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MULTIDISCIPLINARY COMPUTER PLATFORM AS A TOOL FOR KNOWLEDGE TRANSFER INTO SCIENCE AND BUSINESS

Key words

ICT, computer tools, information platforms, knowledge transfer, knowledge management

Abstract

Information and Communication Technologies (ICTs) are indispensable to access the tremendous world of digital knowledge and enable its rapid generation, assimilation, and dissemination. Current tele-information technologies fundamentally influence business relationships and processes; therefore, they are one of the main drivers for social and economic development in the 21st century. Many computer tools are designed to serve in the development of a knowledge-based economy, such as databases, data warehouses, web virtual libraries, and scientific repositories. This paper presents a multidisciplinary computer platform PINF intended for the support of efficient knowledge and innovation transfer into science, industry, and business practice that could be used in organisations of various kinds, such as scientific units, SMEs, or virtual institutions clusters. The paper presents the background and the genesis of scientific and applied research that was undertaken and directed at the development and implementation of an efficient computer tool for knowledge and innovation transfer. Moreover, key issues that influenced the structure of the platform, its multilayer construction, main functional capabilities, applications,

and knowledge bases developed for networked collaboration, exchanging ideas, and working on concepts and solutions are also presented in the paper.

The author shows potential areas of PINF application in a scientific and commercial activity directed at the development of innovative solutions, their improvement, sale, and servicing.

1. ICTs role in a knowledge-based economy

The increasing importance of knowledge as a major source of competitive advantage and innovation, and the continually increasing pool of knowledge are creating a "decline of technical self-sufficiency" that includes companies and research organisations to obtain access to complementary, external sources of knowledge [14]. Knowledge transfer is defined as "the process through which one unit (e.g., group, department, or division) is affected by the experience of another" [2], and this creation and uptake of new knowledge usually implies the use of technology [1, 18], e.g. information technologies.

The capability of organisations to significantly develop or improve their products and manufacturing processes depends primarily upon the capacity of identification, acquisition, integration, and the application of knowledge by individuals in the firm [7].

The generation of mechanisms and methods in knowledge management is especially important for organisations that function within and build a knowledge-based economy [13, 21]. The emergence of Information and Communication Technologies (ICTs) has laid a platform to unravel the potential of this era of knowledge by extending sharing and transferring knowledge to organisations of various types – scientific units, SMEs, or virtual institutions clusters. Today, modern ICT offers the most promising option to improve access to knowledge even in the remotest areas [20]. Current tele-information technologies fundamentally influence business relationships and processes and play a distinctly important role supporting knowledge and innovation transfer.

The ability to gather, process and exchange information that has more and more a digital nature is crucial to obtaining and maintaining a competitive advantage in the market.

ICT has a tremendous influence on changes in society (called “millennials” or “digital natives”) that process and manage information in fundamentally different ways to previous generations [9]. Digital natives are characterised by a number of traits, such as, expecting instant responses to information inquiries, preferring random (or non-linear) access to information, preferring image over text-based content, expecting an instant response and instant satisfaction with the technologies, and the ability to utilise a range of technologies to network with peers [19]. This phenomenon also has a significant impact on organisations, which are becoming much more virtual structures and are functioning with the help of Internet in the alliances of network. A virtual organisation can be

described as a group of network-based systems that can simulate the structure and behaviour of the real domain organisations and quickly and actively exploit fast-changing business opportunities [24].

The ability to gather, process, and exchange information, which is becoming increasingly multimedia, is crucial, especially in the context of information overload. Hence, it is essential to perform complex knowledge management that begins with knowledge widening, then codifying, and finally sharing (knowledge transfer) [17]. However, before the transfer is possible, data and information fundamental for knowledge creation have to be gathered with the use of instruments and management methods, and IT tools.

Knowledge transfer involves two kinds of activities: transmission (knowledge acquiring) and absorption (knowledge adopting and applying) [16]. The absorption is possible if knowledge has a credible source and appropriate structure [8], and there is a special role and challenge for information technologies and computer tools [17].

2. Integrated IT solutions for knowledge management

World trends indicate that modern research and business organisations look for new structures of functioning and mechanisms, including new methods and models that support innovative processes, in order to improve their competitiveness on the global market [3, 22]. Information technologies perfectly harmonise with rapid changes occurring in both organisations and societal structures and provide tools for supporting such structures in efficient functioning and adapting to the internal and external environment. Automatisation of various functions of the organisation causes that complex, integrated, multidimensional computer systems and software are commonly used [4].

