ISSN 1505-4675

Technical Sciences

17(1) 2014

Biosystems Engineering
Civil Engineering
Environmental Engineering
Geodesy and Cartography
Information Technology
Mechanical Engineering
Production Engineering

Technical Sciences 17(1), 2014, 45–56

DETERMINANTS OF THE INNOVATION TRANSFER

***Jolanta Sala*[1], *Halina Tańska*[2]**

[1] Department of Econometrics, Statistics and Information Technologies
Powiślański College in Kwidzyn
[2] Department of Multimedia and Computer Graphics
University of Warmia and Mazury in Olsztyn

Received 27 November 2013; accepted 27 march 2014; available on line 27 march 2014

K e y w o r d s: innovations, methodology of innovation transfer, systems CAD/CAM/CAE, electronic technical document.

A b s t r a c t

The study is a result of research conducted in the environments of engineering and technical employees in industrial enterprises. The authors indicate the main dilemmas of modern entrepreneurship and innovation and present a development methodology based on a parallel increase in the adaptability of cultural and technological innovation. The authors have exposed a language and tool gap in the context of electronic communication and information processing technology, in particular, the effects of application of integrated computer systems CAD/CAM/CAE with a three-dimensional and animated option of electronic documents PDF and DOC.

Introduction

Three basic categories: matter, energy and information have a decisive significance while determining the epoch of the world's civilization development. In the industrial era it was the consumption of energy that determined the success. The era of information has come now and it became a decisive factor of running social-economic activities. The change of epoch became palpable with the mass popularization of the computer, universal software and worldwide network of informative sources, that is the Internet, in other words with very fast development and popularization of ICT technology (Information & Communication Technologies). Present epoch is called differently but undoubtedly it is an epoch of digital processing of information in which the importance of matter and energy decreased, but, of course, they are still indispensable.

* Corespondence: Jolanta Sala, Zakład Ekonometrii, Statystyki i Informatyki, Powiślańska Szkoła Wyższa, ul. 11 Listopada 29, 82-500 Kwidzyn, phone: 48 502 374 448, e-mail: sala@interia.pl

This work is based mainly on research conducted in industrial enterprises, which have to face many contingents of harsh competition not only on the home market but also on the European and the global one. The aim of the study is to identify the reasons for the low level of innovation and application of new technologies in the practice of Polish industrial enterprises and to present the methodology and tools that eliminate the identified causes. The identification of the causes was achieved mainly as a result of the synthesis of the conclusions of the research conducted in the years 2010–2012 (SALA, TAŃSKA 2010a, 2011), which have been verified in the study carried out in 2012. The research was conducted as a part of innovative project testing the international components called „The Way to Professional Excellence" realized within the Operating Program Human Capital, Priority VIII Regional economic human resources: Activity 8.2 The transfer of knowledge; Sub-activity 8.2.2. Regional Strategies of Innovation. The leader of the project is NSZZ Solidarność of Shipyard in Gdansk and the main partner is The Department of Ocean Technology and Shipbuilding at University of Technology in Gdansk.

Material and some methods – identifying the causes of collapse

Polish industrial enterprises experience essential helplessness of different advisory-training-research institutions which should support them. Industrial enterprises do not obtain essential support from the informative sources as far as innovative activity is concerned so they do not trust such entities, Central Statistical Office (GUS 2011) reveals a trace cooperation of innovatively active enterprises with: research center PAN (3.6%), research institutes (6.0%), foreign public research institutes (3.4%), schools of higher education (5.9%). The situation is similar with the usage of informative sources within a group: research-technical group, specialized group, professional societies and committees (4.9%). The market suppliers of innovative solutions are in the best position (GUS 2011). Various fields of science verify their methodological bases and paradigms as well as they experience reorganization and significant lack of subsidies in Polish institutional reality. The term paradigm is used in accordance with the interpretation by R.S. Covey'a, that is it involves „model, theory, perception, assumption and a reference point" (COVEY 2010). Such a situation takes place in humane and social sciences, economic and technical ones, as a result, they are less useful for the practitioners who look for support. At present a quite commonly applicable paradigm (SALA, TAŃSKA 2013a) involves innovation so it is sensible to focus on creating innovation as a part of innovative activity.

