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UDK 338.1(497.5)
Izvorni znanstveni članak

PORT COMMUNITY SYSTEMS - ECONOMIC FEASIBILITY EVALUATION

Abstract

Port Community Systems are complex Information-Communication Technology systems, and such systems should be carefully evaluated in order to determine potential and real monetary benefits which can be derived from their implementation. These benefits can be quantitative or qualitative in nature (subjective). The quantitative benefits can be evaluated in terms of classic project management methodology and financial indicators and methods, while qualitative benefits are best suited to be exploited through strategic analysis. Careful consideration is needed during the analysis, in order to avoid biased input parameters which could obscure the end result. The paper researches Port Community System investment priorities and evaluation, analyzes the prioritization of Port Community System internal subprojects, and investigates risks in Port Community System implementation, based on cost-benefit analysis, return on management and value added analysis.

Keywords

Port Community Systems, economic feasibility, ICT investments, risk analysis

1. Introduction

Investments into seaport Information-Communication Technology (ICT) systems are competing with more traditional seaport investments, which are more readily understandable to Port Community members, investors and the Port Community management. In case of seaports, those more traditional investments typically include storage and transport facilities, and communication equipment. The issue with ICT systems is: they provide a foundation for execution of core business activities, and their outputs are embedded into the outputs of core activities. Therefore, evaluation of return on investment of ICT systems is sometimes obscured and difficult to quantify. In other cases, benefits derived from the introduction of new technologies also have a non-monetary impact, while in the seaport ICT systems scenario, the end result of the new ICT developments and projects should have a clear financial impact on all stakeholders – Port Community members.

In order to evaluate the feasibility of investments into new seaport ICT infrastructure, it is important to distinguish what are the exact benefits of

new investments. Besides the direct investments, it is necessary to anticipate all future investments, and direct and indirect running costs related to newly introduced functionalities. Setting up a plan and evaluation of future investments is one of the most important tasks of strategic ICT management. Definition of strategy is only the beginning and the foundation needed to achieve the results set in the strategy.

Several issues should be addressed in order to reach decisions and to manage seaport ICT investments. This will be achieved by providing answers to the following questions surrounding the introduction of seaport ICT systems:

1. How to measure economic feasibility of seaport ICT investments?
2. How to set proper and measurable priorities in regard to economic and non-economic benefits to the Port Community members derived from new seaport ICT systems?
3. How to establish the follow-up of the goal reaching process?
4. How to evaluate the investment risk of seaport ICT systems?

Evaluation of the past research in this area shows that almost three decades ago, pioneers in the USA have determined the need for a systematic approach by regulatory authorities in order to to improve coordination in port systems[1]. Research of e-business development in the world's leading container ports has lead to the conclusion that in order to succeed and to achieve the best possible quality of port services, access to accurate information, achieved by applying information technologies, is a competitive advantage factor[2]. According to another research, the use of electronic documents in the field of transportation (compared to conventional "paper" documents) can yield financial savings of 38.79% in document flow, leading to possible savings from 0,81% to 1.41% of gross national income[3]. Finally, by investigating the usage of application software for tracking and monitoring of containers and cargo plans, it has been shown that in order to increase efficiency and safety and to reduce possible errors, it is necessary to introduce integral IT systems in seaports, with appropriate, well-suited software packages[4]. All past research in this area shows that the proper alignment of integral e-business system with the set goals and expectations of stakeholdes is a key determinant in the feasibility of to-be introduced seaport ICT systems.

2. PCS investment priorities

Port Community Systems (PCS) are complex logical and organizational systems built in order to integrate and coordinate the execution of business activities in large ports and their surroundings[5]. They are created in order to concentrate, centralize, serve and optimize business processes within port communities[6]. They are represented by holistic, geographically bound information hubs in global supply chains that primarily serve the interest of a heterogeneous collective of port related companies[7]. Port Community Systems include various organizational solutions, blueprints, applications and hardware. They respond to the need to focus on maximizing physical infrastructure and are managing the efficiency of the port operation as a whole.[8].

