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THE ANALYSIS OF OPPORTUNITIES TO USE THE LEAN IT CONCEPT IN MODERN ENTERPRISE

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Abstract: The article concerns the nature of the application of the lean IT conception to optimize business processes and organization's IT infrastructure. The development of the lean manufacturing conception and its real positive impact on the functioning of the company became the justification for the implementation of the lean principles and tools to all areas of the organizations including software engineering and information technology. The dynamic development of IT becomes both reason and opportunity for effective elimination of waste emerging in business processes. Analysis of trends and directions of IT development allow to advance a thesis that the rationalization and optimization of IT processes using the tools and techniques of lean IT will be a priority issue for the coming years. The developed lean implementation model leads to increased application productivity, reduced defects and shortened solutions delivery time.

Key words: lean management, lean IT, optimization, management, information technology

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Introduction

Euroregions The growing need to reduce and rationalize the cost of business operations becomes determinant in the implementation of *lean* concept to areas that have not previously been associated with the place of origin of value for the customer. Rationalization of business processes is implemented in areas including: *lean accounting*, *lean logistic*s, *lean project management*, as well as *lean software development* and IT – *lean* IT. *Lean* IT is defined as a concept of a transfer of principles and tools used in *lean manufacturing* to the orderly IT space system. *Lean* IT is an extension of *lean manufacturing* and *lean services* rules to a new organizational space, and its key aspect is to eliminate waste from IT processes (Kobus, 2016). *Lean* IT is a part of the organizational culture focused on continuous improvement, and its foundation has been provided in the publication titled "*Lean IT: Enabling and Sustaining Your Lean Transformation*" by Bell and Orzen, who defined it as a *"system, which links people using lean principles and tools, focused on the integration of the IT organization with business processes to ensure high quality, efficient information systems"* (Bell and Orzen, 2011).

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Research on IT priorities conducted by Deloitte in 2014 shows that *lean* IT solutions have been a high priority for 13% of leaders of IT departments in Poland for 12 – 18 months, and average for another 40%. These same research shows that the priorities in the global markets are: responding to changing business needs (71%), implementation of new technologies (47%), IT cost reduction/optimization (35%), and the reorganization of the IT operational model (34%) (IT-manager, 2016b).

The aim of the article is to analyze the possibility of use of *lean* concept by companies in the area of information technology, which is a part of a global trend to rationalize the business processes. When analyzing the available sources, it must be concluded that although *lean* IT in the United States and Western Europe is a widely used and rapidly growing concept, it is not yet widespread in Poland, and "*lean*" is still identified with the value for the customer realized in the production process. As noted by Florys (2014 and 2016), the following companies in the automotive industry are the leaders in the implementation of lean management in Poland: General Motors, Scania and Delphi, joined by Siemens, Philip Morris, IKEA, 3M, and others. This shows that the manufacturing companies prevail in the implementation, and *lean* used in the service industry in Poland is only being initiated (Florys, 2014).

Implementation of the Principles and Tools of Lean Management in the IT Area of a Company

Effective building of competitive advantage of a modern enterprise is inextricably linked with information management, and in the era of rapidly developing IT infrastructure, there is growing importance of technology and IT areas. At the same time, the managers who manage companies are faced with a permanent necessity to reduce operating costs, and thus the costs allocated to IT in a broad sense. Particular attention should be paid to transposing of *lean manufacturing* principles, methods and tools from the production to IT areas where the key task is to reduce waste and improve the efficiency of processes by:

- Identification of IT customers,
- Analysis of opinions, expectations, suggestions (*voice of the customer*),
- Defining the value for the customer,
- Value stream mapping,
- Analysis of waste present in processes,
- The use of *lean* tools and techniques to ensure a continuous flow in processes and the elimination of unfinished tasks,
- Building of a pull system controlled by the customer,
- The use of *lean* tools and techniques for continuous improvement of processes and process participants (CT Partners, 2016).

The transformation methods for IT area management shown in Figure 1 affects all aspects from a paradigm shift in the use of infrastructure and technology to Key

Performance Indicators (KPIs) used to measure the actual performance of business processes. The key to identify the innovation is the comparison of the result of the final IT process to the finished product of the manufacturing process. One can therefore find a reference of this approach to the application of lean manufacturing theory in computer models of simulation (Ferrarm et al., 2016).