The concept of innovation is understood as implementing a new or significantly improved product (articles, services) or a process, new organizational method or new marketing method in economic practice, the organization of workplace or regarding the surrounding. In definition accepted in methodology, GUS adds that „A new or considerably improved product is implemented when it is introduced onto the market. New processes, organizational methods or marketing methods are implemented when the actual usage by the enterprise takes place" (GUS 2011).Various measurements and analyses concern the innovative activity which involves engaging the enterprises in different scientific, technical, organizational, financial and commercial undertakings leading to implementing innovation. Some of these activities have an innovative character whereas others are not new but necessary to implement innovation. It is accepted that an innovative activity includes research-development activity as well (R+D), which is not directly connected with creating a particular innovation.

There are many attempts of interdisciplinary „fusions of knowledge" to get to know and which support modern reality. Such an attempt is the idea of commercialization of scientific research results or combining the engineering with managing as well as the concept of instituting of the transfer of knowledge, technology and technical science. A some sort of attempt of motivating the enterprises to cooperation and, as a result, to innovation is the concept of creating an intelligent organization as well as academic entrepreneurship with its main trend of university spin enterprises so called spin-offs or spin-outs. Of course the dilemmas and contingents are similar (CHYBA 2011). The concept of transforming the research results to be used in practice as well as the methodology in a form of a guide for innovators undertakes the intention of „knowledge fusion" (JASIŃSKI 2011).

It seems that all undertakings lack some systematic coherence which would get to the nub of Polish technical, economic and social specification. A Polish role model can be an engineer Eugeniusz Kwiatkowski in II Republic of Poland, who impersonalizes the success of hitting the hot spot of innovative industrial activity. The American guru of proactivity at the turn of 20th and 21th century was S. R. Covey with his relations between the knowledge, skills, desire and habit as a cumulated value. The concept of mutual influence is presented on figure 1.

It is obvious the measurements of the innovativeness of enterprises are not enough, concrete activities supporting innovative activeness are necessary. The knowledge (what and why) as well as skills (how) are not enough. The will I desire-I want is necessary and at that point the condition of making a habit is fulfilled (COVEY 2010). In relation to this the process of transfer or transformation should not be treated as a sign of vertical transfer of technology „from

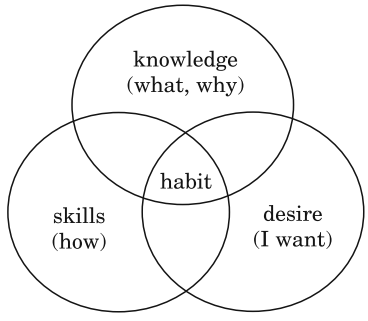


Fig. 1. Effective habits

Source: COVEY (2010).

top to bottom", that is the transfer of scientific-technical knowledge from research center to the enterprise. Unfortunately, too often in our country there is a scheme of such transfer which is interpreted as a traditional, one-directional, line transfer of technology. Many publications mention the modern approach as an interactive model of transfer but it seems all attempts of partner implementations have an incidental and local character.

On one hand we know much about industrial enterprises (in a collective as well as individual aspect), on the other side it is difficult to take responsibility for the way a particular production system should be as it is „designed with a purpose and organized as material, energetic and informative structure exploited by a human being and aimed at manufacturing certain products [...] to fulfill various needs of the consumers" (DURLIK 1993). In regard to the information provided above the issue of how to realize the concept of entrepreneurship and innovativeness in the area of technology is still open. Innovative process in its activity-related meaning is limited by a time range from the concept till the realization.

Working on the process of creating the innovative value the initial analysis of the enterprise's needs is more and more commonly limited to the identification of gaps (JASIŃSKI 2011). The professional literature offers few proposals of identification and measurement of the gaps but they all can be reduced to a generally defined informative gap (OLEŃSKI 2000). According to few interpretations, an informative gap has a multidimensional character. There are also interpretations focusing on indicated measurements, among others, motivational, emotional, competence, educational ones as well as technical, technological, effective or developmental ones.