Typically, the development and introduction of a new PCS is a very complex task, distributed over a number of involved parties with partial interests in the PCS functioning. It calls for prioritization of internal PCS projects: it is close to impossible to ensure quality when introducing all PCS functionalities at once. Prudent model of ICT management would require that the PCS is described in details and divided into sub projects. Sub projects should be ranked by different criteria, most important of which are logical placement into PCS development

1 Fleming, D. K.: The port community: an American view. Maritime Policy & Management, 14: 4, 321-336, 1987
2 Lee, T.: A new efficient EDI system for container cargo logistics, Maritime Policy & Management, 27: 2, 133-144, 2000
3 Cisic, D.: The analysis of impact of e-business on transport system logistics, PhD thesis, University of Rijeka, Faculty of Maritime Studies, Rijeka.
4 Ristov, P., Krile, S.: Package Programs for Container Handling, Naše more, Vol. 57 No. 1-2, 2010
5 adapted according to definition of heterogenous PCS from Rodon, J., Ramis-Pujol, J.: Exploring the Intricacies of Integrating with a Port Community System, 19th Bled eConference, Bled, Slovenia, June 5 - 7, 2006
6 Tijan, E., Kos, S., Ogrizovic, D.: Disaster recovery and business continuity in Port Community Systems, Journal of Maritime Studies, Number 1/Yr. 23, 2009
7 Srour, F. J. et al.: Port Community System Implementation: Lessons Learned from International Scan, Transportation Research Board 87th Annual Meeting, Washington DC, 2008
8 Diaz, M.: Port Community System – A Key Component of the Future Vision for Cargo and Port Security, Government Supply Chain blue papers, Valencia, 2003

dictated by sequence of processes, risk assessment and return on investment (ROI). It would be detrimental to the functioning of PCS to introduce portions of PCS that have lower return on investment while holding back internal projects that have a higher ROI. However, practically speaking, limiting factor of PCS development is usually life ware – its quality and quantity.

3. PCS investment evaluation

Several models could be utilized in order to evaluate investments into ICT systems, and certainly the same also holds for a PCS. Companies need more insight into what drives costs in their business to ensure that cost-cutting is targeted at the right places and that the success of cost management initiatives is properly measured9. Successful ICT projects are approved through rigorous review and approval process, where capital planning process passes through several layers of governance to align it with investment amounts. Large investments usually require approval from the Chairman or CEO, while in order to set strategy and prioritize projects across the enterprise, ICT Councils are usually being used[10].

In "Weighted Scoring Methods", Farbey[11] has found out that merely 50% of ICT investments are formally approved according to internal company criteria, and in less than 50% of the cases these investments are evaluated by standard financial evaluation techniques. Furthermore, less than 30% of ICT projects are evaluated after the implementation to ensure that the initially set targets have been met. Finally, 30% of interviewed companies are not satisfied with the methods of ICT project evaluation, while the rest are usually not entirely satisfied with how the evaluation is being done. Therefore, when introducing the PCS, it is critical to distinguish between the "right" and "wrong" investments into ICT[12].

The research by Standish Group[13] showed that in more than 80% of the cases the question of efficiency of new ICT investments has not been raised. In more than 80% of the cases, ICT directors did not understand the link between business and ICT technologies (neither did the management), and 83% of ICT directors were dealing only with technical aspects of ICT, they were not interested in business impact. Even more alarming data shows how the evaluation of investment into PCS's is being neglected. 16.2% of all ICT projects were completed on time and within budget, with all specified features and functions. 52.7% of studied projects were challenged: they were completed, but at higher cost, over the time and with lack of features and functions. Finally, 31.1% of all studied projects were either abandoned or cancelled and became a total loss.[14] As for the situation in Croatia, the situation shows that only 48% of leading companies have implemented a strategic ICT planning function[15].

