World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:7, No:9, 2013

# Effectiveness of Business Software Systems Development and Enhancement Projects versus Work Effort Estimation Methods

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Open Science Index, Computer and Systems Engineering Vol:7, No:9, 2013 publications.waset.org/16852/pdf

***Abstract*—**Execution of Business Software Systems (BSS) Development and Enhancement Projects (D&EP) is characterized by the exceptionally low effectiveness, leading to considerable financial losses. The general reason for low effectiveness of such projects is that they are inappropriately managed. One of the factors of proper BSS D&EP management is suitable (reliable and objective) method of project work effort estimation since this is what determines correct estimation of its major attributes: project cost and duration. BSS D&EP is usually considered to be accomplished effectively if product of a planned functionality is delivered without cost and time overrun. The goal of this paper is to prove that choosing approach to the BSS D&EP work effort estimation has a considerable influence on the effectiveness of such projects execution.

***Keywords*—**Business software systems, development and enhancement projects, effectiveness, work effort estimation methods, software product size, software product functionality, project duration, project cost.

## I. Introduction

IN an organization facing decision on the execution of Business Software System (BSS) Development and Enhancement Project (D&EP) there are various priorities that come about. While for financial directors, the boards, investors and owners this is economic efficiency of project that is usually of importance, what counts to Chief Information Officers (CIOs) and BSS users, however, is most of all project's effectiveness: to the former ones, as to outside providers, most of all sticking to the planned time and budget while to the latter ones – whether the delivered product matches up the required functions. What's more, according to the author, chance to execute economically efficient BSS project without ensuring its effectiveness undoubtedly decreases. Thus, one may formulate a hypothesis that project's effectiveness determines its efficiency.

Effectiveness – next to rationality and efficiency – is one of the fundamental notions of praxeology (Gr. *práxis* – "action", *lógos* – "word", "discourse" or "reason). Within area of interest of this science about efficient, purposeful human action is, among others, examining the effectiveness of action methods and prerequisites for effective action therefore it deals with analyses concerning causes of their success and failures.

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In case of efficiency assessment this is both effects, also those unplanned, and costs borne to achieve them that are taken into account. What's important for the effectiveness assessment, on the other hand, are only effects, and only those expected ones. Since it signifies degree of accomplishment of the set goal: effective will be called action that leads to the effect having been meant as a goal. Effectiveness ($E$) is measured as the ratio of the achieved result ($Ra$) to the set result ($Rs$), which is expressed as percentages in the following way:

$$E = (Ra / Rs) \times 100\%$$

In case of BSS D&EP this result – first expected and then accomplished one – happens to be assessed following various criteria. Determining those criteria constitutes baseline not only for the analysis of the effectiveness of the given project execution but also for the identification and understanding the causes, due to which some projects are successful and why some fail. According to the opinion of M. Wideman [1, pp. 3, 5, 8], one of the main principles of software project management regards those very criteria: they should be defined, both for the product as well as for the process, at the beginning of the project as key and measurable – as they provide basis for decision-making and project assessment.

In practice, what is assumed to be necessary prerequisite of the BSS D&EP effectiveness is carrying out development activities in a way so that they lead to the development of final product having functions and features required by a client and delivered without time and cost overrun. Numerous studies indicate that the effectiveness of BSS D&EP execution assessed from the perspective of these criteria in practice is not only unsatisfactory but also exceptionally low comparing to other types of IT projects. It leads to the considerable financial losses. The general cause of this situation is improper management of such projects, including first of all their planning.

The goal of this paper is to prove that approach to the estimation of BSS D&EP work effort has significant influence on the effectiveness of such projects. This is because such approach determines correct (reliable and objective) estimation of project's main attributes: cost, duration and project product functionality. Thus, the paper is structured as follows: Part II presents effectiveness of the BSS D&EP execution in the development practice. Part III discusses main

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factors of the analyzed projects effectiveness that come from a variety of studies. Part IV presents methods of work effort estimation by taking into account approaches being most often used in practice as well as their usefulness on the basis of factors of effective BSS D&EP work effort estimation. Part V comprises fundamental conclusions coming from the analysis presented in this paper.

