types of knowledge are presented in Table 4.

Table 4. Main Barriers to Sharing of Particular Types of Knowledge in the Academic Workplace

Substantive knowledge needed for teaching classes	**Substantive knowledge needed for scientific research**	**Methodological knowledge needed to teach classes**	**Methodological knowledge needed to conduct scientific research**
- Reluctance of the authorities to publish didactic scripts - High diversity of issues discussed during classes	- Willingness to maintain one's position in the team (e.g. knowledge of certain modeling techniques or rare statistical methods)	- Lack of didactic teams - Low significance of didactic work in the employee performance evaluation - Lack of methodological competence to be shared	- Lack of organizational units specialized in obtaining funds for research - High specialization - Competing for funds - Unwillingness to employ "the young" in scientific projects

Usefulness of IT Tools in the Process of Sharing Knowledge

The next question concerned the usefulness of IT tools (such as e-mails, discussion fora, databases, blogs, Google Docs, electronic newsletters) in the process of knowledge sharing at the university. The vast majority (over 88%) of respondents considered this type of tools as important, in particular e-mails, databases, and Google Docs. They also listed: fora, blogs, mailing lists, newsletters, team-based wikis, European Union (EU)-oriented sites for international cooperation, databases with access to legal, and organizational documents of the university, well-organized repository solutions for gathering and sharing knowledge, all tools facilitating collaborative work on documents, databases with articles such as ResearchGate. It was also noticed, however, that "most of the knowledge is transmitted orally" and "IT tools cannot replace good atmosphere and communication in a team; if these are missing, IT will not change anything."

Secret Knowledge of the University

The next question concerned the existence of knowledge in the environment of each university, which is secret knowledge, confidential for the organization, constituting its competitive advantage, which should not be disclosed to people outside the university. Over 60% of respondents chose the answer "I do not know", less than 35% stated that such knowledge exists. When asked to define what this knowledge refers to, they indicated knowledge about:

- Ways of attracting candidates for studies, recruitment processes, "all areas";
- Cooperation with the environment, employee remuneration systems, data concerning employment contracts of key employees (financial conditions, etc.), personal data,

business model of the university, marketing strategies, management systems, strategic development plans (e.g. plans to open new studies), details of teaching programs, teaching patterns;
- Intellectual property that can be traded, e.g. research results, patents, know-how, software, didactic materials, knowledge of people and their attitudes to work.

Key Factors Motivating to Share "Hoarded" Knowledge

The last question was as follows: if you were to point to one, most important factor that would encourage or motivate an employee to reveal the most valuable, "hoarded" knowledge to other employees (of the same university), what (if anything) would it be? The following responses were obtained: a feeling of teamwork, academic advancement, constant salary increase and formal recognition of expert status, good remuneration depending on the employee's involvement in the life of the university and friendly treatment of the employee (sense of security), measurable benefits, promotion to a higher position, ensuring safety at least to maintain a hard-earned position, financial incentives, reimbursement of knowledge acquisition costs and/or bonuses, receiving other valuable knowledge in return and feeling that sharing knowledge has a positive impact on the quality of work of the university.

One of the respondents stated that he or she was not aware of having any knowledge worth sharing, yet another one commented: in my case it is always a childish joy that I feel when I can share my knowledge with someone; huge satisfaction that I can show someone something new, and help to solve the problem.

Discussion and Conclusions

Survey respondents - a group of 30 research and teaching staff members of universities in Poland, most of whom had at least a few years of work experience at the university and a Ph.D. degree - recognized the substantive knowledge needed to teach students as the most important type of knowledge useful in their work. Other types of knowledge - methodological knowledge needed to teach classes or substantive and methodological knowledge fundamental to conducting scientific research were also recognized as important in academic work, although to a lesser extent than the substantive knowledge needed for teaching. When it comes to the most effective ways of obtaining/expanding this type of knowledge in the academic environment, respondents emphasized, above all, the role of self-study, their own commitment to improving qualifications, e.g. by studying various types of publications, participation in conferences (foreign conferences) and various trainings, searching for information on the Internet and gaining practical experience outside the university; they also stressed the importance of contacts with other research and teaching staff members.

The most important factors conducive to sharing all types of knowledge with other employees in the academic work environment are: good IT infrastructure, organization of work so that it would require some kind of teamwork, assigning time for conversations (socializing) and time

for learning, organizational culture focused on cooperation instead of competition, openness, employing friendly, sympathetic, helpful people, creating and sharing electronic knowledge repositories as well as ensuring well-designed and equipped university building infrastructure.

According to respondents, the main barriers to knowledge sharing in the academic environment are: lack of time for conversation/discussion, organizational culture focused on competition and achievement of results at all costs, employees' conviction about the high value of their tacit knowledge and high costs of obtaining it, no tangible benefits from sharing their knowledge, weak informal relationships between employees, atmosphere of uncertainty, fear and lack of trust, lack of contacts between employees, lack of uniform technical and organizational support for collecting didactic materials and too narrow specialization of teachers,

Regarding the usefulness of IT tools in the process of sharing knowledge, the vast majority of respondents considered this type of tools as helpful, in particular e-mails, databases, and Google Docs. It was also emphasized, though, that these tools are only means of technical assistance.

As for the question about the existence of secret knowledge in the academic environment, which is a competitive advantage of the university, it is worth noting that the majority of respondents were not aware of the existence of such secretive knowledge. Almost all respondents would be willing to share their "hoarded" knowledge with others and the factors that would motivate them to do so are, primarily: a sense of teamwork, appreciation and recognition of this type of attitude at work, a sense of security, receiving other valuable knowledge in return, and feeling that sharing knowledge has a positive impact on the quality of work of the university.

The analysis of the survey results described above allows to conclude that the right strategy for knowledge management at the university is the personalization strategy, emphasizing the human aspect of generating and sharing knowledge, while the coding strategy should be used as a complementary strategy. Academic and didactic staff members are, by definition, focused on acquiring, deepening, and sharing knowledge. Self-study - through reading scientific publications, online sources, conference trips, conversations with colleagues, teaching others, and creating (through research) new knowledge is the basic activity of a faculty member. The basic type of knowledge of this type of employees is tacit, highly personalized knowledge; it is also passed on (e.g. during classes or supervised research to students) in a non-standardized, very individualized way.

The main challenge for the university authorities is, therefore, to create convenient conditions for creating and sharing knowledge, that is, above all, creating an organizational culture focused on cooperation, supporting teamwork, supporting conference trips and professional, practical training, organizing employees' work time as well as the physical layout of university rooms in a way that allows informal meetings of employees and the free exchange of information. The authorities should also take care of a good IT structure. However, the key factor is employing friendly, cooperative people and creating a working atmosphere that is full of trust and sense of security (e.g., implementing a human resources policy based on long-term contracts). And it should be stressed here that the creation of a university incentive system that would support (also

in a financial way) sharing of valuable (& at the same time difficult to measure) knowledge with colleagues will be quite a challenge.

Summary

In the time of Knowledge-Based Economy, effective knowledge management is one of the factors that can create an organization's competitive advantage. Institutions that are present in every developed economy, and are meant for the creation and dissemination of knowledge are universities. Therefore, the type and perceived effectiveness of knowledge management solutions applied in the academic environment can be considered a topic worth exploring.

The research questions concerned, thus, the most effective ways of obtaining various types of useful knowledge, the factors conducive to and hampering sharing knowledge with academic colleagues and the type of knowledge management strategy that should be implemented at the university. For this purpose, this study - after presenting selected definitions of such concepts as "knowledge", "knowledge management" and a brief description of the most popular knowledge divisions and strategies, presented the results of the pilot study carried out with the help of digital survey instrument on a small group of Polish academics. They showed that research and teaching staff members are highly motivated to acquire knowledge, and have a high level of awareness of the need of self-study.

Tools to acquire knowledge (in particular, the most valuable knowledge they need for teaching) which they consider the most effective and desirable are: participation in conferences (especially foreign conferences) and access to valuable publications and textbooks. Their knowledge should be defined as highly personalized. Scientific and didactic staff members also express great willingness to share knowledge, they even have a problem with defining either their own or organizational secret knowledge, which should not be shared. The factors that support the process of sharing knowledge are primarily: organization of work conducive to formal and informal communication between employees (including group work) as well as organizational culture focused on cooperation and building an atmosphere of mutual trust; the main barriers, on the contrary, comprise lack of time, organizational culture focused on competition and poor formal and informal relationships between employees. As far as IT tools are concerned, the respondents also consider them valuable, but treat them merely as technical assistance. Thus, it can be concluded that the strategy of personalization is a more effective strategy for knowledge management of research and teaching staff members.