Parker et al.[16] have distinguished three primary types of ICT investments:

1. Replacement investments – technology that replaces human input (with purely economic motives).
2. Additional investments – their goal is improvement of productivity and employee efficiency by allowing work to be done in new ways.
3. Innovative investments – they set new competitiveness margins by changing existing ways of how something is being done and by creating new markets.

PCS investments are complex because they appear in all three categories. They replace already existing technologies, improve productivity but also allow for a roll out of new services, thus creating new customers and markets.

Several methodologies could be deployed in order to evaluate the investments into a PCS':

9 KPMG LL,Cutting IT Spend: Taking Action in Turbulent Times, KPMG, 2007
10 Best practices in ICT procurement: Banking, Insurance Companies Lead the Way, CFO Publishing Corp., April 2004, page 10.
11 Binney, J. G.: A Framework for Identifying the Intangible Capital Value of ICT Investments, 11th Pacific-Asia Conference on Information Systems, PACIS 2007, Auckland, July 2007, page 287
12 Applied Information Economics: A New Method for Quantifying IT Value An Executive Overview, Hubbard Decision Research, Illinois, 2004, page 5
13 Standish Group, Yearly report 2004, 2004
14 Frese, R., Sauter, V.: Project success and failure: what is success, what is failure, and how can you improve your odds for success?, Systems Analysis,UM-St. Louis, December 16, 2003., page 3
15 Panian, Z., Spremic, M.: Korporativno upravljanje i revizija informacijskih sustava, Zgombic i partneri, 2007, page 5
16 Parker, M. M., Trainor, E. H., Benson, R.: Information Strategy and Economics: Linking Information Systems Strategy to Business Performance", Prentice Hall, 2009.

1. Traditional investments return technique that quantifies PCS process improvements, resulting in process automation.
2. Value merging that shows improvements in business performance, not only savings that are the results of less iteration. Typical example would be the time which is freed up by process automation of operative tasks in the PCS, time that can be dedicated to more critical and complex issues in other parts of the system.
3. Value acceleration that shows time dependency of other PCS customers, clients and stakeholders to the new and improved PCS. It is demonstrated by the lowered cost of information exchange and improved information flow.
4. Innovation evaluation whose goal is to anticipate the value of the new ICT system to the PCS that is its direct result. In case of PCS, it can attract additional stakeholders, increase the image of the seaport system and therefore indirectly increase the number of involved internal and external customers.

PCS is usually not introduced at once. In that scenario, it would be very difficult to follow up the project execution. Therefore, a prudent approach would require division of internal PCS projects into different categories[17]:

1. Supporting PCS ICT projects,
2. Key PCS operations ICT projects,
3. Strategic PCS ICT projects, and
4. High potential PCS projects.

Supporting projects should contain all internal projects aimed towards the increase of efficiency of preexisting systems. Additional considerations may also include obsolescence of existing systems and general system productivity. If such projects are competing for resources with other projects, they need to show a good ratio of investments versus gains.

Every development of **key PCS operations** should be evaluated in direct financial terms. However, short term financial benefits cannot show the true potential of new PCS introduction. Furthermore, the derived benefits are usually not only financial, and it is very hard to anticipate them in advance, which is in direct contradiction to the requirements of project management calling for quantifiable results. The usual workaround is the usage of feasibility studies which are aimed at finding alternatives that give the best results at lowest possible risk levels.

Introduction of **strategy** into the operative plan means anticipation of future achievements and PCS functioning. It requires a good estimate of future investments and if possible, future profit from those investments. The usually deployed tactic consists of central planning that directly manages risks and opportunities according to business strategy requirements. In case of strategic internal PCS ICT projects, such projects will obtain approval only if they are connected with the strategy aiming to derive financial benefits from the strategy execution. Therefore, strategic ICT projects will primarily depend on the presentation of potential future benefits and alignment with PCS future planning, and secondarily on the ability of PCS governing body to recognize these developments and parameters and to decide whether these projects are worth the anticipated investment.