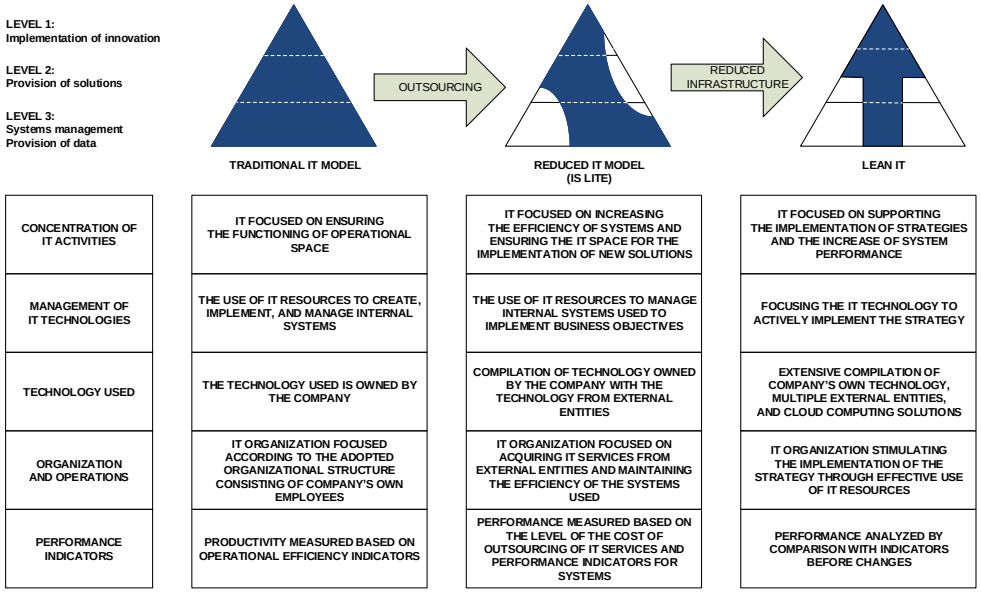

Figure 1. Transformation of the IT area management methods *(McDonald, 2010)*

Bell and Orzen indicate that it is not sufficient to use *lean* tools in the IT area in order to define the organization as the one operating in a *lean* culture. It is necessary to consciously build structures based on *lean* principles, supported by dedicated techniques and tools, which bring about permanent changes in addition to short-term efficiency improvement (see Figure 2) (Bell and Orzen, 2011).

The policies of the enterprise based on *lean* are built on a foundation that Bell and Orzen described as: steadiness of goals, respect for people and the constant pursuit of perfection. Only the approach which is proactive in taking the initiative assumes: personal responsibility for the quality of business processes, shaping the work environment and allowing for permanent implementation of innovation in the IT area. Bell and Orzen demonstrate the objective superiority of the approach of an evolutionary change in processes over single corrective actions in the moments of crisis. The basic principles of *lean* IT approach also include those typical to *lean manufacturing*: *voice of the customer*, *at the Source*, and *Systems Thinking*. The consistent focus on customer needs: a study of their preferences, expectations, undesirable aspects, is the core of *lean* approach aimed at achieving specific, measurable results, such as the increase in the efficiency of business processes by eliminating waste.

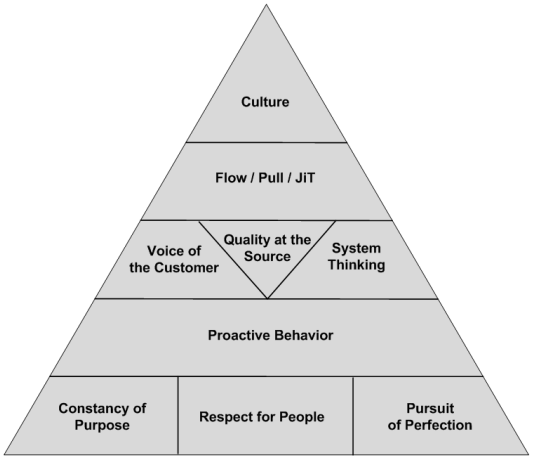

Figure 2. Principles of the company on the lean IT concept
(Bell and Orzen, 2011)