The task for the university authorities is to build an incentive system (including a promotion & remuneration system) that would reward knowledge sharing. The key challenge is also, as in most organizations, employing people who, apart from possessing valuable specialist knowledge, will also be kind, helpful, and empathetic.

This paper was meant as a pilot study. The main value of this study is the collection of opinions and suggestions from a sample of respondents concerning organizational factors and tools

supporting the creation and sharing of knowledge in the academic environment, as well as the barriers to these processes. This can be used as a basis for further research on the purpose and methods of implementing knowledge management systems at universities in Poland. Its limitations include the lack of research on a larger research sample that would include the majority of Polish universities and verification of employee opinions on the effectiveness of applied knowledge management solutions with objective methods measuring the effectiveness of knowledge management. A more sophisticated survey instrument should be (& is planned to be) constructed on the basis of the one used in this pilot study. Also, opinions of students and university authorities should be collected and analyzed. In-depth interviews with teachers and researchers with considerable professional background should be conducted. A more thorough literature review covering more issues connected with knowledge management (such as the role of organizational culture), and an analysis of solutions related to knowledge management applied at leading foreign universities should also be considered as an important direction for further research. The research should cover more issues connected with knowledge management, such as the role of organizational culture and be done alongside an analysis of solutions facilitating knowledge management at leading Polish an foreign universities.

References

Brooking, A. (1999). *Corporate memory: strategies for knowledge management*. London: International Thomson Business Press.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge*. Boston, MA: Harvard Business School.

Drucker, P. (1993). *Post-capitalist society.* New York: HarperCollins Publishers.

Fazlagić, J. (2014). *Innowacyjne zarządzanie wiedzą (Innovative knowledge management)*. Warszawa: Difin.

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems, 18*(1), 185-214.

Hansen, M., Nohria, N., & Tierney, T. (1999). What's your strategy for managing knowledge? *Harvard Business Review, 77*(2), 106-116.

Koźmiński, A.K. (2004). *Zarządzanie w warunkach niepewności. Podręcznik dla zaawansowanych (Management in conditions of uncertainty. Advanced guide.)*. Warszawa: Wydawnictwo Naukowe PWN.

Leonard, D. (1995). *Wellsprings of knowledge: Building and sustaining the source of innovation*. Boston, MA: Harvard Business School Press.

Liebowitz, J. (ed.) (2008). *Making cents out of knowledge management*. Plymouth, UK: The Scarecrow Press, Inc.

Liebowitz, J. (ed.) (2012). *Knowledge management handbook*. Boca Raton, FL/London, UK/New York, NY: Collaboration and Social Networking/CRC Press/Taylor and Francis Group.

Nonaka, I., & Takeuchi, H. (2000). *The knowledge-creating compan*y. Oxford, UK: Oxford University Press.

Paliszkiewicz, J.O. (2007). *Zarządzanie wiedzą w małych i średnich przedsiębiorstwach – koncepcja oceny i modele (Knowledge management in small and medium-sized enterprises - assessment concept and models)*. Warszawa: Wydawnictwo SGGW.

Scheepers, R., Venkitachalam, K., & Gibbs, M. R. (2004). Knowledge strategy in organizations: Refining the model of Hansen, Nohria, and Tierney. *Journal of Strategic Information Systems, 13*, 201-222.

Shveiby, K. E. (1987). *Managing knowhow*. London, UK: Bloomsbury.

Stacey, R. D. (2000). The emergence of knowledge in organization. *Emergence, 2*(4), 23–39.

Teece, D. J. (2009). *Dynamic capability and strategic management: Organizing for innovation and growth*. New York, NY: OUP.

Tiwana, A. (2002). *The knowledge management toolkit: Orchestrating IT, strategy, and knowledge platforms*. Upper Saddle River, NJ: Prentice Hall, Inc.

Von Krogh, G., Ichijo, K., & Nonaka, I. (2000). *Enabling knowledge creation: How to unlock the mystery of tacit knowledge and release the power of innovation*. New York, NY: OUP.

Wiig, K. M. (1994). *Knowledge management foundations: Thinking about thinking – How people and organizations create, represent, and use knowledge*. Arlington, VA: Schema Press.

Author's Biography

Małgorzata Cieciora has spent more than 25 years in the academic community. She has been working in the Polish-Japanese Academy of Information Technology in Warsaw (formerly Polish-Japanese Institute of Information Technology) since it was founded in 1994. Currently, Dr. Cieciora is the Dean of the Faculty of Information Management. Her research is focused on quality management, business process management, and project management in the tertiary education institutions. She has published numerous papers and one book dedicated to management in the academic environment.

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Determinants of propensity to establish academic innovative start-ups

[Research-in-Progress]

Michal Borowy, Warsaw University of Life Sciences, Faculty of Economic Sciences, email address: michal_borowy@sggw.pl

Abstract

Many young (and not only) scientists have a very good research results, which are useful for society and the economy, but do not appear to implement them in the form of their own start-up due to fear of failure. In order to make it easier for inventors to assess their own potential, this work presents personality and non-personality factors in the process of making decisions about starting a new business. Knowledge about particular factors may reduce the fear of commercializing the results of their own research. The study made so far, is only a preparation of the theoretical base before the empirical stage of transnational research embarkes, that will be carried out with participation of innovative start-ups representatives. The final publication may contribute in this way to increase interest, especially among young scientists, in launching spin-off companies. Increasing the number of these entities is important from the point of view of accelerating the transfer of new knowledge from the science sector to business practice, and at the same time contributing to the increase of innovativeness of the small and medium-sized enterprises (SME)'s sector.

Keywords: Innovative entrepreneurship, academic entrepreneurship, start-up, spin-off.

Introduction

Current role of the university is not only to conduct research and education, but also commercialization of scientific results and entrepreneurship dissemination. The modern university is seen as a supplier of solutions for the economy. Moreover, the most profitable form of this transmission is academic entrepreneurship (Polish Agency for Enterprise Development, 2011). Innovative academic start-ups can bring great economic value domestically or transnationally. It is well seen on the examples of such strong scientific centres in the United States, such as Stanford University or Massachusetts Institute of Technology (MIT), where companies were created in connection with the university. They would be able to build, if they were a separate nation, an economy comparable in size to Thailand or South Africa (Wissema 2009).

Obviously, the importance of this business entities depends on how much developed economic environment in which they grow is (Global Entrepreneurship Monitor Report, 2018), but in any case, they play an important role as a catalyst of academic new ideas. Innovative academic start-ups are mostly based on state-of-the-art technologies. However, is the scientific invention enough to build a new innovative business? What factors determine a successful launch of private company?

The main purpose of my research at the current stage is to identify and present personality and non-personality factors in the process of making decisions about starting a new business. The analysis considered such personality factors as: readiness to risk and need for achievement, struggle for independence, locus of control, adaptation, self-efficacy, motivation and also non-personality factors like: regulations, sources of financing, institutional support, cultural aspects and age. All these variables has been presented schematically on the conceptual *Model*, later in this article (Figure 2).

The paper refers to both the classic Schumpeter's theory of innovation and economic growth (from first dacades of 20th centoury) and select contemporary theories of entrepreneurship development. Data for current research were collected using *desk research* method, based on international scientific publications available in traditional and electronic versions, like e-journals databases, i.e. ProGuest, Elsevier or SpringerLink and the latest reports of World Bank, Global Entrepreneurship Research Association (GERA), European Commision and aditionaly my own past experience.

Personality Aspects in the Process of Making Decisions About Starting a New Business

Research carried out so far shows that there appears to be a lack of theoretical tools useful in measurement of readiness for entrepreneurship (Ruiz, Soriano, & Coduras, 2016). Ruiz et al. (2016) were seeking knowledge on this subject from various disciplines of science, i.e. sociology, psychology, and business management. In this paper, I have focused on a few selected aspects that struck me as important in relation with scientists during my work in Transfer Technology Orgnization (TTO) operating at Warsaw University of Life Sciences. Acting the role similar in many aspects to an *Executor* (support for inventor to implement his invention) from the *A-to-F Model* by Kotler and Trias de Bes (2011, p. 17), some personality traits important to launch innovative business by academics were noticed.