High potential PCS projects usually do not carry the exact financial impact values, they are still unknown. They carry the potential for high return but are usually connected with the high risk – it would be appropriate to finance them from the PCS research and development budget. The problem with the exact evaluation of high potential PCS projects is that they are a result of individual creativity and usually not formal planning, so tight control and boundaries have to be set in order to avoid perpetual investing without the adequate (or any) return.

4. PCS internal projects prioritization

Priority setting mechanism is required in order to decide the dynamics of the internal project steps execution, in what order to initiate the projects and which projects should be delayed until certain conditions are met. Therefore, the goal of the project prioritization is to establish the critical path and milestones for the PCS introduction project as a whole. It is important to keep the goals flexible enough, as various problems and delays may occur along the way:

1. The project phases may be late due to higher cause („vis maior“), consequently delaying the steps which follow,
2. The resources needed to complete certain phases may be inaccessible at the time, and
3. New circumstances and opportunities may arise during PCS implementation.

These are all possible reasons for changes of priorities. If the logistics for problem resolution is not in place, problems will have to be resolved by methods of crisis management. Therefore, the priorities should be set in short term in order to enable more efficient resource management, assuming resources will be available at the time, but also keeping in mind the strategic overview of the situation. Several methods are available to evaluate and to follow up on priorities in internal PCS development, and generally they may be divided into three sets of activities:

1. Identifying the most valuable PCS services for the broad spectrum of internal and external customers – identification is done by analyzing change management within the organization and by analyzing how critical these changes are to the functioning of the PCS.
2. Differentiating success rate of the identified PCS functions in regard to available resources.
3. Determining the success rate for identified services` implementation and consider the possible impacts between different services during the implementation.

Considering that a PCS presents a portfolio of new operational functionalities implemented within the Port Community, it needs to show a good compromise between financial return on investment, success factors, impact of possible project introduction risk on current business development and infrastructure improvement. An investment into the PCS is in fact an investment into the port business organization, and is tightly connected with the general management of seaport systems.

5. Risks in PCS implementation

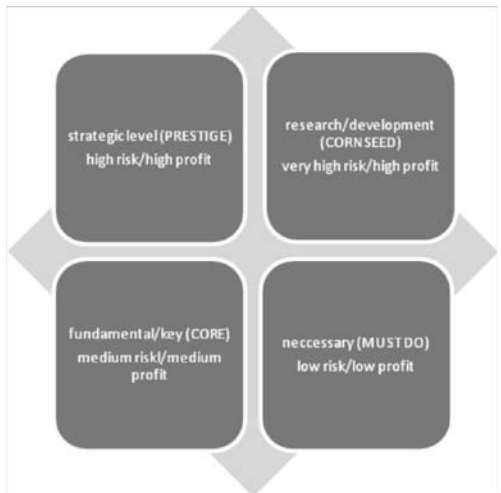
PCS implementation is a risky task, not only because it involves a change in organization perspective and culture and the fundamental ways of how things are done, but also because it involves a change in used hardware, software and orgware. Four possible groups of risks which may influence the development of a PCS can be identified and anticipated:

1. **Technical risks** are the easiest to cope with. They are more often encountered in new technologies, and less often encountered as technologies mature.
2. **Information transfer related risks** are risks that are related to the possible problems when transferring information from old systems to the new PCS platform. They can be partially mitigated by appropriate controls, but are still largely dependent on human factor.
3. **Human resources risks** that arise from users' encounter with the new PCS and the new methods of work. These risks can be satisfactorily mitigated with the additional investments into end user education.
4. **Organizational risks** that arise from the inappropriate placement of PCS within the wider stakeholder perspective. It is quite possible that the PCS will be properly executed, but will not achieve the initially set strategic goals.