It helps to achieve this if we include the quality in the process according to the *First Time Quality* method, which enables the detection of errors and problems at the conceptual and design stage, reducing the cost arose in the subsequent processes, which are the inevitable consequence of unforeseen defects in the process. The *lean* IT principles are supplemented at this level by the systemic approach, which forces the treatment of the organization as a structure based on a variety of inputs and outputs and processes taking place there, which when managed lead to the efficient and effective implementation of the objectives of the company. *Flow*, *pull*, and *Just in Time* are principles typical to the *lean manufacturing* concept, determined by the improvement of the flow of products and information, from order through production process and service provision to the acceptance both by external and internal customers. Interference in the processes eliminated in this way has a direct impact on: improving quality, shortening lead time, improving the evaluation of customer service, reducing inventory and improvement of financial liquidity. The organizational culture is a superior principle in *lean* IT and includes the amplification of behavior striving for continuous improvement (jap. *Kaizen*), in order to achieve high operational efficiency, which is the foundation for achievement and maintaining a competitive advantage through a solid foundations, innovation and continuous learning (Bell and Orzen, 2011). In order to achieve the objectives related to reducing waste in the IT area, *lean* IT offers a broad range of tools, enabling the identification of non-value added processes, analysis of problems, their causes, remedies, implementation of improvements in the processes and continuous monitoring of indicators. At the same time, the practitioners of *lean* IT implementation suggest the use of one or more tools and focusing on building the organizational culture in the early phase of implementation. It is a much more effective approach than using multiple tools simultaneously, which can have negative effects such as a reluctance

to make changes in the organization and expand waste rather than alleviate it. The key to the process efficiency and thus the implementation of the assumed company's strategy is the implementation of a permanent change, for which the use of tools is not an end in itself, and only a way to achieve the superior goal. Specific tools for the *lean* concept in the IT area include: A3 report, VSM, *Kaizen*, *kaikaku*, standardized work, 5S, visual management, *Kano* model, and SIPOC (Bell and Orzen, 2011). The implementation of *lean* principles and tools in the IT area in enterprises becomes a noticeable trend in response to the changing economic situation in the IT area and emerging new IT technologies.

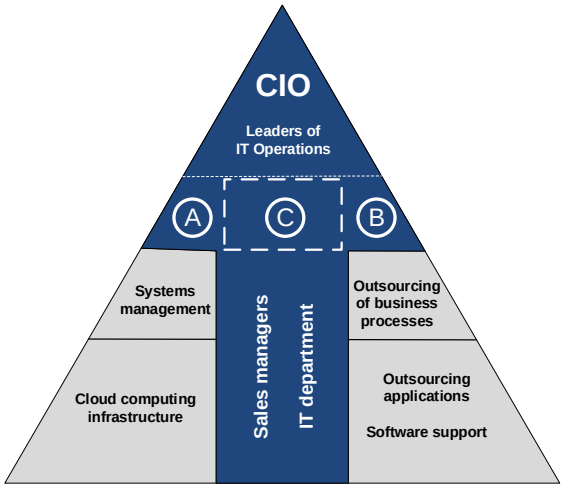

Figure 3. The structure of tasks and competences of employees of IT departments *(Heunks, 2016)*

Along with the change of the role that IT department is to perform in a modified organizational structure, the range of tasks and competences of employees also changes. Figure 3 shows the revised structure of tasks and competences of IT staff from the operating system maintenance and the use of infrastructure (A), through the participation in processes of shaping the IT area and the implementation of the company's strategy (B), to use of agile methods in management in line with the Agile Manifesto (C). The increase in the role of the IT department as a key to the effective implementation of the company's objectives becomes noticeable. In this aspect, *lean* IT also refers to the knowledge and skills of IT staff, who should be involved in the implementation of innovative solutions in the shortest possible time, always in the spirit and culture of *lean*. As pointed out by Florys: *"lean IT is not only thinning and savings, but above all, looking for the potential of the organization and IT resources. According to the lean IT concept, one should challenge any usual procedure, discuss, analyze, select the issues and experiment"* (Florys, 2014). Thus, the dynamic change in the structure of tasks and competences of IT professionals is noticeable, and the real responsibility for implementing the

company's business strategy increases with the increase of their role in the organization.