Computer systems for knowledge management are defined as up-to-date information technologies that are intended for knowledge acquisition, codifying, creation, and sharing [11]. The main aim of these systems is to increase the work efficiency, inter alia, through the simplification of access to data, information, or knowledge required by the user [10].

Among IT integrated systems that support knowledge management in organisation are Business Intelligence systems (BI). BI is a set of theories, methodologies, architectures, and technologies that transform raw data into meaningful and useful information for business purposes. BI can handle enormous amounts of unstructured data to help identify, develop, and otherwise create new opportunities. Integrated IT solutions in this area are, for example, ERP (Enterprise Resource Planning), SCM (Supply Chain Management), CRM (Customer Relationship Management), and specialised expert systems.

Business intelligence can be applied to the following business purposes, in order to drive business value: measurement (programs that create a hierarchy of performance metrics), analytics (programs that build quantitative processes

for a business to arrive at optimal decisions and to perform business knowledge discovery), reporting (programs that build infrastructure for strategic reporting to serve the strategic management of a business), collaboration platforms (programs that enable networking, data sharing and electronic data interchange), and knowledge management (programs to drive the company data through strategies and practices to identify, create, represent, distribute, and enable adoption of insights and experiences).

There is a group of other IT tools such as databases, data warehouses, blogs, chats, scientific knowledge repositories, and virtual libraries that serve the roles of proponents of knowledge in specific areas.

Fig. 1. The computer platform PINF
Source: Author.

The usefulness and efficiency of computer technologies and applications in supporting the realisation and dissemination of the results of innovative processes has also been proven by the experience gained by the Institute for Sustainable Technologies – National Research Institute together with industrial partners during numerous research projects, including the Strategic Programme "Innovative Systems of Technical Support for Sustainable Development of Economy." Within the Programme, the conception and implementation of works concerning the development of a multipurpose and heterogeneous

platform has been carried out. The computer platform PINF (Fig. 1) is considered a tool for knowledge transfer in the area of broadly understood innovativeness.

The concepts of a knowledge-based society and economy, assuming the common use of tele-information systems to exchange and remotely process information, have justified the implementation of the PINF .

3. Structure and capabilities of the computer platform PINF

The multidisciplinary and multipurpose platform PINF intended for the support of innovative processes has been designed and implemented in the Institute for Sustainable Technologies – National Research Institute within the realisation of the Strategic Programme "Innovative Systems of Technical Support for Sustainable Development of Economy." The Programme is realised together with industrial partners and numerous research organisations, and the conception of the platform was created based on consultation with the potential beneficiary and target groups.

The presented platform PINF is a coherent set of technologies, information sources, and applications designed to support business processes, especially in SMEs and research organisations (Fig. 2). The platform has a heterogeneous and multitier architecture that guarantees its functioning in cyberspace, disseminating information, and gathering and processing the knowledge required for innovative processes. The multilayer architecture of the platform integrates the following tiers: communication, operation, application, and information.

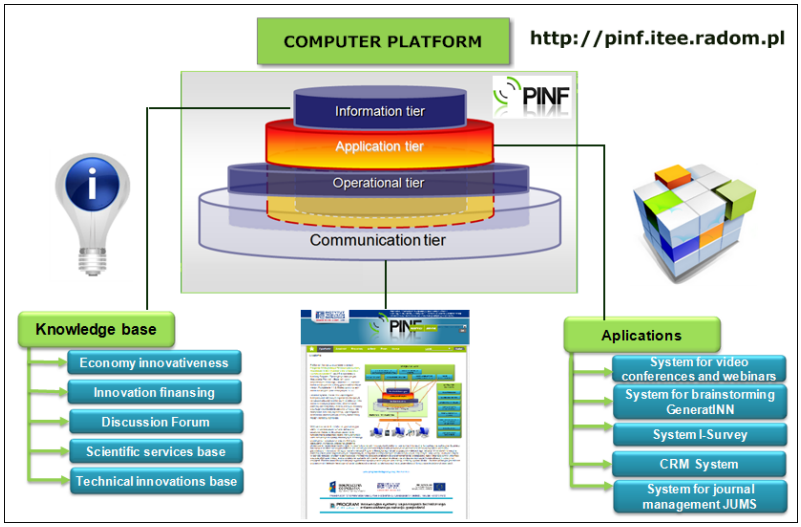

Fig. 2. A multitier structure of the computer platform PINF
Source: Author.