## II. Effectiveness of BSS D&EP Execution in Practice

As it was mentioned above, in practice, execution of BSS D&EP is characterized by the exceptionally low effectiveness, leading to the considerable financial losses. This may be proved by numerous analyses. As indicated by the results of the Standish Group studies success rate for application software D&EP has never gone beyond 37% [2] (see Table I), while products delivered as a result of nearly 45% of them lack on average 32% of the required functions and features, the estimated project budget is exceeded by approx. 55% on average and the planned project time − by nearly 80% on average [3] (for more details see [4]).

TABLE I
Average Effectiveness of Application Software D&EP Execution Over 1995-2011

| Year | Successful projects* (in %) | Challenged projects** (in %) | Failed projects*** (in %) | Challenged and Failed projects (in %) |
|---|---|---|---|---|
| 1995 | 16 | 53 | 31 | 84 |
| 1997 | 27 | 33 | 40 | 73 |
| 1999 | 26 | 46 | 28 | 74 |
| 2001 | 28 | 49 | 23 | 72 |
| 2003 | 34 | 51 | 15 | 66 |
| 2005 | 29 | 53 | 18 | 71 |
| 2007 | 35 | 46 | 19 | 65 |
| 2009 | 32 | 44 | 24 | 68 |
| 2011 | 37 | 42 | 21 | 63 |

* Successful projects – that is projects completed with delivery of product having functions and features being in accordance with client's requirements specification and within the estimated time and budget.

** Challenged projects – that is projects completed with delivery of product that is working yet has functionality lower comparing to the client's requirements specification and/or overrunning the planned budget and/or duration.

*** Failed projects – that is projects that were abandoned (cancelled) at some point of their life cycle or were completed with delivery of product that had never been used.

Source: [2] and [3].

Analyses by T.C. Jones plainly indicate that those softwares D&EP, which are aimed at delivery of business software systems, have the lowest chance to succeed [5]. The Panorama Consulting Group, when investigating in their 2008 study the effectiveness of ERP (Enterprise Resource Planning) systems projects being accomplished worldwide revealed that 93% of them were completed after the scheduled time while as many as 68% among them were considerably delayed comparing to the expected completion time [6]. Merely 7% of the surveyed ERP projects were accomplished as planned. Comparison of actual versus planned expenses has revealed that as many as 65% of such projects overran the planned budget. Only 13% of the respondents expressed high satisfaction with the functionality implemented in final product while in merely every fifth company at least 50% of the expected benefits from its implementation were said to be achieved. Three years later, the respondents of Panorama Consulting Group study indicated that there were significantly more companies with ERP project overruns in 2010 than in 2009 [7].

Similar data, proving unsatisfactory effectiveness of BSS D&EP, are brought by the studies carried out in 2011 among providers of such projects in Poland [8, p. 9]. According to the results, 80% of the surveyed organizations admit that the projects exceed the planned budget, 79% - that they exceed the planned execution time while 64% - that the quality assumptions for software products are not being met. In this case it results from the fact that slight percentage of providers manages the software systems development processes properly. What's interesting, all those numbers increase if the so-called expert methods are used to estimate project work effort, duration and cost – instead of estimates being based on standards and benchmarking data.

Meanwhile BSS are not only one of the fundamental IT application areas; also their development/enhancement often constitutes serious investment undertaking: spending on BSS may considerably exceed the cost of building even 50-storey skyscraper, roofed football stadium, or cruising ship with a displacement of 70.000 tons [9]. Yet quite often client spends these sums without supporting his decision on getting engaged in such investment by proper analysis of the costs, based on a rational, sufficiently objective and reliable basis.