As far as Polish conditions are concerned there are difficult institutional contingents (SALA, TAŃSKA 2013b) of identifying innovation so it is worth signaling the importance of the developmental gap understood as the differ-

ence between the potential of an activity (e.g. the culture of an organization, leadership skills, logistic skills, available resources, that is passive power) and the potential of the influence (e.g. the effectiveness and cultural aspirations, the structure of authority, the features of strategic leadership). The crucial barrier resulting from the experiences of Polish system transformation is a low level of trust which leads to a low level of cooperation. The consequence of such behavior in economic life is operating on a protective level of communication. These dependencies are presented on the diagram on fig. 2.

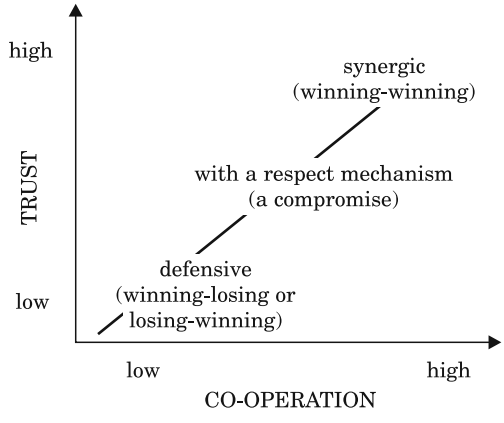


Fig. 2. Dependency of trust and co-operation

Source: Covey (2010)

Defensive level of communication eliminates a synergetic effect resulting from high trust and cooperation. Crossing this barrier is not easy and a methodic proposal was prepared by S.R. Covey. According to the authors, it is a primer for proactive social-economic behavior in our country but this proposal is not enough.

Discussing the results

On the basis of conducted research the authors prepared methodology based on parallel increase of cultural adaptation and technological innovativeness in an industrial enterprise. In the context of communication the language gap was underlined which can be pragmatically called a tool gap because it focuses not on a natural language (mother tongue or a foreign one) but on an artificial language such as computer graphic tools. Traditionally a technical drawing was the main carrier of technical information and from such a form of

presenting a technical project the development of integrated computer systems of CAD/CAM/CAE type started (NIKLAS, ŻRODOWSKI 2012). The present state of the most advanced solutions in processing digital graphics such as CATIA, NX, Pro-Engineer (producers: Dassault Systemes, Siemens PLM Software, Parametric Technology Corporation) offers complete environment to communicate in enterprise. It is not merely a tool to design but to integrate management of the product life cycle in an industrial enterprise regardless the branch and technical education (vocational, technical and engineering). Information gathered during initial research conducted on engineers and technicians supports this thesis.

Undoubtedly the image of a modern enterprise for over 40 years involves its attitude to using information as well as its level. The conceptual assumptions of proposed approach are presented on the figure 3.