The architecture of the platform enables the user interface, functional process logic ("business rules"), computer data storage and data access to be developed and maintained as independent modules, most often on separate platforms [24]. The implemented architecture, apart from the usual advantages of modular software with well-defined interfaces, allows any of the tiers to be upgraded or replaced independently in response to changes in requirements or technology. The information tier is independent from application or business logic and consists of databases and knowledge bases with servers storing and retrieving information that is then passed back to the user. The main sources of knowledge are experts and documents or electronic resources concerning innovation processes. The application tier contains computer applications for knowledge management that support the transfer of knowledge about innovations into business, industry, and scientific practice. The operational tier is a virtual copy of the organisation network and consists of the following procedures: data gathering, searching, monitoring, knowledge exploring, systemic fusion, including the integration of knowledge and information, systemic analysis, and synthesis, the transformation of knowledge, and the distribution of information and knowledge [25].

The communication tier displays information related to offered services, communicates with other tiers, and translates the tasks and results to the end user.

The successively developed platform PINF primarily enables access to the following resources:

– Thematic databases, knowledge bases and repositories containing information related to broadly defined innovativeness, i.e. innovation financing, the economy innovativeness, intellectual property, scientific browsers and portals, current project calls, product and technologies databases (information tier); and,
– Computer applications intended for supporting interdisciplinary research teams in idea creation, innovation elaboration, the management of client relations, marketing activities, the dissemination of research results, the management of scientific journals, and communication (application tier).

The platform PINF has also been equipped with document storage within the digital repository (Fig. 3) that is available to users after a correct authorisation procedure.

Because of the fact that the crucial aim of the platform is to maintain the business processes within the organisation, more attention in this paper was paid to computer applications that are available to the platform users. The platform consists of the following computer applications:

– The system for video conferences and video seminars,
– The system GereratInn,
– The system I-Questionnaire,
– CRM system based on SOA, and
– The system JUMS.

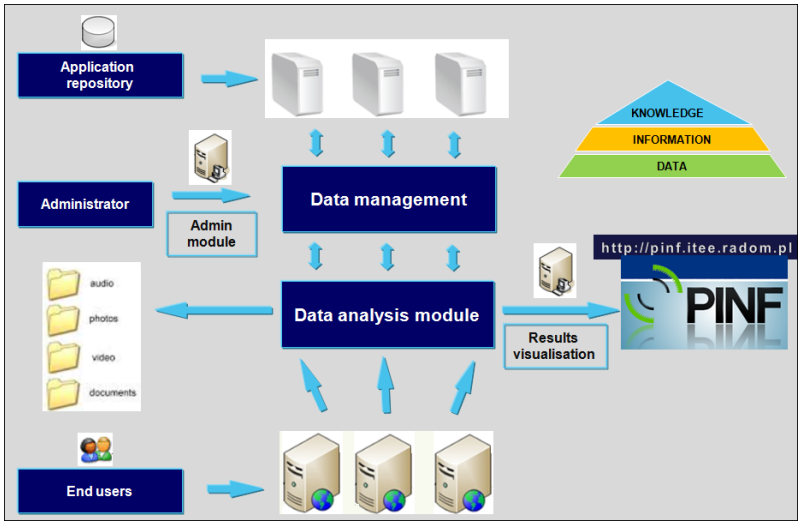

Fig. 3. The structure of the computer platform PINF for supporting innovative processes
Source: Author.

Below is a general description of applications that are available within the computer platform PINF.

Dynamic technological development also influences communication and information exchange techniques that simplify the automatisation of science, business, and educational processes. It is not always possible to communicate indirectly, verbally and visually, by simultaneous two-way video and audio transmissions, which is the most effective form of communication [6]. Therefore, the system for video conferencing, available among the PINF recourses, enables us to organise remote meetings without the necessity of relocation, on short notice, with time and money savings. The video conferencing is often used in e-learning courses, conferences, and workshops, because it eliminates a barrier of distance between people in different geographic locations. This system could also be used for the communication of business or research teams working on a project in various places (cities, countries) through the Internet. Moreover, it could be a useful tool in operation and maintenance instruction, product presentations, and quick and convenient expert consultations. The main advantages of the proposed system are that there is no need of the installation of extra software, the reduction travel expenses, and the reduction in the time of project documentation preparation and distribution.

The computer system GeneratInn is intended for the support of group decision-making with the use of the brainstorm method within sessions through a communication medium such as the Internet. The software could be used in developing ideas of innovative solutions, projects, devices design, and problem solving. One of the latest applications of such systems includes

technical activity, such as designing devices and machines within the brainstorming method.

The I-Survey system is committed to creating, storing, and publishing surveys through the Internet. The system is based on the CAWI method (Computer-assisted web interviewing) and allows executing and reporting the results of research questionnaires. With the increasing use of the Internet, online questionnaires have become a popular way of collecting information. The design of an online questionnaire has a dramatic effect on the quality of data gathered. The implemented system's potential application areas are as follows: market research, the identification of technological niches, the identification of demand for/on a product, or feedback concerning future activities.