Exceptionally low effectiveness of BSS D&EP as compared to other types of IT projects (i.e., maintenance, support, package acquisition, implementation projects, projects delivering other types of software), especially with their costs being considered, leads to a substantial financial losses, on a worldwide scale estimated to be hundreds of billions of dollars yearly, sometimes making even more than half the funds being invested in such projects. The Standish Group estimates that these losses – excluding losses caused by business opportunities lost by clients, providers losing credibility, or legal repercussions – range, depending on the year considered, from approx. 20% to even 55% of the costs assigned for the execution of the analyzed project types (see e.g., [10], [11]). If direct losses caused by abandoning the BSS D&EP result from erroneous allocation of financial means, usually being not retrievable, in the case of overrunning the estimated cost and/or time, however, they may result from delay in gaining the planned return on investment as well as from decreasing it (necessity to invest additional funds and/or cutting on profits due to the overrunning of execution time and/or delivery of product incompatible with requirements) (for more details see [12]). On the other hand, analyses of The Economist Intelligence Unit that studied the consequences of BSS D&EP delay indicate that there is strong correlation between delays in delivery of software products and services and decrease in profitability of a company therefore failures of BSS D&EP, resulting in delays in making new product and services available and in decreasing the expected income, represent threat also to the company's business activity [13].

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What's more, the Standish Group studies also indicate that "the costs of these (...) overruns are just the tip of the proverbial iceberg. The lost opportunity costs are not measurable, but could easily be in the trillions of dollars [for instance - B.C.C.] the failure to produce reliable software to handle baggage at the new Denver airport is costing the city $1.1 million per day" [14]. These losses result from insufficient level of the delivered product compatibility with the client's requirements as to the functions and features: over 1994-2010 an average conformity of this type never went beyond 70%, which means that the delivered applications lacked at least 30% of the specified functions and features [3]. Incompatibility of the delivered product with the required one proves to be the highest for large projects, in case of which the delivered product lacks on average even 60% of the required functions and features. While for medium- and small-sized projects such incompatibility amounts to approx. 35% and approx. 25% of functions and features, respectively.

Thus, effective estimation of BSS D&EP cost and time, being of key significance to clients, encounters serious problems in practice. It results from the fact that objective and reliable BSS D&EP work effort estimation still appears to be a great challenge to the software engineering.

## III. Factors of Effective BSS D&EP Execution

Many analyses have been carried out concerning fundamental reasons for BSS D&EP failure. Here we only present selected exemplary studies as the results of the majority of the remaining ones boil down to the conclusions similar to those coming from the presented analyses.

According to the studies of T.C. Jones [15, pp. 133, 196, 197, 198, 199], chance for BSS D&EP to end in success gets significantly increased by, first of all, considerable experience with both project management and developing products of similar kinds, use of effective development methods / processes, use of effective tools supporting management, including estimation tools, as well as those of CASE (Computer Aided Software/System Engineering) type, also by effective involvement of a user, use of formal estimations for duration and costs, measurement of quality and productivity. According to Jones, the fact that BSS D&EP are characterized by significantly lower success factor comparing to projects aimed at developing other kinds of software results, among others, from insufficient control of product quality, insufficient monitoring of the progress of works over time and their costs, but most of all from the size of such projects - projects concerning developing small BSS (below 1,000 IFPUG function points (FP) – for more details about IFPUG method see [16]) end in success definitely more often. That's why among the so-called best practices of project management the author listed: necessity of product size measurement, productivity measurement with this product size taken into account, and yearly evaluation of software process, e.g., with the use of Capability Maturity Model Integration (CMMI – for more details about CMMI model see [17]), which in case of providers of the considered type of software happens relatively rarely. According to the author, use of correct estimation methods and measurement of key attributes of project alone increases likelihood of successful completion by twice as much [18]. As one of the most effective ways of avoiding project duration and/or cost overrun is possibility to introduce accurate estimates as early as at the initial stages of its life cycle. This view has been also shared by E. Yourdon [19, p. 1], who used to underline not only the need to make early estimates but also the necessity to continue them throughout development activities since they may serve as the important signals about project going wrong.