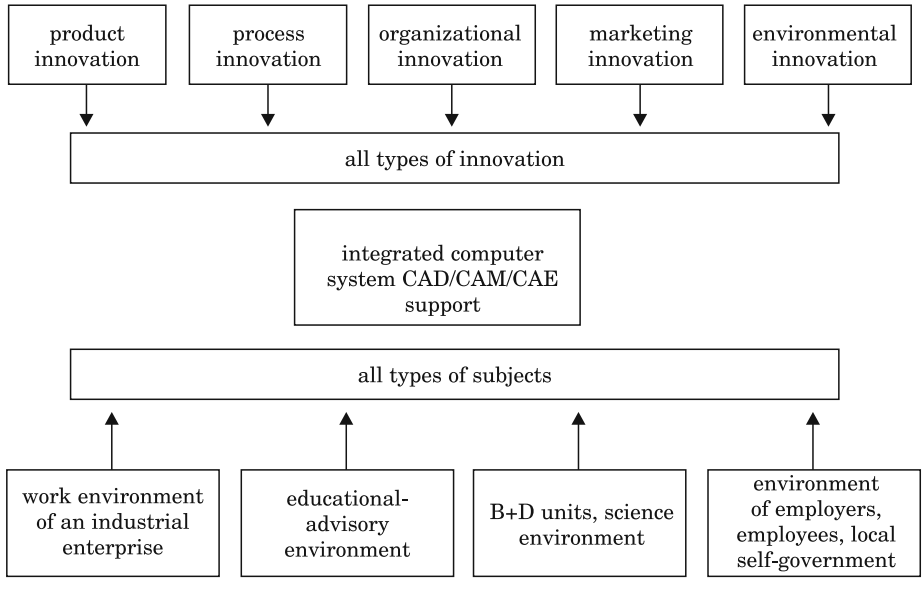


Fig. 3. Conceptual assumptions of tool approach to the transfer of knowledge

The assumptions of approach presented on figure 3 are very simple. All potential subjects of pro-innovative cooperation require mutual language as a platform to communicate. This language cannot, of course, be too difficult and should support all types of innovation. At the beginning of the research the authors, using the „top-down" approach, elaborated the positive verification of UML language (SALA, TAŃSKA 2010b), but unfortunately mainly on the level of organizational innovation. UML language is a tool of software engineering and

in the context system, business and process diagrams constituate a useful graphic language of communication on the decisive level. Between the managers on all levels, during the conceptual cooperation as well as during implementation, exploitation and modernization in the IT system life cycle. Unfortunately UML turned out to be too abstract and not efficient enough for industrial enterprises, especially in reference to communication with the engineering-technical employees during the product innovation. In 11.4% of Polish industrial enterprises the product and process of innovation took place in percentages of all industrial enterprises between 2008–2010. In the developed countries belonging to UE this indicator shapes at the level of 20–30% of all industrial enterprises (GUS 2011).

As a result of „bottom-up" analysis of technicians and engineers it can be ensured, although the research hasn't been completed yet, that the proper platform of cooperation and communication is a graphic language integrated to a computer system of CAD/CAM/CAE type. The verification at workplace realized by the individuals with formal education on the level of a vocational school is planned for the season 2013/2014. The starting point was the diagnosis of gaps in engineers' competences with different areas of specialization in reference to the standard competence of a new profession „Product Engineer". Self-diagnosis was prepared and improved as a part of few research projects (SYMELA 2011). The analysis showed that a narrow atomization of technical specializations is a barrier for the flexibility, effectiveness and innovation in practice. The practitioners experienced by Polish conditions feel like „the prisoners" of traditional divisions and tools. The self-diagnosis and brief introduction to the potential of modern tools and the ways of team cooperation used by tool-advanced industrial enterprises stimulated the imagination and motivated to the development in this direction. Few tests on the level of an engineer were prepared for testing (42 hours), on the level of a technician (24 hours) and on the vocational level (18 hours). Unfortunately, the first stage of research verified only the conceptual assumption of the tool approach toward the transfer of knowledge. Strengthening this initial fascination of engineering-technical workers requires much more work-consuming and consequent method presented on figure 4.

The methodology assumes the realization on two methodic layers, usually weakly integrated in industrial enterprises casually called „soft" and „hard" (or clean and dirty, or white and blue collars or accountable for daily wages and task-piecework or administration and production). These are old divisions and antagonisms which Polish industrial enterprises did not manage to eliminate, even in the case of the most modern „high-tech" enterprises (and such enterprises were studied). On the diagram of methodology (fig. 4) the left side represents main „soft" contingents, and the right one – „hard" ones. In such

a case one can think about an integrated pro-innovative effect in a Polish industrial enterprise if at the same time the increase of cultural adaptation is guaranteed (left side of the diagram) as well as the increase of technological innovation (right side of the diagram). The method of integrating two essential layers can be achieved as a result of realization of central process of team integration by the coordination of design works (workshop).

