Evaluation of Business Software Systems Development and Enhancement Projects Effectiveness and Economic Efficiency on the basis of Functional Size Measurement

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Abstract - *Each rational investment decision, also that made by client with regard to the Business Software Systems (BSS) Development and Enhancement Projects (D&EP), should meet two measurable criteria: of effectiveness and of economic efficiency. In the case of BSS D&EP the assumption concerning measurability of these criteria is often treated as controversial. Thus the paper aims at proving from theoretical perspective the capabilities of using the so-called concept of BSS D&EP Functional Assessment (FA), proposed by the author and already verified in practice, based on Functional Size Measurement (FSM) concept and methods, in the area of ex ante and ex post quantitative evaluation of these two criteria. By linking the FSM issues with economic aspects it may contribute to better understanding of the FSM importance, still being underestimated by business managers. Meanwhile, BSS D&EP FA can constitute the basis for rational decisions not only for BSS providers, but also for clients. These issues classify into economics problems of Software Engineering Research and Practice (SERP).*

Keywords: rational investment decision, functional size measurement, functional assessment, business software systems development and enhancement projects effectiveness and economic efficiency

1 Introduction and related work

Each rational investment decision should meet three basic criteria [1], which in the context of Business Software Systems (BSS) Development and Enhancement Projects (D&EP) should be interpreted as fallows:

- Criterion of economic efficiency, meaning that the decision should benefit to the maximisation of the relationship between the effects to be gained as a result of project execution and the costs being estimated for the project.
- Criterion of effectiveness, meaning that such decision should contribute to achieving the assumed result, in the case of BSS D&EP usually being considered as delivering product meeting client's requirements with regard to functions and features without budget and time overruns.
- Criterion of consistency, which means that the project should comply with the environment (economic, organisational, legal and cultural) – unlike the above two criteria, this criterion is not subject to quantitative assessment therefore it is skipped in this paper.

Generally speaking, in the case of economic efficiency evaluation, effects are compared against costs necessary to achieve these effects while in the case of effectiveness evaluation these are only results that are of significance. Thus, economic efficiency (*Ef*) is measured by relating total effects (*Efec*) to total costs (*C*), most often as:

$$Ef = Efec / C. \quad (1)$$

Meanwhile, effectiveness (*Efs*) is measured by the ratio of the achieved result (*Ra*) to the assumed result (*Ras*), which is being conveniently expressed as a percentage:

$$Efs = (Ra / Ras) \times 100\%. \quad (2)$$

Both economic efficiency criterion as well as effectiveness criterion is based on the obvious assumption that the effects, costs and results are measurable. However, in the case of BSS D&EP this assumption is often treated as controversial. Numerous studies indicate that evaluation of BSS D&EP efficiency is made relatively rarely while fundamental reason for this *status quo* are difficulties related to identification, and most of all quantitative expression, of benefits resulting from the execution of such projects (see e.g., [2], [3], [4], [5], [6]). These studies reveal that difficulties related to identification and quantitative expression of BSS D&EP costs too are of significance, which also is of importance to the evaluation of their effectiveness.

Key conclusions coming from the above mentioned studies have been confirmed also by the results of studies carried out by the author of this paper in two research cycles among Polish dedicated BSS providers [7]. They revealed that at the turn of the years 2005/2006 the results obtained with the use of the effort estimation methods, employed only by approx. 45% of the respondents, were designed for estimating BSS D&EP costs and time frame while relatively rarely they were used to estimate economic efficiency – such use of these methods was indicated by only 25% of those using effort estimation methods. Heads of IT departments in Polish companies, for which BSS D&EP are executed, still explain the sporadically required calculation of this type of investments efficiency mostly by the necessity to undertake them – most often due to the fact that without such solutions they lack possibility to match competition from foreign companies, as well as to match foreign business partners requirements. While Polish public administration institutions in practice still do not see the need for the BSS D&EP economic efficiency evaluation, in most cases as an argument giving the non-economic purposes of systems being implemented in this type of organisations. On the other hand, at the turn of the years 2008/2009 the results obtained with the use of the BSS D&EP effort estimation methods (approx. 53% of BSS providers surveyed in this cycle declared they commonly employed such methods) were more often used to estimate efficiency: there was an increase to approx. 36% of those using effort estimation methods. This applies to internal IT departments of Polish companies yet still it does not

comprise public administration institutions. This increase may be explained first of all by stronger care about financial means in the times of recession, however it still leaves a lot to be desired.