Figure 1. Relation between risk and profitability in PCS implementation
Source: authors

The classic matrix identifying the relation between risk and profitability in PCS implementation is shown in Figure 1.

Project-oriented activity of new PCS implementation can be found in the top-right corner of the



matrix, where projects with high risk and high

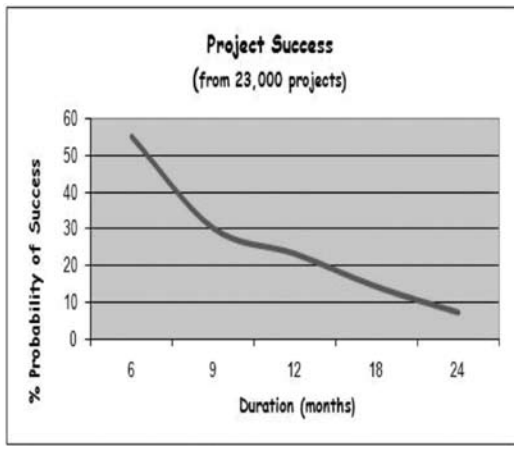
17 Khosrow-Pour, M (Editor).: Managing IT Resources in Organizations in the Next Millennium, 1999 Information Resources Management Association International Conference, Hershey, Pa, USA, May 16-19, 1999

return are typically situated. In such projects, due to complexity and variety of involved stakeholders, risks cannot only be evaluated in quantitative terms, but their qualitative side also has to be adequately evaluated.

To understand the true drivers behind the increased risk of large scale projects, one has to understand the basic relation between project duration and ability to deliver the project in order to achieve the set goals of quality and profitability within the initial time frame. Research by Standish Group[18] showed that there is almost an exponential drop in large scale project success with the prolonged project duration, as shown in Figure 2. There is a pronounced drop in project success for projects that last longer than 9 and 12 months respectively.

Figure 2. Relation between project success and project duration
Source: Johnson, J. (Standish Group): PMI Global Congress Conference in Toronto, 2004, downloaded from http://leadinganswers.typepad.com/leading_answers/2007/05/large_project_r.html,

In their inherent nature, PCS projects are long lasting but at the same time also fast-track projects,



thus inherently having high levels of embedded risk. Complexity increase is not linear, and growth of the project increases the required efforts and risks at a faster, non-linear rate. General business, therefore also the Port Community business changes during the project implementation, as do priorities of main stakeholders, team members involved in implementation and, consequentially, the used communication channels (in number of communication points and quantity of exchanged information). One possible way to mitigate risks identified during the implementation of a complex systems such as PCS is to divide it to smaller projects that will correspond to organizational areas inside the PCS or concession holders. Implementors may choose to introduce the PCS firstly for that part of Port Community activities that are the most important and straightforward, and only then to attend to more complex intricacies of subsystems. Furthermore, project managers of the PCS should carefully match risk mitigation tactics with specific requirements of user groups and replacements of existing, non-digital subsystems.

6. Cost-benefit analysis

Due to the complexity and the number of involved stakeholders, direct economic efficiency of the PCS is difficult to evaluate. Included and derived costs and benefits that are attributed to other parties cannot easily be converted into numbers. Some of the benefits are general for the whole community and cannot be expressed in monetary terms at all. Cost-benefit analysis is usually better suited for profit-oriented organizations, therefore in PCS's the biggest challenge is selecting metrics used to assign quantitative value to qualitative identifiers. A standard set of key cost–benefit indicators, including the following, may be used for appraisal of efficiency of implemented investments into PCS infrastructure:

- NPV - net present value of PCS infrastructure
- PVB - present accumulated value of benefits derived from new investments into PCS infrastructure
- PVC - present value of costs incurred by new investments into PCS infrastructure
- BCR - benefit cost ratio = PVB / PVC
- Net PCS investment benefit = PVB - PVC

Net Present Value ratio = NPV/k

(where k is the level of initial funds available, or initial investment cost, usually represented as net present value per initially invested monetary unit)