Struggle for Independence and Propensity for Risk Taking

The tendency to take risks, need for achievement and independence are listed among key individual psychological characteristics of entrepreneurs, that differentiate them from the rest of

society (Ruiz et al., 2016; Cuervo, Ribeiro, & Roig, 2007; Kihlstrom & Laffont, 1979; McClelland, 1961).

The willingness to be independent as a trait of entrepreneurial people is not only about financial independence, but probably mainly on the freedom of action and realization of goals according to one's own rules. According to classic approach. innovative entrepreneur implementing *new combinations of resources* should accept the risk (Schumpeter, 1934). In current reality - especially at the early stages of enterprise development, like seed or start-up, when the risk is very high. At these stages, the role of venture capital funds is very important, however, the most important is inventor who has to decide whether they are ready to take responsibility for implementing their scientific results. Such personality traits do not represent a big number of people, as it can be seen from the example of spin-off companies number at universities in Poland. The analysis carried out in the group of all Polish life science universities showed that scientists who undertook cooperation with the economic environment they prefered commissioned works for external entities (i.e. expertise, opinions, analyzes, etc.) - 20% and participation in projects financed from public funds - 18%, than commercializing the results of their research in the form of sales, licensing or by launching a private spin-off activity - only 9% (Figure 1) (Borowy, 2017).

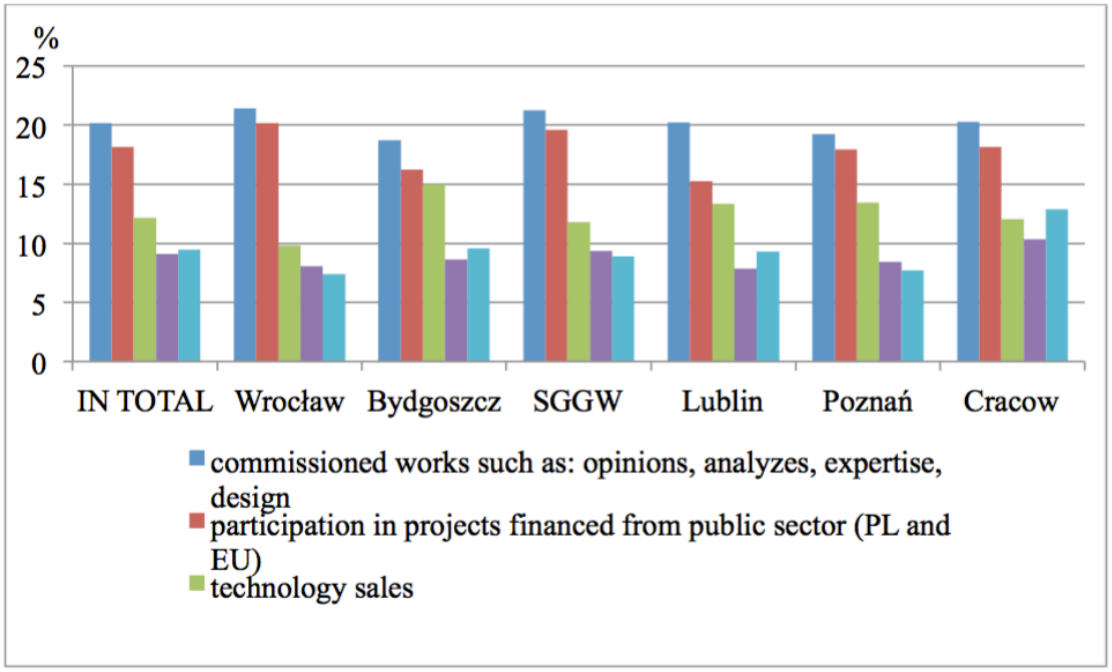


Figure 1: The most benefitial kinds of science business cooperation in opinion of scientists from Polish life science universities (N=172)

Locus of control

Some scholars draw attention to another important aspect, relevant to need for achievement - locus of control, which is related to *belief that actions determine outcomes* (Ruiz et al., 2016; Pitt & Kannemeyer, 2000; Rotter, 1966). It means that people who do not have or do not believe in the possibility of their own influence on the outcome, have no motivation to actively change the environment around them, including setting up a self company. It is when the locus of control is external. Conversely, when people represent internal locus of control then they are more active in making own business.

Adaptation

Launching an innovative start-up is associated with high risk and high degree of uncertainty, so this is why the ability to adapt right business strategy to changing market conditions should also be considered. This issue is "crucial for the performance (measured as survival)" of new technology-based, capital-intensive business (Andries & Debackere, 2007, p. 81) to achieve stability (Pitt & Kannemeyer, 2000). Entrepreneur must be flexible enough to react on unpredictable situations and should be able even replace the current company model with a completely different one, if necessary (Brukaw, 1991). The key to entrepreneurial success, as Morris, Altman, and Pitt (1999) pointed out "lies in the decisions of individual entrepreneurs who identify opportunities, develop strategies, assemble resource, and demonstrate initiative*"* (p. 6). At the same time, they emphasized that the ability to adapt, on a large extent, depends on the entrepreneur and his/her learning ability.

Self-Efficacy

Some personality traits are more frequent and others less often in entrepreneurs who have achieved success. The aspects discussed above, such as tolerance of ambiguity, locus of control (more internal one), tendency to take risks are classified as most consistent characteristics. While such characteristics like creativity, need of independence, and being well organized occur with more variability (Moris et al., 1999). However, the need for independence, based on anecdotal observations with scientists, when related with the leader personality, can be of no less importance for initiating of a new enterprise than propensity for risk taking, for example.

Organizational talent, creativity and cognitive thinking have influence on self efficacy, which is immanent in the process of creating a new company. Self-efficacy gives a sense of inner conviction about the ability to achieve designated goal (Ruiz et al., 2016; Bandura, 1997; Chen et al., 1998). Ruiz et al. (2016), following other authors, explained in four points the relationships between self-efficiency and entreprenaurship. They list arguments as fallow: 1) "people choose vocations they feel they are capable of doing (Krueger & Dickson, 1994)" (Ruiz et al., 2016, p. 1033); 2) "entrepreneurs need high levels of self-efficacy" in high-risk situations (Ruiz et al., 2016, p. 1033); 3) "perseverance to cope with difficulties, and personal effectiveness (Bandura,

1986; Krueger & Dickson, 1994)" (Ruiz et al., 2016, p. 1033); and 4) "incentive to act is greater when entrepreneurs believe their actions have achievable outcomes (Sanchez et al., 2005)" (Ruiz et al., 2016, p. 1033).

Motivation

Motivation is hardly related to mentioned above locus of control. Lauching new technology based start-up in academic sphere has to be profitable for inventor. The scientist needs motivation to combine university responsibilities with work for the economy. It is important for example from the point of view of creating incentive systems in public universities, especially in the aspect of intellectual property rights (IPR) division. Passing all IPR to inventors (like i.e. in Sweden) or a substantial part of it may imply an increase in the number of academic spin-offs. These issues concern the institutional environment, which will be discussed below, in the section devoted to non-personality factors

Non-Personality Aspects in the Process of Making Decisions About Starting a New Business

Obviously, the decision to start a business depends not only on endogenous factors. Significant role plays here exogenous factors, which result from the overall business climate related to economic, legal and cultural environment. The importance of these factors confirms annual comparative studies carried out by international organisations like i.e. Global Entrepreneurship Research Association (GERA), World Bank or European Commision. The Conditions accompanying the starting and running of business differ in different countries of the world. But positive business climate does not have to be exclusive domain of highly developed economies, and the economies with most business-friendly regulation are relatively diverse. As noted in *Ease of doing business ranking* by World Bank, concededly 18 of the top 20 are classified as high-income economies, but the other two are classified as upper-middle-income economy or lower-middle-income one. Furthermore, as found in the Global Entreprenaurship Monitor (GEM) (GERA, 2018), despite that entrepreneurship ecosystem is strongest overall in the innovation-driven economies, the largest percentage of Total-early-stage Entrepreneurial Activity (TEA) and Established Businesses (EB) ownership rates (business up to and over 3.5 years, respectively) was recorded in less developed factor-driven economies (twice biger rate than in innovation-driven economies). On the other hand, the companies established in innovation-driven economies are more often based on modern technologies, more competitive, can employ more people, they are characterized by greater survivability and entrepreneurial employee activity. The new companies in innovation-driven economies are also mostly opportunity-driven, while the factor-driven economies reported the lowest average opportunity-motivation.