The discussed problem was also subject to a wide-ranging research carried out by the Idaho University researches, including D. Babcock [20], H. Kerzner [21], and J. Meredith and S. Mantel [22]. The first of the authors mentioned above included the following, among others, to the main reasons for BSS D&EP failure: lack of adequate skills with regard to project management, insufficient cooperation with client, poor control of development activities, unrealistic schedule, incorrect change management procedures as well as wrong estimation of the degree of product complexity. His first list of main reasons for failure of the considered types of projects H. Kerzner published as early as in the 1980s. When analyzing its contents it is hard not to conclude that proper conclusions from his studies have not been drawn yet – as practice shows that such failure factors as e.g., unrealistic planning, low quality of estimates (without basing them on standards), building plans based on incorrect and/or insufficient data (too scanty benchmarking data) as well as lack of attempts to systemize the planning process, still apply. J. Meredith and S. Mantel, on the other hand, point to the following main factors of the success of development activities: project being supported by the executive management, appropriate project plan, right cooperation with user, right control over project at every stage on the basis of consistent and up-to-date information as well as ensuring adequate data for all key project participants.

Studies carried out by the researchers of Arizona State University [23], on the other hand, have disclosed that among most often occurring factors of failure of the analyzed projects should be listed: modification of requirements concerning product – its negative effect reveals especially in case of large projects, imprecise estimation of project costs, inaccurate prognosis of project duration as well as insufficient involvement of users and executive management in the project. The reasons for incorrect costs estimation should be seen in: using inappropriate methods and tools supporting project management, deliberate lowering of costs by persons making analysis, assuming only optimistic variants of project execution as well as in changing external preconditions. Differences concerning duration are generally caused by inappropriate project management too.

Conclusions similar to the last one result also from the analyses carried out by T. DeMarco and T. Lister [24, pp. 102, 104]. As the most important among major factors of risk, being common to all types of BSS D&EP, they consider erroneous planning. This factor is associated with estimation of project duration and costs while it should be perceived as a

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tendency for inaccurate – none or definitely too optimistic - *ex ante* evaluation of the size of product to be delivered as a result of project execution. „If no serious efforts are made aimed at determining what should be product size, then all estimates will be based on nothing but wishful thinking only" [24, p. 102]. Next the authors state that if a project plan is being worked out without product size being taken into account then overruns on the level of 50-80% are very likely to occur. In their opinion, what appears to be unquestionable fact is that many providers do not measure product size at all, using backward scheduling or just wishful thinking instead.

D. Churchville [25], on the other hand, claims that two in three projects of the discussed type end in failure due to, among others, attempt to define all requirements to the product at the very beginning of project life cycle, ignoring dependencies between product size and time and resources (costs), mainly work effort costs, assuming unrealistic resolutions made together with client, monitoring activities (their duration and costs) instead of size (functions and features) of product being developed, and lack of updating of the scheduling throughout the works. According to the author, if a project does not have to be deadline-driven, i.e., date of its completion is not of deciding importance to it, does not result from an imposed, fixed dates that must be absolutely met, then it should be scope/size-driven. However, even in case of deadline-driven projects it is sometimes necessary to make product size estimation as a base for determining project's work effort on the basis of which client has to prioritize functions and features of those likely to be delivered on scheduled time. It is worth mentioning here that imposing deadlines for BSS D&EP in the situation where it is not necessary is also considered to be one of the main causes for such projects' failure.

The Standish Group, a research institution mentioned earlier in this paper, also undertook works aimed at determining factors that decide on the success of the discussed projects. It has been publishing lists of success factors since mid-1990s, as a rule at 2-year intervals. The most recent list usually comprises certain changes, however for years the list had included, among others, success factors such as: user's engagement in development works, support for the project on the part of the board, clear business goals of the project, optimization/minimization of the size and requirements, right planning, etc. (see e.g., [2], [3], [11]). It should be noted that as the main reason for the increase in the effectiveness of the execution of the analyzed projects by over 100% (see Table I) over the analyzed period (1994 – 2010) the Standish Group analysts consider minimization of those projects' size. For projects having work cost below USD 750 000, success coefficient is even as high as 61% whereas for those costing more than USD 10 million – 0% [3]. This is a consequence of using iterative approach to project development, including agile one, more frequently over time, contrary to waterfall approach that requires defining of all requirements at the very beginning of project life cycle, which, as proven in practice, is unachievable. Other reasons for the success coefficient increase, indicated by the Standish Group, include: generally increased skills of project managers, resulting from development of the discipline of the projects management as well as promulgation of standards and tools supporting management of the analyzed projects, including mainly management of their size, for which of main importance is using right approaches to the project work effort estimation.