In case of introduction of such a complex system, the outcome of cost-benefit analysis will depend

18 Khosrow-Pour, M (Editor).: Managing IT Resources in Organizations in the Next Millennium, 1999 Information Resources Management Association International Conference, Hershey, Pa, USA, May 16-19, 1999

on how accurately both investment costs and the monetary benefits have been estimated, so they rely heavily on heuristic and predictive methods. Inaccurate anticipation of costs and benefits presents a true risk factor in the implementation of a PCS. Several methods exist which could be applied in order to mitigate this risk:

1. Correct determination of major cost-drivers included into the analysis. Caution needs to be exercised in order to avoid special groups bending the issue towards their personal interests.
2. Avoidance of incorrect extrapolation based on similar past projects executed under different circumstances, thus incomparable.
3. Excessive relying on heuristics and guesswork in order to identify the financial impact of intangible benefits of PCS implementation, derived by peripheral stakeholders.

7. Return on management

In the early stages of development of complex information systems, it appeared that the relationship between investments into computer systems and overall business profitability did not exist. Strassman undertook the research in this area called „The Business Value of Computers"[19] and started from the fact that the measured relationship between profitability and investments into computer systems appears to be random (Figure 3).

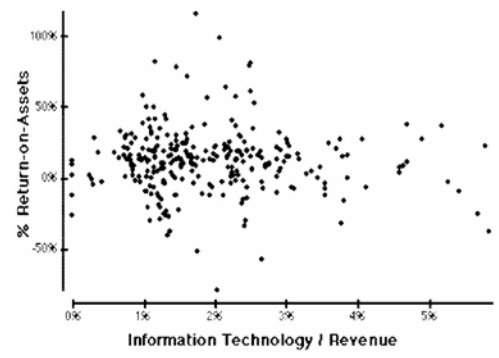
Strassman correctly realized that the diversity of the distribution is attributable not to the introduction and usage of new information systems but to the Management Value-added, since the management of information is inseparable from management's general roles. This concept also presents the beginning of strategic ICT function inside corporations and complex systems. Return on management can be used in PCS context to determine the added value to the management system resulting in improvements. It is represented by index of total management effect as a ratio between management value-added and the direct cost of management. If the added value is bigger than the cost, effort and functioning of the PCS management (or governing body) is productive, therefore the outputs outweigh the inputs (costs).

19 Strassman, P. A.: The business value of computers – An Executive`s Guide, The Information Economics Press, 1999, page 4

Figure 3: Relation between investments in strategic ICT projects and return-on-assets margin
Source: Strassman, P. A., The business value of computers – An Executive`s Guide, The Information Economics Press, 1999.

8. Value added analysis

Value added analysis is a tool that can be used to determine whether the activities that comprise the PCS will eventually benefit the organization as



a whole. Therefore, value added analysis will not be aimed towards lowering the cost, but towards increasing the anticipated output. This is achieved by analyzing the impact of functionality on the investment cost, as follows:

Value = Functionality / Cost

It is clear that the value of the output can be increased both by lowering the investment cost into the PCS or by increasing the effectiveness or functionality of the output. When the investment into PCS functionality is evaluated using value added analysis, all alternatives should be based on their impact on efficiency and effectiveness. Minor increases in functionality at a major cost are generally not acceptable, while major increases in functionality with a reasonable cost are readily accepted. PCS are generally geared towards mid and low investments compared to overall impact on added value.

Value added analysis applied to PCS development has several key advantages:

1. Quick identification of stakeholders' interest areas in order to agree on acceptable values for quality of outputs.

2. Improved communication between analysts and stakeholders.
3. Flexible evaluation and anticipation of costs and profits that enables the management involved in the introduction of PCS to continue or to stop the process at any given time.
4. Evolutionary approach suited to changes in the PCS.