The Use of the Cloud Computing Model to Reduce the Operating Costs of IT Infrastucture

Cloud computing is undoubtedly one of the key technologies in the context of the implementation of the *lean IT* concept. This technology, also known as cloud computing, refers to the use of extensive IT services available on-line by organizations (GUS, 2017). According to a study by Eurostat differences between countries operating in the EU are significant. The leaders include companies from Finland 66% (57% in 2016), Denmark 51% (42% in 2016) and Norway 48% (40% in 2016), while at the end there are businesses from Poland 10% (8% in 2016), Latvia 12% (8% in 2016), and Romania 11% (7% in 2016) (Eurostat, 2017). At the same time, there are also significant differences between the groups of companies ordered by their size. In the case of Polish companies, the use of *cloud computing* model is at the level of 7.6% (6.3% in 2016) (for small companies), 17.2% (13.1% in 2016) (for medium-sized companies) and 37.1% (31.1% in 2016) for large companies (GUS, 2017). The growing interest in "cloud-based" solutions is related mainly to such aspects as (Dwyer, 2015; RightScale, 2016; Wielki, 2015a):

- Increasing capacity and reliability of Internet connections,
- The development of Internet services and increase their availability,
- IT commoditization processes,
- Decreasing concerns about the security of *cloud computing.*

There are a number of benefits associated with the use of this technology. The most important include: greater flexibility and operational efficiency, lower costs and a higher level of security associated with a different philosophy of its provision (Archer and Burg, 2016; Clutch, 2016; GUS, 2017). As various studies have shown for many years, a large part of the costs spent by organizations on IT is wasted. On one hand, it is related to partial, and sometimes fragmented use of the capabilities offered by the IT infrastructure of enterprises, and on the other hand, low efficiency of the use of software they own. In both areas, "cloud" solutions offer a whole range of possibilities to improve this state in terms of cost. As for the physical IT infrastructure, the most important include (Wielki, 2015):

- The reduction or elimination of waste related the level of use of the purchased equipment,
- The reduction of cost associated with maintaining the equipment,
- The reduction of cost associated with the consumption of electricity (this mainly concerns large companies),
- The possibilities of ongoing cost analysis and the selection of the optimal level of service performance.

The model for the delivery of "cloud" services in the context of the physical infrastructure is infrastructure-as-a-service (IaaS), in which the organization uses

the equipment of the service provider, such as servers, disk space or network infrastructure, and the provider is responsible for its maintenance and the efficient and reliable operation. As for the software used in the *cloud computing* model in this area may be a source of reducing or eliminating the costs associated with (Wielki, 2015):

- Purchase and installation of software and its maintenance,
- Acquisition of improper software,
- Low level of use of the software,
- Development and testing of applications.

Two basic models of provision of "cloud" services are used in the context of software, i.e. *software-as-a-service* (SaaS) and *platform-as-a-service* (PaaS). In the first case, the company uses the application via the Internet, and the company that provides it ensures the continuity of its operations, provides security and is responsible for the development and adaptation of functionality to the user's needs. However, in the case of the second model, the environment is offered that enables the creation, development and testing of company's own applications. At the same time, the companies reaching for the *cloud computing* model can use three basic types of "clouds", i.e. public, private, and hybrid clouds. In the case of public "clouds", the service provider provides users with open access to resources, such as computing power of servers, data storage, network infrastructure or the use of different types of *on-line* applications. Private "clouds" operate within the corporate network, and their resources are only used by users at the organization. Hybrid "clouds" combine the features of the two previous types. They remain separate entities, but they are related by the respective technical solutions enabling the mobility of applications and data (Wielki, 2018).

Undoubtedly, organizations can achieve the greatest cost benefits by using the public "clouds". As shown in the results of research conducted by RightScale, although a large portion of the surveyed companies use the public "cloud", the dynamics of growth in this area is relatively small. This percentage was 88% in 2015 and 89% in 2016. The biggest growth has been recorded in the development of private "clouds" (63% - 2015, 77% - 2016). At the same time the increase in use of hybrid "clouds" by companies should be noted (58% - 2015 71% - 2016) (RightScale, 2016).