The diagram of methodology (fig. 4) distinguishes three stages of time dynamics. The boundaries of vertical and horizontal divisions were not graphically presented on the fig.4, to avoid the deterioration of readability of the transfer of integrating relationships. Stage 1 involves the preparation to implement the methodology (in an actual cycle) by preparing few or few dozen leaders of team work, stage 2 is the research part of undertaken projects, stage 3 is a project and documentation part. Methodology has a cyclical character which means it should be repeated. The first cycle can be on the advantage of the theoretical solutions (acquired during trainings) over the practical solutions which serve more to credibility than their utility(similar to the process of creating academic papers but within a team, not in an individual way). Second and following cycles should have more practical character with keeping the correctness of used methods and techniques. More often advisors, consultants and scientists get to know the specific of an enterprise (the change of the direction of the transfer of knowledge). The necessary condition is the publication of the research results of every team, subjecting every work to the process of reviewing by scientists and practitioners as well as public presentations (at least to all teams and all cooperating specialists of the responsible advisory-training-research unit). Unfortunately, the implementation of methodology in 40 enterprises did not obtain the subsidy in a contest organized by PARP and its efficiency is presently studied in a selective way, not in a complex way. It seems that a complex realization of methodology in an industrial enterprise would cause the most spectacular effect in the period from 1 year to 2 years depending on the branch and the size of the enterprise.

Finally the time has come for the attempt of implementing methodology leveling the gaps requiring interactive but not one-directional transfer of innovation. Identification and enlightening of the most essential contingents of pro-innovativeness take places as a result of the verification. The barrier of outside cooperation between an industrial enterprise and symbolically presented advisory-training-research unit is crossed. The need of inner cooperation in an enterprise is stimulated and the ways, methods and techniques (almost approaching a habit) are acquired and strengthen. The communication language necessary to increase the effectiveness of cooperation between engineering-technical positions as well as with other participants of design, production and service processes, that is in all business processes, was accepted, adapted and verified.