9. Other methods

Several other complex methods could be used to evaluate the investment effects into a PCS. One possible suggestion is the method usually used in complex systems with multiple stakeholders that usually relies on Analytic Hierarchy Process method creating a hybrid MOMC model – a derivative of linear goal programming, known under the name Multi-Objective, Multi-Criteria analysis[20]. This method allows the analyst to incorporate both quantitative and qualitative inputs by assigning the priorities to objective (quantitative) criteria and importance of qualitative criteria (divided into qualitative and risk factors) according to own needs and perception.

Figure 3: PCS strategic analysis process
Source: authors

Another method is strategic analysis, highly qualitative and subjective, focused on evaluation and ranking of primary ICT systems used to support a business strategy. Strategic analysis differentiation is geared towards the main generic strategies: differentiation strategy and low cost strategy. Differentiation strategy is aimed towards the creation

of a specific product, special due to its design, high quality and added value.

PCS is, without a doubt, a „product" which should possess such qualities from its inception. Therefore, if the strategic analysis tool is selected, it should be focused on providing low cost structure that enables high return and profit. Low cost strategy should be incorporated into phases of PCS design, PCS marketing towards end users, PCS start-up phase, PCS follow up and administration, and finally PCS operative phase (Figure 4).

10. Conclusion

Every implemented PCS is a result of a joint effort of all involved stakeholders. It is in their best interest to implement adequate metrics in order to decide on project commencement, development and follow up, in order to ensure anticipated return on investment in terms of quantitative and qualitative indicators.

Complex organizational and ICT systems, such as PCS, have to be carefully evaluated against set priorities and possible implementation risks, using well established project management methodologies. Several methods for evaluation of economic results of implementation of PCS are available, and the most suitable among them are cost-benefit analysis, return on management, value added analysis, Multi-Objective, Multi-Criteria and strategic analysis.

Recommended indicators to be included in portfolio of methods used to evaluate efficiency and effectiveness of PCS's are comparable to those indicators used in corporate ICT governance and general business models. Implementers should be vary of selection of methods and indicators to be best suited to the system that contains a significant number of stakeholders operating in changing environment that is sometimes hard to quantify. Implementers should start the evaluation under the premise that PCS implementation is a strategic project which will benefit a large number of entities, not only those immediately involved in the project execution.

Careful selection of methods needs to be undertaken in order to select best suited methods that will, provided that the input is adequate, enable realistic prediction of output results. Successful PCS implementation will show adequate return on investment and added value to all involved parties, while at the same time raising qualitative and subjective operative experience after the implementation.

20 http://www.prioritysystem.com/glossary1d.html, November 12th 2010

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Lučki komunikacijski sustav (PCS) – procjena ekonomske izvodljivosti

Sažetak

Lučki komunikacijski sustavi (PCS) složeni su sustavi informacijsko-komunikacijske tehnologije (ICT), za koje je neophodna pažljiva evaluacija kako bi se odredile potencijalne i stvarne novčane koristi ostvarive njihovom implementacijom. Te koristi mogu biti kvantitativne ili kvalitativne (subjektivne) prirode. Kvantitativne se koristi mogu procijeniti uobičajenom metodologijom za upravljanje projektima, te pomoću financijskih indikatora i metoda, dok je kvantitativne koristi ponajbolje istražiti uz pomoć strateške analize. Pri analizi je potrebna osobita pozornost kako bi se izbjegli pristrani parametri unosa koji bi mogli iskriviti konačni rezultat. U ovome će se radu istražiti investicijski prioriteti i procjene za lučki komunikacijski sustav, analizirati prioriteti kod internih podprojekata u lučkom komunikacijskom sustavu, te ispitati rizici u implementaciji lučkog komunikacijskog sustava na temelju cost-benefit analize, povrata od upravljanja (ROM) i analize dodane vrijednosti.

Ključne riječi:
Lučki komunikacijski sustavi, ekonomska izvodljivost, ICT investicije, analiza rizika