Regulations

The biggest challenge, among the determinants of starting and running business in the majority of the world economies are administrative and legal regulations. As stated in the GEM report globally (GERA, 2018), government policies related to taxes and bureaucracy as well as research and development (R&D) transfer have a hindering rather than stimulating impact on entrepreneurial activity in 2017, what can cause prevent entrepreneurs from entering the formal economy. In economy conducive to creating a start-up's, the rules should be accessible, transparent, predictable and stable. As the World Bank report stated in 2016/2017, only 38 from 190 econmies simplified the rules of setting up companies by reducing the procedures, time or cost associated with the process. Majority of them simplified registration formalities by, for example, abolishing requirements to obtain various approvals or consolidating several registration processes into one. Among the other solutionts were also mentioned i.e. set up or improved one-stop shops, reduced or eliminated minimum capital requirements and set up online platforms for entrepreneurs (GERA, 2018). Since such information did not appear in the report, it is worth adding that in the case of academic enterprises, internal regulations of the university regarding the management of IPR of great importance when starting a business.

Sources of Financing

The innovative academic start-up activity can be financed generally from public and private sector. The first means financing from central or local government entrepreneurship programs. For example in European Union (EU) countries, the part of structural funds are spent on start-ups stimulation. The second one is more diverse. It can be financed from own entrepreneur's capital or from external sources like venture capital funds, business angels or banks. Usually, the use of public funds is associated with the lowest risk, while the capital investments are the more risky but associated with a chance for a bigger profit. Total expenditure on R&D as percentage of Gross Domestic Product (GDP) express Gross domestic spending on R&D (GERD) indicator. GERD determines the level of economy innovativnes. In high income economies, value of this indicator exceeds 3%, on average for OECD countries its value is 2.4% (OECD, 2018).

Institutional Support

The inventors can count on the support in starting their own company from various forms of innovation centers, both within the university and outside it. A group of such institutions includes i.e. Science Parks, Technology Incubators, Academic Business Incubators or Transfer Technology Organisation (TTO). The activities of these institutions are supported by various entities conducting consulting and financial activities, such as, for example, Technological Accelerators, Venture/Seed Capital Funds, who are ready to invest in projects at very early stage of innovative idea development. All these institutions act as moderators of dialogue between

representatives of science and business, facilitating their mutual integration and the development of innovative undertakings. The key task of these organizations is to improve the competitiveness of the national economy by supporting the process of implementing the results of scientific research and the development of innovative activities of enterprises and the creation of start-up companies. Among these organizations the largest are Science Parks because they can contain all the other mentioned forms of innovation centers as part of their activities. Currently, there are more than 400 Science Parks in 77 countries worldwide (IASP, 2017).

Cultural Aspect

It is important to understand that each economy to grow needs solid social basis. The proper cultural system requires: 1) To create a consensus within society in regard to common goods and goals, going beyond the interests of particular social, political and professional groups; 2) An acceptance of common, long-term goals or tasks requiring the ability of collective (group) social action. Group creativity must be enriched with individual creativity; 3) Ability to compromise; and 4) Ideological and moral tolerance, which is a condition for the functioning of society in a globalizing world in which the flow of goods, services, capital, ideas, and people from different cultural backgrounds takes place (Kleer, 2011; 2018). Creating and maintaining an entrepreneurial culture of economy requires appropriate educational programs starting from the earliest stages of learning. Currently, there are some disproportions in this sphere between world economies in favor of innovation driven economies (GERA, 2018).

Age

Regardless of phase development in all studied economies the highest prevalence of entrepreneurial activity is among those aged 25–34 years and 35–44 years. The lowest differences among age groups are found in factor-driven economies. In these countries occured also the largest group of young people representing early entrepreneurial activity, being at the age of 18-24 year olds. Twice bigger than in innovative driven economies (GERA, 2018).

Industry 4.0

A new approach to setting up companies requires a different perspective in the light of the ongoing industrial revolution (Industry 4.0) and the rapidly progressing digitization of economic processes, including innovative ones. But the analysis of this problem requires very broad, deepen studies and will be the subject of my next research.

Figure 2 shows the model illustrating schematically all described earlier determinants of propensity to establish academic innovative start-ups.

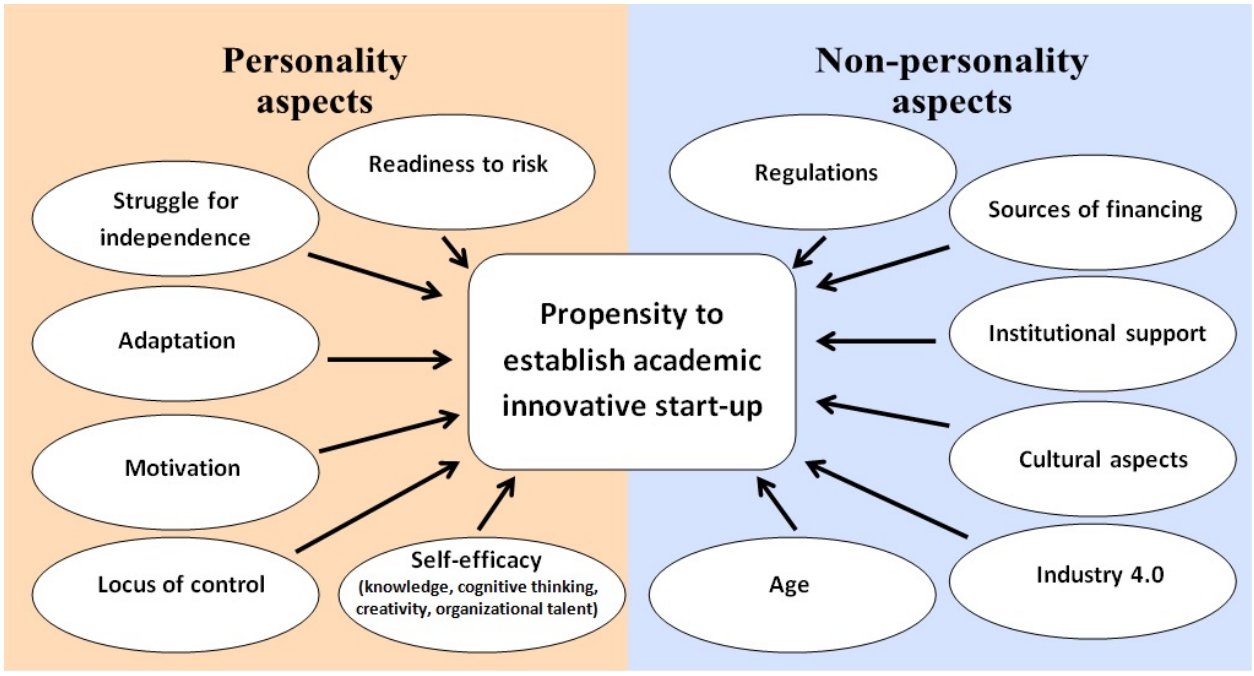


Figure 2: Model of personality and non-personality determinants of propensity to establish academic innovative

Conclusions

As Drucker (2007) stated, entrepreneurship does not require neither geniuses nor will be done if we wait for inspiration and for the 'kiss of the muse'. Many people are afraid of starting their own company, fearing that they do not have the right attitude. But it is worth to note that most of the factors presented in this paper on personal traits are dependent on the ability to learn, like i.e. locus of control, adaptation (Ruiz et al. , 2016; Hansemark, 2003; Peacock & Wong, 1996; Moris et al., 1999) or self-efficacy. That should be important especially for scientists who appear to easily acquire new knowledge. Of course, people are different and have different propensity to risk, but at different stages of their lives their motivations also change. Human decisions result from the circumstances in which they are in a given time. Such aspects as strong motivation, need for achievement and struggle for independence can have a positive impact on propensity for taking risk. It is easier for a person who represent right personal traits to adapt to changing economic conditions. Prior knowledge about available regulations and a diferent forms of institutional or financial support can make it easier to start a new business. Obviously, even if

one meets all the recomended conditions, it is uncertain whether their venture will succeed, but it is worth trying.