## IV. Methods of BSS D&EP Work Effort Estimation

### *A. Approaches to the Work Effort Estimation in the Practice of BSS D&EP Execution*

Basic approaches used in practice for the BSS D&EP work effort estimation first of all include (for more details see [26], [27]):

- expert methods (e.g., brain-storming, Delphi method),
- decomposition methods (usually based on Work Breakdown Structure - WBS), also called engineer or bottom-up methods,
- analogous estimating,
- parametric extrapolation methods, also called empirical or algorithmic methods, based on product size expressed in (for more detail see e.g., [4]):
  - programming units (e.g., source lines of code),
  - functionality units (e.g., function points),
- so-called "price-to-win" technique,
- Parkinson rule.

"Price-to-win" technique and Parkinson rule may hardly be considered as having methodical grounds hence we did not use the term „methods" here. The first of these two ways takes no notice of the product size and complexity whereas the effort does not depend on client's requirements but rather on client's budget to which the product is then being adjusted. What also is not recommended is the use of the approach known as the Parkinson rule, according to which „work expands to fill the available volume". In this case the effort is determined by the arbitrarily decided time frame and by the human resources available – and not by the objective criteria (e.g., software product size). Expert methods require extensive experience in the field of project execution and with regard to the specific technology being used as well as they call for estimates being derived by several independent experts, whose knowledge is costly whereas gaining them over for the project is a difficult task. Bottom-up estimating methods require project to be split into detail activities, which is not always possible as early as at the beginning of the project life cycle. Method of analogous estimating comes in useful only as giving very general idea of the total costs. Techniques of BSS D&EP effort estimation built on empirical parametric models are based on benchmarking data coming from a number of similar projects that had been completed in the past and thus they generalize experience in terms of dependencies between the work effort and the software product size (for more details see e.g., [26], [28]). What's more, only one of the above mentioned approaches is compatible with the three main factors of effective BSS D&EP work effort estimation.

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*B. Factors of Reliable and Objective BSS D&EP Work Effort Estimation*

Theoretical and practical analysis of the approaches to the BSS D&EP work effort estimation made by the author revealed that the most important factors of reliable and objective effort estimation include (for more details see [27]):

1. Estimation made on the basis of software product size (see also [12], [29]).
2. Software product size expressed in appropriate size units (see also [4], [30]).
3. Use of appropriate benchmarking data to adjust estimation approach to a given organization's specificity (see also [26]).

In the author's opinion the main reason for ineffective BSS D&EP work effort estimation is effort estimation made on the basis of resources whereas such planning activity should ground on the required software product size, which determines the work effort. "Measurement of software size (...) is as important to a software professional as measurement of a building (…) is to a building contractor. All other derived data, including effort to deliver a software project, delivery schedule, and cost of the project, are based on one of its major input elements: software size." [31, p. 149]. The parametric extrapolation methods are the only ones among approaches mentioned above that are based on such assumption. However, the utility of such methods depends on the size unit used to express the software product size, which – putting it synthetically – may be expressed with the use of programming units or functionality units (for more details see e.g., [4]).