The growing popularity of the latter is undoubtedly related to such aspects as moving the ERP systems which are of key importance for the organization to the "cloud", which results from a much lower cost of ownership of such solutions. In this context, the growing attractiveness of hybrid systems related to the fact that some processes, particularly the key ones, will be implemented within the framework of the internal infrastructure of companies, and part in the "cloud" or SaaS model for a long time due to investments in traditional (on-premise) solutions made earlier. This is one of the reasons why Cisco forecasts the largest increase in total cloud workload in relation to this particular model. It shall amount to 74% in 2020 compared to 65% in 2015 (Cisco ,2016).

Analysis of the Relationship of Costs to the Potential Benefits of the Implementation of Lean IT Concept in an Enterprise

Lean IT concept is gaining popularity and is part of the current IT trends thanks to the real benefits gained by companies implementing the principles and practical solutions. The most important benefits include:

- The capability to respond voice of the Customer and the determination of the value for which customers are willing to pay,
- The capability to identify the activities which add value and which do not (*Value Stream Mapping*),
- The achievement of continuous improvement of processes and the growth of real commitment to streamlining of actions,
- The capability to measure value by linking operational objectives with the real customer needs (*Critical to Quality Tree*),
- The capability to measure the Operational Business Process Efficiency,
- Engaging all employees and the external environment (suppliers and customers) in the improvement of business processes,
- Standardization of processes, operations and activities,
- Shortening the lead times,
- Real reduction of IT inventory and the increase of process productivity by transposing spare capacity to the point of real value creation,
- Reduction in the operating and administrative expenses,
- Shortening the time between the emergence of the project concept and the start of its implementation (Spencer, 2008).

The report by McKinsey & Company shows that in 50 deployments in data centers, there has been an increase in efficiency through such things as the reduction of mean time to restore services after system failure by 50 - 80%, and compliance with established *service level agreement* increased by as much as 10%. Efficiency in the maintenance and development of applications has increased from 15 to 25%, and time-to-market for services was reduced by 25%. According to McKinsey, the implementation of *lean* involving the introduction of changes to the IT infrastructure and the development of standards of conduct can be carried out within 16 to 24 weeks (Szafrański, 2014). Improper implementation of *lean* concept in all areas of the company, including IT, carries a risk of exposure the organization to high costs associated both with the implementation, and the consequences of changes in the focus of business activities. To minimize the negative phenomena arising during the implementation of *lean* IT solutions, it is recommended to conduct a thorough pre-implementation analysis, the aim of which is to determine the critical success factors (*CSF*), enabling evaluation of *lean* IT implementation.

One should also clearly define the purpose of the implementation of *lean* solutions, not as actions aimed at reducing the operating costs, but as solutions to eliminate waste from IT processes. Although the reduction of waste is closely related to the

reduction in costs, only such an emphasis could bring about the expected evaluation of the effects of implementation (Jadhav et al., 2014). Although the scope of *lean* IT implementation may vary depending on the individual preferences of the enterprise, the effective implementation in the organizational space depends on a comprehensive acceptance of values, principles, and tools. Successful implementation of changes in the IT departments in line with the *lean* concept depends on the awareness of the effects of the transformation of the management of the IT area at the enterprise and its impact on the whole business space and the implemented strategy. The proposed model of *lean* IT concept implementation shown in Figure 4 presents a comprehensive scheme of implementation based on the DMAIC methodology. The organizational space has been divided into three levels: *Lean Philosophy*, *Applying Lean to Business*, and *Transformation to Lean Organization*, and each contains specific implementation steps. Only the focus on all organizational areas enables to maximize the benefits of implementing the *lean* IT concept.