The CRM system based on the SOA conception [15] is intended for the management of partner or customer relationships and enables users to plan the realisation of work schedules for research and business teams, to increase the effectiveness of providing partner or customer service by providing complete and homogeneous information, to plan and promote marketing campaigns, to provide visibility of the internal environment organisation's management. The proposed system also could be used to check future demand on innovative solutions among current customers or monitoring the work of project groups.

The computer system JUMS for the management of scientific journals is intended for gathering, reviewing and publishing scientific and practical results obtained while developing innovative solutions.

The presented applications have separated interfaces and could be selected dependently from the user needs and operated autonomously. They run in the computational cloud that enables one to achieve numerous benefits crucial for the platform's functioning, particularly, the elimination of peer-to-peer connections, the isolation of individual computer systems through program interfaces, and a strict control over communication processes between users in business and research processes.

To sum up, solutions and computer technologies applied in the developing platform belong into the group of knowledge management systems of the fourth generation, which are currently being investigated within research conducted throughout the world by the most significant manufacturers and providers of computer software.

Summary

The knowledge that transfers from knowledge sources becomes the raw material in knowledge creation for a recipient organization, and successful knowledge transfer is an important driving force in knowledge creation [23, 24]. Dynamic changes in the world's economy and the modern challenges of industry and science undoubtedly intensify the development of cooperation between R&D units, companies, and government organisations, especially in the context

of knowledge sharing and networking. Therefore, the computer platform PINF was designed to be a dynamic, scalable, and virtual structure intended for the efficient communication, integration, dissemination, and information processing, while providing selective fusion of knowledge resources of corporations, research institutes, research units and advisers, and experts that aim at developing innovative technical solutions and new technologies.

A heterogeneous, distributed structure of the platform enables one to successively widen its information scope and include new databases and software. The implemented platform PINF ensures stable and continuous cooperation between research and business organisations directed at solving complex technical problems. The future directions of the platform development include a module for remote access not only to research results, but also to modern laboratory apparatus at least at the national scale.

References

1. Amesse F., Cohendet, P.: Technology transfer revisited from the perspective of the knowledge-based economy. Research Policy, Nr 30, 2001, pp. 1459––1478.
2. Argote L., Ingram P.: Knowledge transfer: A Basis for Competitive Advantage in Firms, Organizational Behavior and Human Decision Processes, Nr 82 (1), 2000, pp. 150–169.
3. Beimborn D., Joachim N.: The joint impact of service-oriented architectures and business process management on business process quality: an empirical evaluation and comparison, Information Systems and e-Business Management, Volume: 9, Issue: 3, September 2011, pp. 333–362.
4. Bielińska-Dusza E.: Zastosowanie metod informatycznych w zarządzaniu przedsiębiorstwem [in:] Rozwój koncepcji i metod zarządzania, ed. J. Czekaj, M. Lisiński, Fundacja Uniwersytetu Ekonomicznego w Krakowie, Kraków 2011, pp. 453.
5. Dobrodziej J.: Multipurpose computer platform supporting the transfer of innovation to business practice, Scientific Problems of Machinery Operation and Maintenance, Vol. 46, 1(165), 2011, Polska Akademia Nauk Komitet Budowy Maszyn.
6. Firestone S., Ramalingam T., Fry S.: Voice and Video Conferencing Fundamentals. Indianapolis, IN: Cisco Press, 2007, pp. 10.
7. Grant R.M.: Toward a knowledge-based theory of the firm. Strategic Management Journal, Nr 17, 1996, pp. 109–122.
8. Gravin D. A., Edmondson A.C., Gino F.: Czy kierujesz organizacją uczącą się?, Harvard Business Review Polska, nr 3, marzec 2009, pp. 135.
9. Howe N., Strauss W.: Millennials Rising: The Next Great Generation, New York, Vintage, 2000.