What's more, majority of BSS D&EP fail to meet criteria of their effectiveness, what leads to the substantial financial losses, on a worldwide scale estimated to be hundreds of billions of dollars yearly. As indicated by the results of Standish Group analyses success rate for application D&EP has never gone beyond 35%, while currently 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 time – by nearly 80% on average [8]. In the case of new application development the success rate is only 4% [9]. Meanwhile, analyses by T.C. Jones plainly indicate that those software D&EP, which are aimed at delivery of BSS, have the lowest chance to succeed [10]. It was proved also by the Panorama Consulting Group, which revealed that merely 7% of the surveyed ERP (Enterprise Resource Planning) systems projects were accomplished as planned [11].

All above presented results unequivocally implies a significant need to rationalize investment decisions made with regard to BSS D&EP. For each BSS D&EP there are functional goals being set. Thus if one assumes that fundamental benefit for a client coming from the execution of such project is functionality of BSS or increase in functionality it brings, it may then justify the necessary investment costs. What allows for making this assumption is a specificity of the considered types of projects, which indicates that BSS D&EP product functionality is an attribute of priority significance to a client, deciding on the possibility of business processes execution therefore determining the value of BSS. What is more, software product functionality may be expressed quantitatively – with the use of the so-called product functional size, for which are meant the concept and the methods of Functional Size Measurement (FSM), having been recently standardized by the ISO/IEC (see [12], [13], [14], [15], [16], [17]), thus constituting rational basis for determining BSS D&EP key attributes (work effort, cost and duration). The product functional size is defined as „size of the software derived by quantifying the Functional User Requirements", while functional user requirements (FUR) stand for the „sub-set of the User Requirements describing what the software does, in terms of tasks and services" [12, Part 1].

The FSM concept and methods constitutes basis of the southernSCOPE [18] and northernSCOPE [19] methodologies supporting the management of BSS D&EP functional scope, i.e., scope measured on the basis of functional size of their product. Concurrently with the above methodologies the author of this paper proposed and verified in practice her own concept, designed for the functional assessment of BSS D&EP. As this paper aims at proving from *theoretical* perspective the capabilities of using this approach in the context of *ex ante* and *ex post* quantitative evaluation of BSS D&EP effectiveness and economic efficiency, the short presentation of the functional assessment concept appears vital here as well. It should be mentioned that due to the limited volume of the paper it will only feature conclusions coming from the *practical* verification of functional assessment concept – this verification is widely presented in [20] and [21].

2 Functional Assessment of BSS D&EP

The FSM capabilities can be used for the assessment of BSS D&EP from a functional – that is from the most important to a client – point of view. *Ex ante* and *ex post* assessment of such projects made on the basis of their products' FSM will be then called Functional Assessment (FA). Key attributes of FA include: product functional size (*FS*), work effort which needs to be spent on *FS* development/enhancement (*E*), and functional productivity (*P*) understood as the ratio of product functional size to the work effort on *FS* development/enhancement (*FS/E*), or – being inversion of functional productivity – work effort necessary to achieve functionality unit ($E(fu)=E/FS$) that determines work cost per *FS* unit ($C(fu)$).

In order for BSS D&EP to be considered as complying with the criteria of FA, its ***r***equired (*FSr*, *Er*, *Pr*), ***o***ffered (*FSo*, *Eo*, *Po*) and ***re***alized (*FSre*, *Ere*, *Pre*) functional attributes should meet the following conditions:

1. Product functional size – both required by a client (*FSr*) as well as offered (*FSo*) and realized (*FSre*) by a provider – must be within the range allowed for *FSr*, i.e., [*FS*min, *FS*max], where: *FS*min – stands for minimum while *FS*max – stands for maximum required functional size. Defining of *FS*max results from the fact that only about 20% of functions and features specified ever get used [8]. Thus delineating *FS*max reduces the risk of delivering needless functionality.
2. Work effort – both expected by a client (*Er*) as well as offered (*Eo*) and realized (*Ere*) by a provider – must be within the range allowed for *Er*, i.e., [*E*min, *E*max], where: *E*min – stands for minimum while *E*max – stands for maximum effort expected by a client. *E*min should not be lower than the effort enabling for delivering minimum required functional size (*FS*min).
3. Functional productivity – both required by a client (*Pr*) as well as offered (*Po*) and realized (*Pre*) by a provider – must be within the range allowed for *Pr*, i.e., [*P*min, *P*max], where: *P*min – stands for minimum while *P*max – stands for maximum productivity required by a client. Having *P*max defined is useful for rational provider offer selection, i.e., from the point of view of limiting the risk of choosing the offer where the productivity would be defined as overstated value. Since such situation would mean that in fact the effort per functionality unit (i.e., function point) is likely to be exceeded, what would entail the risk of delivering product having functional size lower than the allowed one as the provider would be probably trying not to go over the offered effort. In addition, delineating *P*max is conducive to the increased probability of delivering product of sufficient quality.