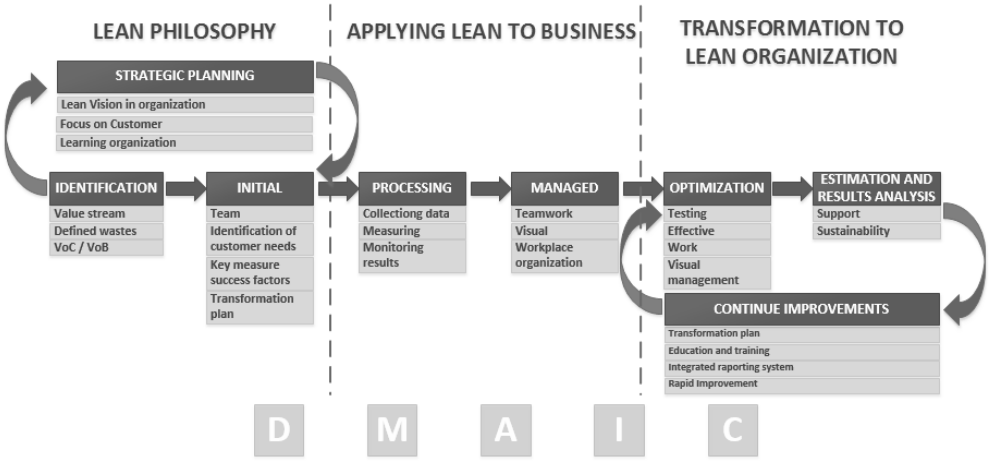

Figure 4. The model of the lean IT concept implementation

An innovative approach to IT infrastructure management resulting in limiting the number of IT projects in progress, the implementation of project management, embedding mechanisms to improve the processes and the use of process performance indicators in IT, provides a new look at the role of the IT department focused on ensuring operational efficiency, to focus on the optimization of processes. A comprehensive approach in line with the *lean* IT concept, including continued improvements and results analysis, releases significant organizational resources committed in maintaining operational efficiency and brings about greater effects than the widespread use of IT outsourcing.

Review of Trends in the Development of the Lean IT Concept

Rapid development and the capability to use the existing infrastructure elements for new functions is a characteristic feature of information technologies. Widespread computerization of businesses entails the development of new trends in the IT area. They include: *Internet of Things*, *Digital Manufacturing*, *Smart Manufacturing*, *Machine Learning*, *Demand Driven Supply Network* or Cloud Computing analyzed earlier. A component of each of these trends is *lean* IT, whose development and dissemination becomes a natural consequence of changes in the economics of information and the needs related to the rationalization of IT infrastructure costs. The report by IDC shows that businesses spending on information technology solutions in 2020 will amount to 2.7 trillion dollars. Apart from the medical industry, which is a leader in investment in IT, will IT spending will also increase in manufacturing companies and financial institutions at a rate of 4.7% per annum, reaching 475 billion dollars in 2020 (IT-manager, 2016a).

When it comes to Internet Things (IoT), the term should be understood as "sensors and actuators embedded in machines and other physical facilities, which have been used for data collection, remote monitoring, decision-making processes optimization in all areas from production, through infrastructure to health care" (Dobbs et al., 2015). The research published by Rockwell Automation shows that 84% of managers believe that the Internet of Things will create new sources of revenue for their business, and 46% noted an increase in productivity as the main benefit of IoT. The analysis by Cisco shows that the number of objects connected to the network will grow from 8.7 billion (1%) 50 billion (5.8%), and about 4 billion people will use the Internet in 2020 (ITU, 2015).

Digital Manufacturing is a consequence of, among others, design for manufacturing (*DFM*), computer-integrated manufacturing (CIM), and *lean manufacturing* and is defined as *"the focal point of the integration of product lifecycle management process with devices and applications running on the production floor*". Digital manufacturing provides advanced tools enabling the efficient management of production space and its transformation at the stage of design and planning. The idea of Smart Manufacturing or Smart Factory involves the transformation of a typical production process in the comprehensive meeting of individual customer needs by quick and fully automatic adaptation of measures and processes to continuous changes, combining different production spaces of enterprises in intelligent networks capable of independent optimization. The term Industry 4.0 is also used in this context (Wielki, 2016).

The development of computerized production systems, recognition of images and sounds, intelligent data compression systems and the progress in the construction of man - machine cooperation systems leads to the development of machine learning. In the framework of common *lean* IT and *Machine Learning* there is a new trend, i.e. cognitive computing, representing all activities leading to autonomy and automation of the work of IT resources, which coordinate the operations, providing the company with relevant data and affecting the