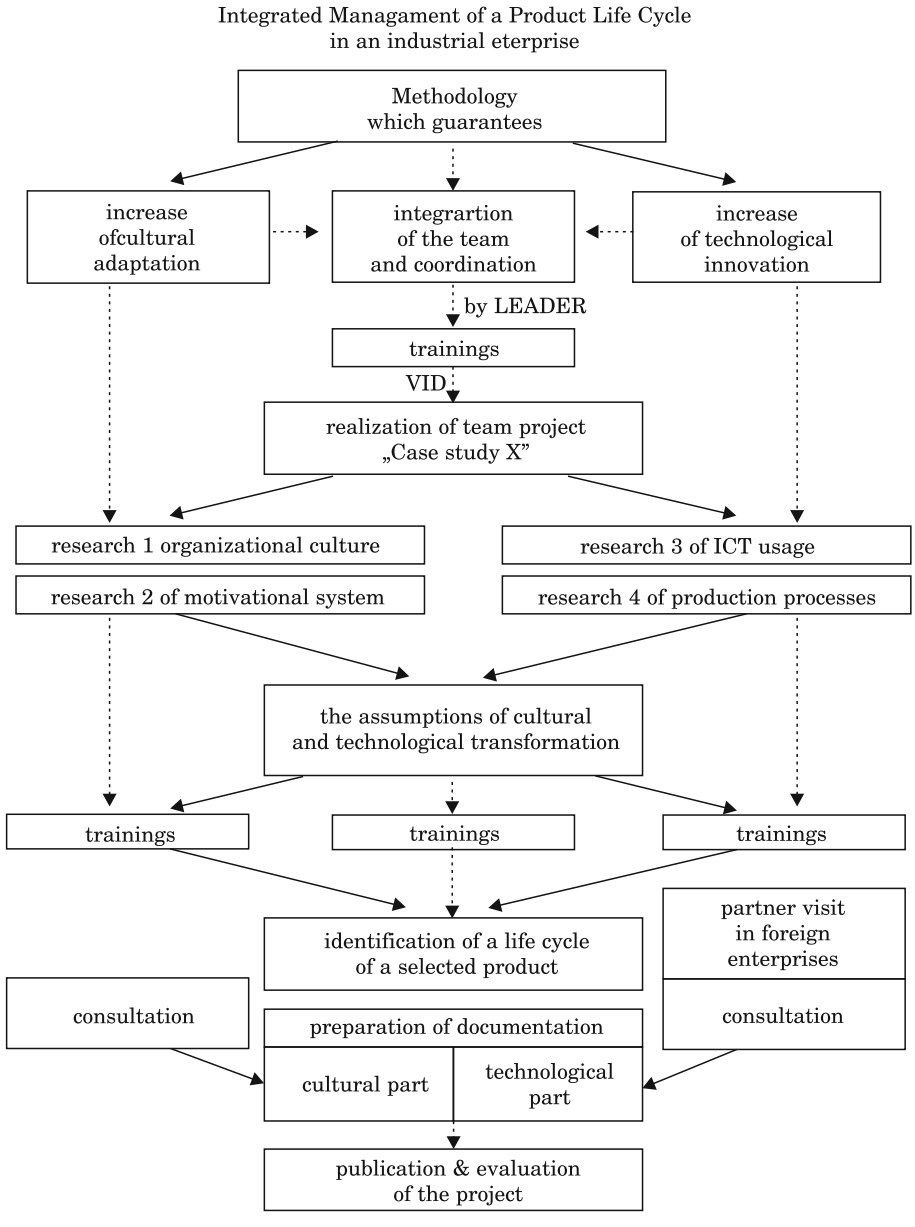
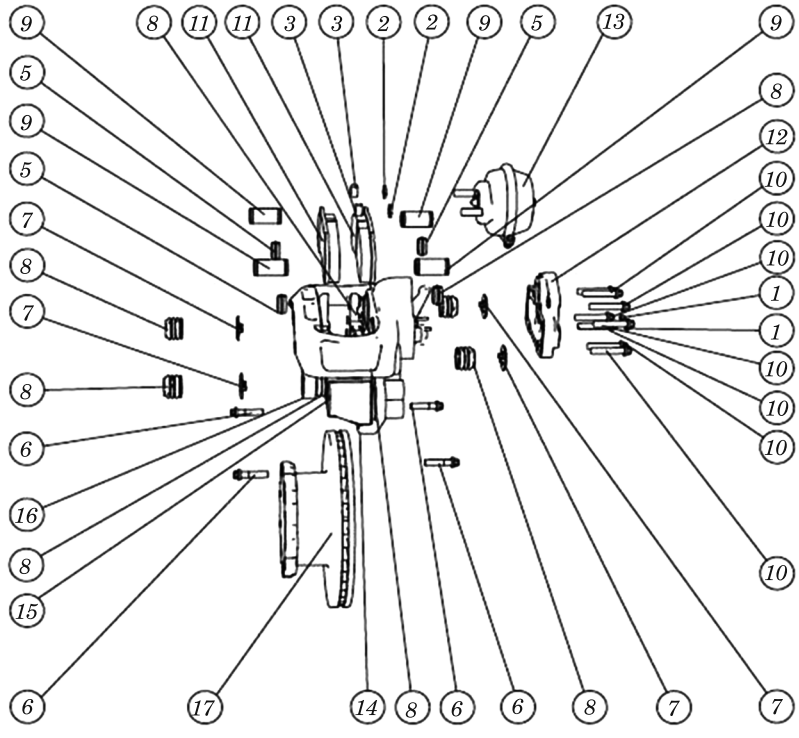


Fig. 4.The methodology of the increase of cultural adaptation and technological innovation in an industrial enterprise

Regarding the above, another task is to make the contingents for the technical information carriers more precise so the document would be useful for all and at the same time the cooperation would become too work-consuming and one-directional. An example of traditional documentation is presented on figure 5.



1	2	E3098150.PRT	*5*	4	E3088158.PRT.	*9*	4	E3088157.PRT.	*13*	1	975334A.PRT.	*17*	1	976030.PRT.			
2	2	WASHER_625.PRT	*6*	4	E3088045.PRT.	*10*	8	E3088028.PRT.	*14*	1	6000415.PRT.						
3	2	NUT62.PRT	*7*	4	E3088165.PRT.	*11*	2	6000414.PRT.	*15*	1	E3088020.PRT.						
4	2	E3088037.PRT	*8*	9	E3088159.PRT.	*12*	1	E3088273.PRT.	*16*	1	E3088271.PRT.						