Further Research

The analysis made so far in this paper is only a preparation of the theoretical base before the empirical stage of this research. Significance of particular factors and relationship between mentioned variables will be the subject of further research, using the regression method in basis on transnational empirical research conducted in collaboration with the representatives of innovative academic entrepreneurship. The interviews with representatives of innovative start-ups will be conducted with the use of quantitative method Computer Assisted Web Interview (CAWI). The research, when completed, is expected to bring new useful knowledge, both for young scientists and policy makers, who put a big effort into creation of effective national innovative systems, but the number of academic spin-offs is still insufficient.

References

Andries, P., & Debackere, K. (2007). Adaptation and performance in new businesses: Understanding the moderating effects of independence and industry. *Small Business Economics, 29*(1-2), 81-99.

Bandura, A. (1986). Fearful expectations and avoidant actions as coeffects of perceived self-inefficacy. *American Psychologist*, *41*(12), 1389-1391 .

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman and Co.

Borowy, M. (2017). *Transfer wiedzyiinnowacji z sektoranauki do otoczenia gospodarczego (naprzykładzie publicznych uczelni przyrodniczych w Polsce);* EN: *Knowledge and innovation transfer from the science sector to the economic environment (on the example of life sciences universities in Poland).* Warsaw, SGGW

Brokaw, L. (1991, April). The truth about start-ups, inc.. 52–67.

Chen, C. C., Greene, P. G., & Crick, A. (1998). Does entrepreneurial self-efficacy distinguish entrepreneurs from managers? *Journal of Business Venturing, 13*(4), 295-316.

Cuervo, A., Ribeiro, D., & Roig, S. (2007). Introduction. In Cuervo, A., Ribeiro, D. and Roig, S.S. (Eds), *Entrepreneurship: concepts, theory and perspective.* Berlin, Germany: Springer.

Drucker, P. (2007). *Innovation and entrepreneurship.* Oxford, UK: Elsevier Ltd.

Global Entrepreneurship Research Association (GERA). (2018) *Global entrepreneurship monitor (GEM). Global Report 2017/18.* Retrieved from https://www.gemconsortium.org/.

Głodek, P., & Pietras, P. (2011). *Finansowanie komercjalizacji technologiii przedsięwzięć innowacyjnych opartych na wiedzy*, Warsaw, Polish Agency for Enterprise Development (PARP), Warsaw

Hansemark, O. C. (2003). Need for achievement, locus of control and the prediction of business start-ups: a longitudinal study. *Journal of Economic Psychology, 24*(3), 301-319

International Association of Science Parks and Areas of Innovation (IASP). (2017) *Broshure.* Retrieved from http://www.iasp.ws/

International Bank for Reconstruction and Development/The World Bank. (2018) *Doing business 2018. Reforming to create jobs.* Washington, DC: World Bank Group, 22-26.

Kihlstrom, R. E., & Laffont, J. J. (1979). General equilibrium entrepreneurial theory of firm formation based on risk aversion. *Journal of Political Economy, 87*(4), 719-748.

Kleer, J. (2011). *Raport „Polska 2050"; EN: Report "Poland 2050",* Warsaw, Polish Academy of Science, Prognosis Committee "Poland 2000 plus"

Kleer, J. (2018). *Cultural foundations of innovation.* Materials from conference titled *Poland and Russia in the face of common challenges*, Moscow, Russian Academy of Science-Polish Akademy of Science.

Kotler, P., & Trias de Bes, F. (2011).*Winning at innovation: The A-to-F model*. Palgrave Macmillan, Warsaw, Polish Academy of Sciences

Krueger, N. F. Jr, & Dickson, P. R. (1994). How believing in ourselves increases risk taking: perceived self-efficacy and opportunity recognition. *Decision Sciences*, 25(3), 385 – 400.

McClelland, D. C. (1961). The achieving society. New York, NY: The Free Press.

Morris, M. H., Altman J. W., & Pitt, L. (1999). The need for adaptation in successful business concepts: strategies for entrepreneurs. Research Gate. Retrieved from: https://www.researchgate.net/publication/228532145_The_need_for_adaptation_in_successful_business_concepts_strategies_for_entrepreneurs

Organisation for Economic Co-operation and Development (OECD). (2018). *Gross domestic spending on R&D (indicator). doi:10.1787/d8b068b4-en*. Retrieved from https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm

Peacock, E. J., & Wong, P.T.P. (1996). Anticipatory stress: The relationship of locus of control, optimism, and control appraisals to coping. *Journal of Research in Personality, 30*(2), 204-222.

Pitt, L. F., & Kannemeyer, R. (2000). The role of adaptationin microenterprise development: A marketing perspective. *Journal of Developmental Entrepreneurship, 5*(2), 137–155.

Rotter, J. B. (1966), General expectancies for internal versus external control of reinforcement. *Psychological Monographs, 80*(1), 1-28.

Ruiz, J., Soriano, D. R., Coduras, A. (2016). Challenges in measuring readiness for entrepreneurship. *Management Decision, 54*(5), 1022-1046.

Sánchez, J. C., Lanero, A., & Yurrebaso, A. (2005). Determinant variables of the entrepreneurial intention in the university context. *Revista de Psicología Social Aplicada, 15*(1), 1-24.

Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle. Cambridge, MA: Harvard University Press.

Wissema, J. G. (2009). *Towards the third generation university. Managing the university in transition*. Cheltenham, UK: Edward Elgar Publishing Limited.

Author's Biography

Michał Borowy, Ph.D. works as a scholar at the Faculty of Economic Sciences, Warsaw University of Life Sciences. In his professional work he focuses on practical and theoretical aspects of technology transfer from the sphere of science to business. He carried out research in this field both in Poland and abroad, in science parks in Lund (Sweden) and Moscow. In 2012-2017 he worked professionally for the commercialization of scientific results in Transfer Technology Organization (TTO) at Warsaw University of Life Sciences. The results of the research work of M. Borowy (*The model of transfer of new knowledge from Polish life sciences universities to business environment*) were applied at the stages of planning and implementation of two projects entitled respectively *Innovation Incubator* and *Innovation Incubator+* (2013-2015; 2017-2019) financed from EU funds for a total amount of nearly 1 mln euro.

International Institute for Applied Knowledge Management

Refereed Paper Proceedings - KM Conference 2018 – University of Pisa, Italy

A Publication of the International Institute for Applied Knowledge Management

Amelioration of the bibliographical records as a case for knowledge acquisition

[Research-in-Progress]

Aleksander Z. Wassilew, Warsaw School of Economics, Poland, alex@sgh.waw.pl

Monika Komuda, National Library of Poland, Poland, m.komuda@bn.org.pl

Abstract

Information systems operate on bits – digital data – interpreted by specific systems as signs and symbols. These last are subject to operations in formal systems. Computers are syntax machine, therefore, the analysis of the "correctness" is possible only on the syntactic level. The analysis of the semantics or meaning, thus, remains beyond the capabilities of these processing systems and requires the intervention of human factors. The meaning of the words (or constructed sentences) is strictly related to the used natural language. Throughout the history of the dynamic world, languages evolve and the words change their meaning – it is called semantic change (shift). The organizing of the library catalogues is a particular case of knowledge acquisition – like the creating of a semantic network. The bibliographical data are not placed automatically and moreover, it is necessary to accomplish an amelioration (better ordering, refining) of the existing records by librarians. The last one is illustrated with a few cases taken from practice. The main goal of this article is to consider the semantic changes (shifts), the amelioration of the bibliographical records and the role of human factors for this task.

Keywords: Language evolution, semantic changes (shifts), libraries catalogues, MARC, bibliographical records, amelioration of data.