implemented strategy and operational activities. Intelligent solutions and machine learning allow the prediction business phenomena much more accurately than in the past, thereby creating a real tool to gain competitive advantage.
Making deliveries while minimizing inventory levels, the improvement of the accuracy of demand forecasts and flexible impact on the dynamic changes in demand necessitate the creation of Demand Driven Supply Network (DDSN) in enterprises that is carried out through integrated IT solutions. DDSN is based on the *lean* philosophy, the essence of which is to provide the products in the *pull* system. Moving away from the typical pulling production (*push* system) is designed to reduce costs, inventory, and manufacturing on dedicated orders in smaller production batches. Construction of DDSN is a process inspired by getting the customer closer to the manufacturer by shortening the path of information flow and the product for which there is a demand.
Lean IT is an effective complement to many methodologies such as: Agile software development — Scrum structure, Six sigma, CMMI model – *Capability Maturity Model Integration*, USMBOK (*Universal Service Management Body of Knowledge*), ITIL Code, COBIT (*Control Objectives for Information and related Technology*) standard, *TenStep*, *Prince2* methodology etc. (Szafrański, 2014). At its core, the *lean* IT concept provides a number of tools for clear identification of waste in business processes.

Conclusion

The expansive development of information technologies in all areas of the economy stimulates the formation of new, previously unknown possibilities of creating and running a business. The development of electronic markets, widespread computerization and automation provide new spaces for the possible use of IT solutions. At the same time, the relatively easy availability of these means makes competition more dynamic, which requires a constant rationalization of business processes, from the production to IT ones. The comprehensive use of information technology to optimize processes is common, and now a reversed trend is discernible, i.e. optimization tools implemented to the organization's IT areas. Lean IT is therefore a set of field-proven, structured tools, methods, and rules of conduct, whose primary objective is to eliminate of shown and hidden waste from IT processes. The key aspect in the context of accomplishing this task is reorientation of functioning of IT departments from maintaining operational efficiency to realization of companies' strategy and optimization of solutions been used. The article should become the starting point for detailed research on the tangible effects of the implementation of Lean IT solutions in a company. It is a fact that the published research has shown that basic IT activities, such as regular review and change of IT resource access competencies, can shorten these processes from as long as 8 days to about 15 minutes. The McKinsey & Company report shows that the implementation of Lean IT principles has reduced the error rate in documents by 75% and shortened the reporting time by 25%. The development of

information technologies and their growing contribution to the strategy of enterprises entails the need to rationalize the use of organizational resources, and by analyzing the global economics of the organization, it may be assumed that the need to implement the concept of lean IT in the coming years will grow dynamically.

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ANALIZA MOŻLIWOŚCI WYKORZYSTANIA KONCEPCJI LEAN IT WE WSPÓŁCZESNYCH PRZEDSIĘBIORSTWACH

Streszczenie: Artykuł poświęcony jest analizie możliwości wykorzystania koncepcji *lean* IT do celów optymalizacji procesów biznesowych i infrastruktury informatycznej organizacji. Rozwój koncepcji *lean manufacturing* oraz jej realnie pozytywny wpływ na funkcjonowanie przedsiębiorstw stał się uzasadnieniem implementacji zasad i narzędzi *lean* do wszystkich obszarów działalności organizacji, w tym inżynierii oprogramowania i technologii informatycznych. Dynamiczny rozwój IT staje się równolegle motywem i szansą na realnie skuteczną eliminację powstających

w procesach biznesowych marnotrawstw. Analiza trendów oraz kierunków rozwoju IT pozwala wysunąć tezę, iż racjonalizacja i optymalizacja procesów informatycznych z wykorzystaniem technik i narzędzi *lean* będzie priorytetowym zagadnieniem na najbliższe lata. Opracowany model wdrażania koncepcji lean prowadzi do zwiększenia produktywności aplikacji, zmniejszenia błędów oraz skrócenia czasu dostawy rozwiązania.
Słowa kluczowe: zarządzanie, technologie informatyczne, lean management, lean IT

现代企业利用精益理念的机遇分析

摘要:本文涉及精益IT概念应用的性质，以优化业务流程和组织的IT基础架构。精益生产概念的发展及其对公司运作的真正积极影响成为向组织的所有领域（包括软件工程和信息技术）实施精益原则和工具的理由。IT的动态发展成为有效消除业务流程中出现的浪费的理由和机会。分析IT开发的趋势和方向可以推动一个论点，即使用精益IT工具和技术合理化和优化IT流程将成为未来几年的优先问题。开发的精益实施模型可提高应用程序生产率，减少缺陷并缩短解决方案交付时间。
关键词:精益管理，精益IT，优化，管理，信息技术