Verification of various approaches to the measurement of software product size over many years showed that what for now deserves standardization is just the concept of software Functional Size Measurement (FSM). Due to the empirically confirmed effectiveness of such approach, it was in the last years normalized by the ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission), and turned into the six-part international standard ISO/IEC 14143 [32]. Five of the FSM Methods (FSMM) have been now acknowledged by the ISO/IEC as conforming to the rules laid down in this standard, namely: (1) International Function Point Users Group (IFPUG) method [16]; (2) Mark II (MkII) function point method proposed by the United Kingdom Software Metrics Association (UKSMA) [33]; (3) Netherlands Software Metrics Association (NESMA) function point method [34]; (4) Common Software Measurement International Consortium (COSMIC) function points method [35]; and (5) FSM method developed by the Finnish Software Measurement Association (FiSMA) [36]. The FSMM standardized by the ISO/IEC differ in terms of software product size measurement and estimation capabilities with regard to different software classes (i.e., functional domains), but all of them are adequate for business software systems (for more details see [30], [37]).

*C. Usefulness of the Work Effort Estimation Methods – Results of Selected Studies*

Surveys that aimed at analyzing the usage of BSS D&EP work effort estimation approaches by the Polish dedicated BSS providers as well as the reasons behind this *status quo* were conducted by the author of this paper in two research cycles: at the turn of the years 2005/2006, being the time of economic prosperity, and next at the turn of the years 2008/2009, that is in the initial stage of crisis and increased investment uncertainty associated with it. Their results were widely presented in [38]. With regard to the problem analyzed in this paper these surveys indicate that considerable part of the respondents (first cycle: 55%, second cycle: 47%) declares they do not commonly employ any of the methodology-based approaches to the BSS D&EP effort estimation, in most cases pointing to the "price-to-win" technique as the preferred estimation approach (not methodology-based) when providing software systems for government institutions, because legal regulations reward the cheapest offers. However, the level of using the BSS D&EP effort estimation methods (i.e., analogous estimating, decomposition methods based on WBS, expert methods, and parametric extrapolation methods) has increased over the analyzed time (from 45% to 53% of the surveyed providers).

In both research cycles the respondents declared rather widespread usage of at least one of the effort estimation methods, mostly pointing to the expert methods, which are burdened with high risk (first cycle: 36%, second cycle: 43% of total respondents). FSM methods still place at the penultimate position among analyzed methods used by the surveyed providers for BSS D&EP effort estimation, however the level of using them has increased in the second research cycle (from 20% to 26% of total respondents). In both research cycles relatively low popularity of the FSMM results mostly from insufficient familiarity with such methods, but the FSMM awareness has increased over the analyzed time (from 27% to 34% of total respondents). In both research cycles as the main purpose of using the FSM methods was considered product size estimation in order to effectively estimate the work effort, costs and time frame for the initiated project. As the main advantages of the FSM methods were considered methods' objectivity and high usefulness, including most of all possibility to employ them at initial project stages at sufficient accuracy level of estimates, which helps increase the effectiveness of delivering the required functionality on time and within the planned budget. Disadvantages of the FSM methods include first of all high level of difficulty in using them. It happens relatively often that expert methods are employed along with FSMM. Fundamental reason why FSMM along with expert methods are employed is lack of sufficient resources of adequate own benchmarking data, which would allow for deriving dependencies specific to an organization.

Similar results were delivered by the studies conducted among software organizations in Poland at the end of 2011 [8]. These studies revealed that over 80% of the respondents pointed to the use of expert methods when estimating BSS

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D&EP effort whereas only 6% pointed to the use of methods based on FSM [8, pp. 10-11]. In those studies this is also effectiveness of the above mentioned effort estimation methods that was analyzed. Thus, with regard to [8, pp. 11-12]:

- planned budget overrun, in case of expert methods 87% of the respondents pointed to discrepancies higher than 10% while in case of algorithmic methods based on function points – 50% of the respondents,
- planned completion time overrun, in case of expert methods 86% of the respondents pointed to discrepancies higher than 10% while in case of methods based on FSM – only 25% of the respondents.

It is also worth mentioning that the study indicates that nearly 50% of the organizations declare they monitor projects effectiveness [8, p. 15-16, 19]. However as many as 57% among them are not able to specify how they do that. This probably is a result of the fact that BSS D&EP effectiveness is identified with two main measures, i.e., duration and budget of a project whereas what also is of significance is size (functionality) of product that can be measured with the use of FSMM. What's more, as indicated by the study, 28% of the organizations undertake process improvement actions while only 7% of the respondents claim such actions bring some results. On the other hand, only just 6.5% of the companies and institutions compare their results to the benchmarking data when analyzing them whereas such comparison is a source of important information allowing for the enhancement of the BSS D&EP management processes.