Introduction

Information systems are useful tools for improving actions and processes, especially for routine, formal, and algorithmic tasks. Computer systems, in fact, only accelerated those automatic intellectual activities, which could be easily well-described, structured and formalized. They operate on data encoded and recorded in digital form and on formal models – without "understanding" the meaning of their work. We should be very careful when we speak of data and information as well as the symbolic representations of the human intellectual processes. Floridi (2004) stated that "information is still an elusive concept". Information assumes the interpretation of data (signals) from the reality. The objects in the real world are usually described in a natural language and only in it is possible to conclude whether given sentence is true or not (Wassilew & Papińska-Kacperek, 2017).

Natural languages evolve in time in the opposite of formal and artificial languages. The world is permanently changing, therefore, the language, which describes it, is changing itself. It is necessary to actualize the model of reality and the data (words) describing it. The evolution of the language in time effects in semantic changes (shifts) of the used words. Bralczyk (2017) stated that words are not logical, precise and consistent, while it is hard to set them in order scientifically. In the opposite of wiki-based websites, where crowd wisdom has a big impact of knowledge acquisition – linking data (terms in which is coding) into a semantic network, in the libraries, the task is done by librarians. The particular case of this creation is the way, in which the library records are ameliorated (ordered, refined) further by specialists. Thus, the main goal of this paper is to describe mechanisms for changing of semantic space and to present, in a few cases*: the problems of the semantic changes (shifts), the amelioration (refining, better ordering) of the bibliographical records and the role of human factors in this task*. The methodology used in the work is based on: a) a socio-cognitive (interdisciplinary) approach – including socio- and psycho-linguistics, philosophy (epistemology), logic, anthropology, system analysis and b) participant observation on the practice in the libraries.

Formal Systems

Information systems operate on bits – digital data – interpreted by specific systems as signs and symbols. All these data operations are subject to the rules of (purely logical) formal systems. Formal systems are applicated in the creation of formal models – descriptions of selected abstract features of the studied objects from the real world (Tadeusiewicz, 2013). It is possible to create a model (referring to the outside world) by assigning real symbols and formulas to real objects in the case when it is possible to interpret and declare the truth of a formal statement. This is achievable only by verbalization – in natural language! (Dennett, 2015).

Syntax Machine

Computer operation is implemented on algorithms – which are some kind of formal processes. The key (hard to define) features (Dennett, 2015) of algorithms are:

1) substratum neutrality (independence from the used means and symbols) – as a result of its logical structure;
2) thoughtlessness at the fundamentals – trivial simple steps of each step of the procedure, which do not require "wise decisions, subtle judgments or intuitions from performer" (Dennett, 2015);
3) guaranteed results – reliability of the algorithm.

All these steps could be performed by people manually “on the paper”. Information systems simply perform all steps faster. The computer systems as physical systems are powered by physical properties ("translated" into binary code), therefore, they react to differences in the values of physical details, and the results of all processes are also presented as physical properties (data on tangible media). Generalizing – every computer program is based on

algorithms. Performing instructions mechanically step by step, it only needs a set of formal rules without the need to "understand" what they do. The correctness of their operation can be checked only at the syntax level – hence computers can be described as *syntactic* engines, at most inferential (Dennett, 2015).

Digitalization

Data can be imported into the information systems a) manually or b) by converting the quantified analogue signals into digital forms. In the process of digitization, the objects of the external world are coded and preserved in a digital form. These data files are produced in a "raw" state (unprocessed, unsorted, uncatalogued). Afterwards, it is necessary: to convert these data from the source carrier to the target one, to refine (including interpretation, reduction of redundancy, integration, standardization, aggregation, amelioration), to store (including building a data model within the meaning of the database), to encode their categories and dimensions and – finally – to create a *properly described* digital file (labels, tags, descriptors or subject headings). Most of these activities require understanding, choosing and decisions of qualified and competent humans (librarians).

At the level of data, we can examine relations between signs and symbols (*syntax*), at the level of information – relations between signs and their meanings (*semantics*), while at the level of knowledge – relations between characters and their users and their use in a specific context (*pragmatics*).

We can speak about information only when the data is interpreted and achieve meaning (sense) for the user in a specific context. For the interpretation of the data, it is necessary user's *prior* knowledge (human capital), *how* to understand it (data model), and his experience of *how* such "extracted" information can be used (Wassilew, 2016).

Knowledge as a synthesis of experience can be *declarative* (propositional) or *tacit* (habitual, procedural). The user not only knows *what* but also *how* to use it. According to Nonak and Takeuchi (2000), knowledge is produced by him and embedded in the recipient's convictions and expectations. Therefore the crucial question for reflection is *how do you know?*

In his classic work, Shannon (2001) emphasized that "semantic aspects of communication are irrelevant to the engineering problem" (p. 50). As it was explained above analysis of the "correctness" of IT processing is possible only on the syntactic level. Analysis of semantics, intending meaning, remains beyond the capabilities of these processing systems.

Semantics

The data require also additional data about them themselves, i.e. metadata that facilitate linking (Linked Data) between them. The structured resources and their logically connecting effects in a semantic network. In informatics, the ontology is a *formal representation* of knowledge by defining the terms, their properties and the relationship between them. The practical

implementation of the ontology consists in presenting this knowledge in the form of a tree or graph, in which concepts are found in the vertices and the edges describe the type of relations linking them (Wassilew & Papińska-Kacperek, 2017). The most general notion is written in its root. The metadata record consists of a set of attributes, which are necessary to describe the data. Each described object can be interpreted differently, depending on the context. The verbal description of the interpretation may have many synonyms in a given natural language. Confidence is an important element of the vision of T. Berners-Lee's semantic network (Artz & Gil, 2007). It refers often to the validation mechanisms of the source of information – *where do you know from*? In the case of global application, the same language should be used to describe metadata.

In semantics, words and their meanings stand in a network of relationships. There is a problem with the "knowledge" of the *meaning* of the words. There may be different types and answers to the question "*Do You know this word?*":

- Yes, I heard this word, but I don't know what it means.
- Yes, I know the dictionary definition(s) for different areas.
- Yes, I know collocations (with which other words it may be used) – I know the semantic network for this word.
- Yes, I know concrete examples for the class, named by this word (core meaning and prototype theory) (Rosch & Lloyd, 1978).
- Yes, I know when, where and how to *use* this word.

This is more obvious while learning a foreign language, but sometimes it happens whilst using mother tongue. There are many aspects of "knowing", which depends on the user's (not only linguistic) competence and his experiences and it is changing in time.

Semantic Change (Shift)

Natural language serves as a means of communication between people – and only in it can be stated about the truthfulness and meaningfulness of a given utterance. Additional knowledge (*presuppositions*) is necessary about conditions under which something can be confirmed or denied. There may be an inconsistency in the interpretation of individual concepts by the recipient – it depends on the degree of cultural and conceptual compatibility (of the used language) as well as on the individual linguistic and communicative competence of interlocutors (Bell, 2018).

Language as a dynamic process (Blank, 1999) is speaker-based. It occurs transformation of the form and meanings of the currently used words. Throughout the history we observe the evolution of word's usage – a shift of the original meaning and the word's variety of senses and connotations alter. It should be also paid attention to the continuous evolution of the language. The meanings of words are changing, new concepts are appearing – related to new phenomena or referring to old ones (Lau, 2015). New words are borrowed from other languages, and new dialects and professional jargon are created (Sapir, 2010). New words are borrowed from

different languages and afterwards many original words disappeared. Most loans do not replace the native words with similar meanings. They rather attain connotations which the native words do not possess (Semantic Change, n. d.). The semantic shift occurs not when completely new terms are formed, but when an already existing word changes or extends its use (Lau, 2015). For example, few old words get a "very" new meaning: window, mouse, virus, web (Rodd et al., 2012).