Fig. 5. Traditional documentation of component details and product installation
Source: NIKLAS, ŻRODOWSKI (2012)

Undoubtedly the knowledge on technical information carriers is very crucial and connected with precise contingents but simplifying it involves the necessity of introducing a three-dimensional and animated documents, an example of which is presented on fig. 6. Such a document can be read by using universal and free browsers (e.g. Adobe Viewer), to which, with the document itself, an additional tool stripe regarding animated operations is downloaded as well (fig. 7).

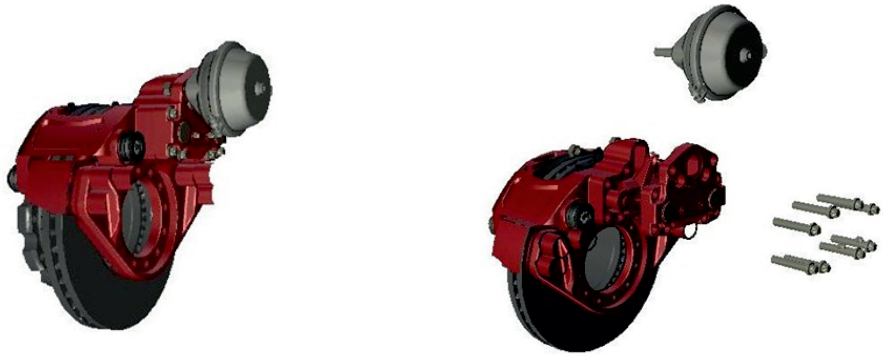


Fig. 6. Three-dimensional and animated operation of an electronic document of a product and its installation from fig. 5 (stages and component details) in a PDF format started
Source: NIKLAS, ŻRODOWSKI (2012).

Figure 7 presents the two toolbars – top bar applies animated PDF document and toolbars at the bottom of the drawing on an animated document in DOC/JT. Toolbars ensure that each 3D object (model, product) can be rotated and enlarged, it can be viewed by the structure (tree) model from different perspectives and with different types of light. In this way, anyone can read the information relevant to the professional activity and its role in the team or process (from design through production, operation, and visualization, promotion and sales).

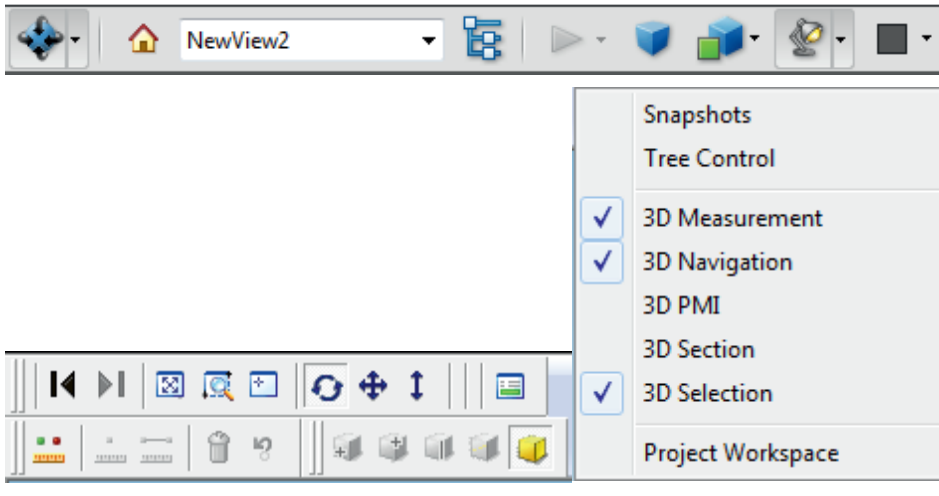


Fig. 7. Toolbars for animated electronic technical document in PDF format (top) and DOC/JT (bottom)

Of course, what is important and unique is the organization of the flow of documentation for individual files (such as PDFs in Figure 5–7) to the group of specific arrangements.