Practical usefulness of FSM techniques has been confirmed by additional surveys, including e.g., those carried out by the State Government of Victoria [39] and International Software Benchmarking Standards Group (ISBSG) [40], proving that BSS D&EP, in case of which the FSMM were used for the effort planning, are characterized by relatively accurate estimations. Studies by the State Government of Victoria indicate that pricing of BSS on the basis of product size expressed in functionality units results in reducing the average budget overrun to less than 10% – comparing with current average budget overrun amounting to approx. 55% [3]. The ISBSG report confirms these results: in the situation where the methods based on product functional size are employed in making cost estimation, in 90% of the cases the estimates differ from the actual costs not more than by 20%, and among these very cases 70% are accurate to within 10%. Moreover, the ISBSG studies reveal that the accuracy of effort estimations made with the use of this type of methods is higher comparing to the decomposition (bottom-up / engineering) estimation methods [40]. On the other hand, expert methods are burdened with high risk: tests show that the ratio of the effort estimates, being calculated by experts from different business areas for the same project may be 1:6 or even 1:12 at the worst [41]. Also analysis of the results of 25 studies concerning the reliability of the most important BSS D&EP work effort estimation methods, made by the author of this paper on the basis of the subject literature in [29], revealed that currently the highest accuracy of effort estimations is delivered by the parametric extrapolation methods based on software product size expressed in functionality units.

That's why FSM methods, despite relatively high complexity, are used worldwide more and more often, clearly due to their proven effectiveness. For instance, in the UK, the Mark II method is a method recommended by Central Computer and Telecommunications Agency (CCTA) in the execution of application D&EP for the needs of public administration. On the other hand, COSMIC method is a national standard in Japan and in Spain; this method has been listed also by the US Government Accountability Office in its "Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs" [42], as was the IFPUG method. What's more, these methods are widely employed not only by providers but by clients as well [43].

## V. Concluding Remarks

Effectiveness of the BSS D&EP execution in practice turns out to be not only unsatisfactory but also exceptionally low comparing to other types of projects, including IT projects. The results of that situation are considerable financial losses. Various studies quoted in this paper reveal factors of the effectiveness of BSS D&EP execution that are shared by their authors. Putting them synthetically it should be stated that those most important include:

1. Right management of development / enhancement activities, including:
   - realistic planning, with particular emphasis put on reliable and objective estimates made for project's key attributes,
   - right management of project scope, most of all consisting in undertaking small projects, i.e., projects whose product is characterized by small size.

   Both factors require product size measurement.
2. Authentic engagement of a client in the project. That's why product size measurement should be carried out by taking into account mostly perspective of a recipient of software system being developed, i.e., using such units of product size that are of significance to him (functionality units).

Hence if main possibilities to reduce uncertainty accompanying execution of the discussed types of projects, in consequence to increase chance of their effective execution, lie in accurate estimation of their key attributes, undertaking small projects and client's engagement in such projects, then a significant factor of the BSS D&EP success becomes objective and reliable measurement of their product's size with particular attention given to client's perspective. Thus, it favors lessening of the scale of failure of such projects' execution, so far being extensive, and reduction of losses caused by it. This is, among others, one of the reasons for many years' attempts to develop effective methods of software product size measurement.

The above has been confirmed by the results of studies quoted in the paper, indicating that among approaches to work

effort estimation employed in practice this is parametric estimation methods based on product size expressed in functionality units (function points), i.e., based on the FSM concept and methods, that at the moment are characterized by the highest effectiveness. Although they are not ideal – as they require using adequate benchmarking data, and also are complicated methods and happen to be considered as non-universal – they can, however, have significant influence on increasing the effectiveness of the BSS D&EP execution. Thus, the method of BSS D&EP effort estimation affects significantly the effectiveness of those projects.

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