The dynamics of English language changes can be demonstrated by the rejecting to update the third paper edition of the *Oxford English Dictionary*. The preparation for printing does not keep up with the current changes in English (Gleick, 2012). For any live language, there are never-ending studies on semantic changes (shifts) whenever (Lau, 2015). The most important types and kinds of this subject are listed below from the rich literature on this subject (Bloomfield, 1935; Blank, 1999; Grzega & Schoener, 2007; Rodd et al., 2012, Semantic Changes, n.d.):

- *Narrowing (specialization* or *restriction)*: The new meaning is more precise, covers only the part of the original meaning. It changes from superordinate level to subordinate level. restricts the range of meanings. E.g.: Verb originally meant "word" and still does so literally but in the case of *a verb*, now it is a particular type of a word denoting *action*.
- *Specialization*: a downward shift in a taxonomy. Similar to above. E.g.: Meat was a word for *food*, now it is restricted to an *edible flesh*. Doctor meant *teacher*. Surf for navigating the Internet.
- *Widening (broadening, extension, generalization*): The meaning of the word is widened (usually observable diachronically – increase its range of meaning over time). It involves the widening of a word's signification until it covers much more than the idea originally conveyed. E.g.: Once *camp* had only the meaning of the *military* camp.
- *Generalization*: an upward shift in a taxonomy. Similar to above. E.g.: Entrepreneur like a small-business owner or worker.
- *Genericization (Trademark erosion):* Loss of secondary meaning. The process by which trademark rights are diminished or lost as a result of common use in the marketplace. Specific brand names being used for the general product. E.g., Xerox, Google, Walkman.
- *Branching*. The lexeme becomes polysemous; the newly developed may be connected to more than one sememe. E.g.: Head means part of the body, life (it cost him his head), leader, something looking like the head of the body (of cabbage), culmination, the top or the beginning of a page or letter (headlines) etc.
- *Metaphor*: Change based on a semantic similarity of thing (or connection between concepts – the new sense and the original one). It is based on the association of similarity of shape, position, location, form, function, behaviour, colour etc. between two objects. E.g.: Foot of a page.
- *Metonymy*: Change based on contiguity (nearness) between concepts. It does not involve two completely separate objects, but rather concepts that are 'near each other in space or time' and are 'neighbours'. The new senses are not entirely foreign to the original

meanings, but rather an addition of related associations. The name of an attribute of a thing is used instead of the thing itself. E.g.: Crown means *monarchy*, listen to *Mozart*.

- *Antonomasia:* A phrase or epithet takes the place of a proper name, also as an archetypical name. E.g.: Aretha Franklin as *The Queen of Soul*.
- *Eponymy* (functional change): A proper name (noun) is taken to serve a concept of the common word. E.g.: bikini, White House.
- *Synecdoche*: Change based on whole-part relation. A type of metonymy involving a part of the whole relationship. E.g.: Manchester like the football team of the *city.*
- *Hyperbole*: Change from weaker to stronger meaning. E.g.: Wait for *ages*.
- *Meiosis*: Change from stronger to weaker meaning. E.g.: I fear I am not in my perfect mind (King Lear).
- *Degeneration* (*pejoration, deterioration*): The new meaning is negative, the word acquires a pejorative emotive charge. Words losing particular meanings, and attaining a less favourable and negative sense. E.g.: Silly meant *blessed*.
- *Elevation*: The new meaning adds positive charge – words attain an increasingly positive meaning as compared to its original understanding. E.g.: Queen initially meant *woman*.
- *Cohyponymic* transfer: a horizontal shift in a taxonomy. E.g.: The confusion of mouse and rat in some dialects.
- *Antiphrasis*: Change based on a contrastive aspect of the concepts. E.g.: Perfect lady for *a prostitute*.
- *Auto-antonymy*: Change of a word's sense and concept to the complementary opposite. E.g.: Bad in the slang sense of *good.*
- *Auto-converse*: Lexical expression of a relationship between the two extremes of the respective relationship. E.g.: Take in the dialectal use as *give.*
- *Ellipsis*: Semantic change based on the contiguity of names. The meaning of one of the words is gradually transferred to its partner, so one word can stand for the whole phrase. E.g.: To be expecting (a baby).
- *Folk-etymology*: Semantic change based on the similarity of names. E.g.: Female from *the male*.
- *Analogy*: One member of a synonymic set acquires a new meaning, the other members acquire it, too: the word catch acquired the new meaning of understanding. E.g.: Life is like a box of chocolate.
- *Newspeak* a linguistic design meant to limit the freedom of thought – personal identity, self-expression, free will – characterised by a continually diminishing vocabulary; complete thoughts reduced to simple terms of simplistic meaning. E.g.: Freedom fighter.
- *Discourse* may be changed in a very short period of time and implicating different connotations, consequently causing ambiguous meaning of the used words. E.g.: War against terrorism.

So it seems that the words might be used according to the context with a different meaning. Therefore the words should be treated like data and the task is to find every possible relation

linking these words into a semantic network. Crowd wisdom might be applied in the *wiki*-based websites – finally, the meaning depends on using of words and statistically it must work. In the libraries linking the different items is simpler – there are established procedures for the workers, nonetheless, the effects depend on the competence and the erudition of the librarians.

Library Records

Information systems are implemented in the libraries, for placing, encoding, cataloguing, updating, access etc. of the library resources. Standard formats allow to share and to exchange bibliographical data between libraries and are helpful for constructing user's interfaces. Machine-Readable Cataloging for the 21st century (MARC21) is one of the most popular standards of digital formats for representation and communication of the catalogued bibliographic and related descriptions in libraries in many countries all over the world (Marc, 2018). It may be applied to printed and manuscript textual materials (books, newspapers), digital files, maps, music and sounds recordings, visual materials (microforms, pictures, films) and other resources. MARC21 is metadata transmission standard, not a content standard. It contains fields filled with particular information about recorded bibliographical data or reference records – mainly tree-structured. For identification of each field in the record, MARC21 uses a simple numeric code (001-999) – above 008 they could be divided into subfields, numbered with a single number or letter: a, b, c, d, e, f, q, r, s, t. The filling of the fields is generally made by humans – cataloguers place the actual content, which is usually governed and defined by standards outside of information system. The objects (concepts) of reality are encoded in the form convenient for librarians and library users.

The main sources of information for filling the records' fields are (BN, n.d.): encyclopaedias (Wikipedia), dictionaries, thesauri, databases of national libraries, specialist publications, search engines (google) and websites, informers, promotional publications, correspondence etc. The problem is not only the trust to the information sources. Many of the recorded data needs actualization and/or refinement – not always is possible to make automatically by the information systems.

Ameliorating of the Library Records

The ameliorative (corrective) actions for the libraries catalogue are taken whenever it is appropriate. More of the data for the real world is changing in the time. It is not only the matter of the semantic shifts in the language. The base for cataloguing the item is an existing publication – material or digital. The most useful information for users is an author, title and subject. The subjects may be the same as the keywords (from the book or article), but sometimes may be described by words, which not appears in the document. They are the only thing, which may change their semantic, especially in a longer period of time.

The important matter is deciding what is the name(s) of the author (none, one, or more). There is no problem as long as one author is linked with only one title. Difficulties begin when the author (name and surname) appears with more titles. The problem may appear with a transcribing

and/or transliteration from foreign languages of the original name, as well with the polonizing the names in certain cases. There may be already existing another form(s) of recording his name(s) and one of them must be chosen as main unless the author wants to be distinguished with different names (nicknames). In this case, there are created different reference records for this person.

The main task is to describe every record unambiguously. Sometimes it needs an additional information, which is not always available – for example, years of life. For instance, a woman, who gets married, or a man after gender-change, may change her/his names or surnames. The related places and occupations may change and enhance throughout her/his life and the corresponding fields should be modified.

The term (concept) can have more than one meaning and there is not possible to unravelled automatically without human intervention. Generally, there are established rules and procedures, anyway, it requires a human intervention to choose between proposed available options. Important factors of succeeding in these tasks are experiences of the librarians, good erudition, intuitions, enough time for rummage and luck.

Some Cases of Problematic Melioration of the Bibliographical Records

Case Wiącek

There is a record in the library catalogue for the name *Wiącek, Alicja*, as an author of few books. The first cause of doubt, that this name is related to more than one person, was the big time interval (40 years) and the different places of the publications along with the focus of the books.

For one of authors named *Wiącek, Alicja*, there two kinds of books: language handbooks and tourist-guides – published in 2005-2008. For the other author named *Wiącek, Alicja*, there is only one kind – related to the history of literature – the book published in 1976. It is still not clear if there is any relations between these two people with the same name. During the investigating of the sources, it becomes clear that the tourist-guide was written by another *Wiącek, Alicja*. Meanwhile, it was found out that she had married and had changed her surname *Łukowska, Alicja* (the book from 2013). The same had happened to the author of language handbooks – her name became *Jankowiak, Alicja* (books from 2013).