Conclusion

In the summary of reflections concerning authors' proposals for Polish industrial enterprises of the first decade of the 21st century it is worth underlining that an enterprise cannot be innovatively active or innovative among other things without: objective identification (self-reflection of the employees and employers), the state of activeness and, as a result, without credible and advanced ICT usage as well as using effective methods and the ability to cooperate.

References

CHYBA Z. 2011. *Perspektywy i bariery rozwoju małych i średnich przedsiębiorstw akademickich*. In: *Wspomaganie i finansowanie rozwoju małych i średnich przedsiębiorstw*. Ed. M. Matejun. Difin, Warszawa.

COVEY R.S. 2010. *The 7 Habits of Highly Effective People*. Franklin Covey Company.

DURLIK I. 1993. *Inżynieria zarządzania*. Cz. I. *Strategie organizacji produkcji nowe koncepcje zarządzania*. Placet, Gdańsk.

GUS. 2011. *Innovative activity of enterprises in 2008–2010*. 2011. CSO in Szczecin, Warszawa.

JASIŃSKI A.H. 2011, *Zarządzanie wynikami badań naukowych. Poradnik dla inwestorów*. Wydawnictwo Naukowe ITE – PIB, Warszawa – Radom.

NIKLAS K., ŻRODOWSKI C. 2012. *Wprowadzenie do zintegrowanych systemów komputerowych CAD/CAM/CAE. Kompendium wiedzy – poziom inżynierski*. Partnerstwo „Droga do doskonałości zawodowej", EFS PO KL, OM NSZZ „Solidarność" Stoczni Gdańskiej, Gdańsk.

OLEŃSKI J. 2000. *Elementy ekonomiki informacji*. Katedra Informatyki Gospodarczej i Analiz Ekonomicznych. Wydział Nauk Ekonomicznych. Uniwersytet Warszawski, Warszawa.

Studium przypadku. Model Transferu Wiedzy Narzędziowej. Case study 4 instytucjonalny. 2012. Załącznik 2 do strategii wdrażania projektu innowacyjnego testującego „Droga do doskonałości zawodowej", EFS PO KL, OM NSZZ „Solidarność" Stoczni Gdańskiej, Gdańsk.

SALA J., TAŃSKA H. 2010a. *An illusion of development and technological decline in Poland*. In: *eCommerce, Epayments and New Enterpreneurship*. Eds. B.F. Kubiak, A. Korowiecki. Journal of Internet, Banking and Commerce, Array Development, Ottawa.

SALA J., TAŃSKA H. 2010b. *Interdyscyplinarne i multiorganizacyjne modelowanie procesów na rzecz rozwoju przedsiębiorstwa sieciowego*. InfoGlob, Sopot.

SALA J., TAŃSKA H. 2011. *The modelling of information processes – cybernetic approach*. In.: *Information Management*. Eds. B.F. Kubiak, A. Korowiecki. Prace i Materiały Wydziału Zarządzania Uniwersytetu Gdańskiego, 3, Fundacja Rozwoju Uniwersytetu Gdańskiego, Gdańsk.

SALA J., TAŃSKA H. 2013a. *Information management in Polish industry. Diagnosis of the transformation results*. Journal of Management and Finance, 3.

SALA J., TAŃSKA H. 2013b. *Rozwiązania instytucjonalne na rzecz transferu wiedzy i kompetencji*. In: *Organizacja i zarządzanie*. Ed. J. Lewandowski. Politechnika Łódzka, Łódź.

SYMELA K. 2011. *System monitoringu i ewaluacji kompetencji pracowników*, Państwowy Instytut Badawczy, Radom, on line: www.diagnozowaniekompetencji.pl

Zarządzanie wynikami badań naukowych. Poradnik dla innowatorów. 2011. Ed. A.H. Jasiński. Wydawnictwo Naukowe ITE – PIB, Warszawa – Radom.