10. Grudzewski W., Hejduk I.: Zarządzanie wiedzą w przedsiębiorstwach, Difin, Warszawa 2004, pp. 103.
11. Kaczmarek B.: Narzędzia informatyczne wspierające zarządzanie wiedzą [in:] Multimedia w biznesie i zarządzaniu, ed. L. Kiełtyka, Difin, Warszawa 2009, pp. 282.
12. Kang J., Rhee M., Kang K.H.: Revisiting knowledge transfer: Effects of knowledge characteristics on organizational effort for knowledge transfer, Expert Systems with Applications, Nr 37, 2010, pp. 8155–8160.
13. Kessels J.W.M.: Learning in organisations: a corporate curriculum for the knowledge economy, Futures, Nr 33, 2001, pp. 497–506.
14. Landry R., Nabil A., Ouimet M.: Determinants of knowledge transfer: evidence from Canadian university researchers in natural sciences and engineering, The Journal of Technology Transfer, Nr 32, 2007, pp. 567.
15. Łabędzka J.: Aplication of CRM-based systems in decision making in the area of innovativeness, Maintenance Problems 4/2012, pp. 163–174
16. Łopusiewicz B. (ed.):, Zarządzanie wiedzą w systemach informacyjnych, Wydawnictwo Akademii Ekonomicznej, Wrocław 2004, ISBN: 83-7011-722-8, pp. 92.
17. Makowiec M.: Technologie i systemy informatyczne w tworzeniu i transferze wiedzy w organizacji, [w:] Nierówności społeczne a wzrost gospodarczy. Społeczeństwo informacyjne – stan i perspektywy rozwoju, Zeszyty Naukowe Uniwersytetu Rzeszowskiego, Katedry Teorii Ekonomii i Stosunków Międzynarodowych, nr 22, ISBN 978-83-7338-708-9, ISSN 1898-5084, Rzeszów 2011, pp. 230–245.
18. Oliver A.L., Liebeskind J.P.: Three levels of networking for sourcing intellectual capital in biotechnology: Implication for studying interorganizational networks. International Studies in Management and Organization, Nr 27(4), 1998, pp. 76–103.
19. Prensky M.: Digital Natives, Digital Immigrants, On The Horizon, Vol. 9, No. 5, October 2001.
20. Rave P.: ICT as a tool for knowledge transfer, Focus: ICT in rural areas, International Journal of Rural Development, Vol. 42 Nr 6, 2008.
21. The Europe 2020 Competitiveness Report: Building a More Competitive Europe, Insight Report, 2012.
22. Yves P., Hannes W.: Design and management of business models and processes in services science, Systems and e-Business Management, Volume: 7, Issue: 2 March 2009, pp. 119–121.
23. Zack M.H.: Developing a knowledge strategy, California Management Review, Nr 41(3), 1999, pp. 125–145.
24. Zhugea H., Chena J., Fengc Y., Shi X.: A federation–agent–workflow simulation framework for virtual organisation development, Information & Management, Nr 39, 2002, pp. 325–336.

Multidyscyplinarna platforma informatyczna jako narzędzie transferu wiedzy do sfery nauki i biznesu

Słowa kluczowe

Technologie ICT, narzędzia komputerowe, platformy informatyczne, transfer wiedzy, zarządzanie wiedzą.

Streszczenie

Technologie informacyjne i komunikacyjne (*ICT Information and Communication Technologies* (ICTs) są niezbędne w zakresie tworzenia dostępu do wiedzy cyfrowej i umożliwiają jej dynamiczne generowanie, asymilację i dyseminację. Współczesne technologie informatyczne fundamentalnie wpływają na relacje i procesy biznesowe, zatem stanowią jeden z głównych czynników rozwoju społecznego i ekonomicznego XXI wieku. Istnieje wiele narzędzi informatycznych, których głównym celem jest wspomaganie rozwoju gospodarki opartej na wiedzy, takich jak m.in. bazy danych, hurtownie danych, biblioteki wirtualne czy repozytoria naukowe. W artykule przedstawiono multisycyplinarną platformę wspomagającą efektywny transfer wiedzy i innowacji do sektora nauki, przemysłu oraz biznesu. Potencjalne obszary zastosowań Platformy PINF obejmują przede wszystkim różnego rodzaju organizacje takie jak jednostki naukowe, MSP czy klastry wirtualne. W artykule przedstawiono tło i genezę prac badawczych i aplikacyjnych podjętych w celu zaprojektowania i zaimplementowania efektywnego narzędzia informatycznego dedykowanego wspomaganiu transferu wiedzy i innowacji. Ponadto przedstawiono strukturę platformy, jej wielowarstwową konstrukcję, główne możliwości funkcjonalne, udostępniane zasoby informacyjne oraz aplikacyjne, które wspomagają pracę interdyscyplinarnych zespołów badawczych, np. zdalną współpracę grupową, wymianę pomysłów, tworzenie i rozwiązywanie problemów technicznych.

W artykule przedstawiono także potencjalne obszary zastosowań platformy PINF zarówno w działalności naukowej, jak i komercyjnej ukierunkowane na opracowanie innowacyjnych rozwiązań, ich modyfikację, sprzedaż i ich serwis posprzedażowy.