Because of lack of the birth year of authors in the printed books, it is impossible to fully identify their identity. It is established, that in the library catalogue there are records with the changed names and these forms are chosen as the main forms, while the former name is rejected. In this situation the form of the name *Wiącek, Alicja* is unique in the library base and thus, we have:

Wiącek, Alicja (tourist-guide) => *Łukowska, Alicja*

Wiącek, Alicja (language handbooks) => *Jankowiak, Alicja*

Wiącek, Alicja (history of literature) => *Wiącek, Alicja*. There is no information about further writings or changing her names.

Case Mortkowiczowa

There are two translators of children literature: *Mortkowiczowa, Janina (1875-1960)* and *Bernsteinowa, Rozalia* (nickname). It is not clear if these two names are referred to the same person. In the sources of two researchers, there are different conclusions. It is not easy to choose which opinion to accept at that moment.

Case Zofia Hertz

In the record of *Hertz, Zofia* there is the birth year 1911 – used by her during all her life, while accepted and used in the catalogues, even on her grave. According to pre-war documents, there is a known typo since her real birth year is 1910. The two versions are accepted officially and it is not clear which one to choose in the bibliographical data. The first date is more spread in the public discourse, although it is not the correct one per the documentation. In some cases, there is used 1910/1911. It is an interesting topic in the context of truth and reality.

Case Roman Grus

There is a book from 1925, where all that was initially known about the author were the initials *R.G.* and it was noted in the catalogue in 1998. About 20 years after, it was easier to identify the author as – *Grus, Roman*, although he was a forester, and the book was about polish language.

Case Franz Hofmann

It is still popular to polonize some foreign names. In the bibliographical record appeared the name *Hofmann, Franciszek* created on the base of an article about him. It was not obvious at the beginning that he is not Polish. Later, it was established from other sources that he was Austrian lawyer *Hofmann, Franz* with the same years of life – 1845-1897. His identity was decided based on the titles of the books he had written.

Case Societas Iesu

The old form appeared in prior records as: *Societas Iesu*. Lateron, a new form of the name appeared as: *Jezuici*, because it is the most popular term among the users of Polish language at that moment.

Case Parlament – Ukraina

The old form appeared in prior records as: *Parlament – Ukraina*. At present, this form is replaced by a new form: *Rada Najwyższa Ukrainy*. These types of changes should be prepared previously in the databases, indicating the identity of the object.

Case White House

The record *White House* may refer to the building or to the institution, therefore, it should be registered in different fields in the catalogue.

Case Xiao Bing

Xiao Bing is the name of a real person and the name of artificial intelligence writing a poetry. In the second case, the name should be registered in a different field – not for humans – according to the present rules. But this is a new phenomenon that may change in the future.

Case Royal Family

The form *Middleton, Catherine Elizabeth* existed in the catalogue. After the marriage and entrance in the royal family the record was changed into *Katarzyna (księżna Cambridge; 1982-)*. In the same way the record for *Markle, Meghan* will be changed after the marriage with Prince Harry. In these cases, the names (without surnames) are polonized and in brackets is added the honour title.

Implications and Conclusions

Information systems are very useful for the routine and algorithmic tasks. They operate on data in the formal systems, i.e. only on the syntax level, therefore, they cannot be trusted when the task is concerning meaning and understanding. At that moment we need humans for managing with semantic problems. In the real world, the evolution of natural languages is a never-ending process. Its dynamic manifests with an adaptation of new words, semantic changes (shifts) of the older ones, creating quite new terms and concepts. It is realised during human communication.

Crowd wisdom could be applied to some websites and might be helpful in creating a semantic network for knowledge bases. However appearing too many tags from users may only increase the ambiguity. Finally, someone must decide what to choose according to the given context. The amelioration of the bibliographical records in the catalogues of libraries is a particular case of the way in which the data and information are linked in the general semantic network. The database in the libraries is created manually or by digitalization of analogue data. However, they need further processing and refining for convenience for librarians and users. The tagging-principle is not applicable in this case. It is performed by workers capable of 'wise decisions and subtle judgments.' All these tasks require erudition, invention, intuition, experience, and stroke of luck of human capital. Sometimes it needs deeper investigations.

The information systems demand *well-shaped* data for their effectiveness. This needs standardisation from the very beginning, i.e. from all the publishers. For instance, we have a few standards for references. Artificial Intelligence (AI) and machine learning may be applicable when they will be able to resolve the cases above. Until then, we must rely on humans for the amelioration of the bibliographical records.

References

Artz, D., & Gil, Y. (2007). A survey of trust in computer science and the semantic web. *Web Semantics: Science, Services and Agents on the World Wide Web, 5*(2), 58–71.

Bell, R. T. (2018). Sociolinguistics: Goals, approaches, and problems. Retrieved 14.02.2018 from https://www.researchgate.net/publication/44461707_Sociolinguistics_goals_approaches_and_problems_Roger_T_Bell.

Blank, A. (1999). Why do new meanings occur? A cognitive typology of the motivations for lexical semantic change. *Historical Semantics and Cognition, 13*, 61-90.

Bloomfield, L. (1935). *Language.* London & Aylesbury, Great Britain: Compton Printing Ltd.

BN (n.d.). Retrieved from http://przepisy.bn.org.pl/deskryptory/zasady-tworzenia-deskryptorow-bn.

Bralczyk, J. (2017). *1000 słów*. Warszawa, Poland: Prószyński Media & Agora.

Dennett, D. (2015). *Dźwignie wyobraźni i inne narzędzia do myślenia*. Kraków, Poland: Copernicus Center Press.

Floridi, L. (2004). Open problems in the philosophy of information. *Metaphilosophy*, *35*(4), 554-582.

Gleick, J. (2012). *Informacja. Bit, wszechświat, rewolucja*. Kraków, Poland: Znak.

Grzega, J., & Schoener, M. (2007). English and general historical lexicology. *Eichstätt-Ingolstadt: Katholische Universität*.

Lau, J. (2015). Semantic change in the English language: Evolution of words. Retrieved from https://justinlau15.wordpress.com/2015/11/30/semantic-change-in-the-english-language-evolution-of-words/.

MARC21 (2018). Retrieved from https://www.loc.gov/marc/.

Nonaka, I., & Takeuchi, H. (2000). *Kreowanie wiedzą w organizacji*. Warszawa, Poland: Poltext.

Rodd, J. M., Berriman, R., Landau, M., Lee, T., Ho, C., Gaskell, M. G., & Davis, M. H. (2012). Learning new meanings for old words: effects of semantic relatedness. *Memory & Cognition*, *40*(7), 1095-1108.

Rosch, E., & Lloyd, B. B. (Eds.). (1978). Cognition and categorization. Hillsdale, NJ: Lawrence Erlbaum Associats, Inc.

Sapir, E. (2010). *Język. Wprowadzenie do badań nad mową*. Kraków, Poland: Universitas.

Semantic Change (n.d.). Retrieved from https://www.uni-due.de/SHE/SHE_Change_Semantic.htm.

Semantic Changes (n.d.). Retrieved from https://www.ff.umb.sk/app/cmsSite Attachment.php?ID=2352.

Shannon, C. E. (2001). A mathematical theory of communication. *ACM SIGMOBILE Mobile Computing and Communications Review*, *5*(1), 3–55.

Tadeusiewicz, R. (2013). *Biocybernetyka. metodologiczne podstawy dla inżynierii biomedycznej*. Warszawa, Poland: Wydawnictwo Naukowe PWN.

Wassilew, A. Z. (2016). Cena a wartość w gospodarce cyfrowej – wybrane problemy. *Ekonomiczne Problemy Usług*, *122*, 165-176.

Wassilew, A. Z., & Papińska-Kacperek, J. (2017). Wybrane problemy semantyczne we współczesnych systemach informatycznych. *Roczniki KAE*, *44*(2), 23-33.

Authors' Biographies

Aleksander Z. Wassilew is a lecturer in the Institute of Information Systems and Digital Economy at the Warsaw School of Economics. His research interests include system analysis, discourse, cognitive science, socio- and psycho-linguistic, epistemology, semantics, (meta)communication, socio-cultural consequences of the implementations of the new technologies, quality of life and lifestyle, human and social capital, interdisciplinarity.

Monika Komuda is a custodian in the National Library of Poland in Warsaw.