Allowed minimum and maximum values of functional attributes (*FS*min, *FS*max, *E*min, *E*max, *P*min, *P*max) depend on the development stage and thus on the FA stage. They take into account maximum allowed (in accordance with the rules of FSM) estimation error: at the analysis stage estimation error up to ±30% is allowed

while in the case the detailed FUR are already known, estimation error should not exceed ±10%. Attributes required by client (*FSr, Er, Pr*) are being corrected by this error – minimum and maximum values of functional attributes allowed at given stage are thus calculated.

The verification of FA approach, presented widely in [21], showed that fulfilling these conditions ensures:

- Rationality of client requirements with regard to the FA attributes.
- Conformity of the potential provider offers with rational client requirements concerning FA attributes.
- Conformity of the realized project with rational client requirements concerning FA attributes.

Advantage of the FA concept over southernSCOPE and northernSCOPE methodologies, proved and explained in detail in [20], results from the fact of the concept adopting two significant assumptions, not being explicitly specified in these methodologies, namely:

- Need to apply upper bounds of the allowed tolerance intervals for required, offered and realized functional size and functional productivity and lower bounds for work effort.
- Need to employ at least two stages of estimation: first one for proper assessment of the investment decision rationality while second stage – in order to choose suitable product provider.

Therefore, comparing to these methodologies, usage of the FA concept reduces the risk of choosing inappropriate provider as well as the risk of lowered *ex ante* and overstated *ex post* product pricing, and consequently, it reduces the chance of failing to deliver required functionality and/or product of insufficient quality.

3 Using Functional Assessment to the BSS D&EP effectiveness evaluation

What appears to be of particular importance in view of problems concerning effective execution of BSS D&EP that may be found in practice (see section 1) is the possibility to specify quantitative criteria allowing for the evaluation of compatibility degree of the submitted providers' offers and the executed project with client requirements. Delineation of FA attributes allows to define indicators of both offered and realized effectiveness with regard to such attributes. Hence defining (see formula (2)):

- Compatibility degree of *FSo* (*CDFSo*), where:

$$CDFSo = (FSo \,/\, FS\max) \times 100\%,$$

  allows to express quantitatively the conformity level of functionality offered by provider with optimum functionality for a client.
- Compatibility degree of *Eo* (*CDEo*), where:

$$CDEo = (E\min \,/\, Eo) \times 100\%,$$

  allows to express quantitatively the conformity level of work effort offered by provider with work effort being optimum to a client.
- Compatibility degree of *Po* (*CDPo*), where:

$$CDPo = (Po \,/\, P\max) \times 100\%,$$

  allows to express quantitatively the conformity level of the offered functional productivity with functional productivity being optimum to a client.
- Compatibility degree of *FSre* (*CDFSre*), where:

$$CDFSre = (FSre \,/ FS\max) \times 100\%,$$

  allows to express quantitatively the conformity level of functionality realized by provider with optimum functionality for a client.
- Compatibility degree of *Ere* (*CDEre*), where:

$$CDEre = (E\min \,/\, Ere) \times 100\%,$$

  allows to express quantitatively the conformity level of work effort realized by provider with that being optimum to a client.
- Compatibility degree of *Pre* (*CDPre*), where:

$$CDPre = (Pre \,/\, P\max) \times 100\%,$$

  allows to express quantitatively the conformity level of the realized functional productivity with functional productivity being optimum to a client.

Fulfilling the functional assessment conditions presented in section 2 means that the following conditions for the *offered effectiveness* indicators are also met:

1. *CDFSo* is within the allowed range, that is:

$$CDFSo(\min) \le CDFSo \le CDFSo(\max),$$

   where:
   - *CDFSo*(min) – minimum accepted compatibility degree of functionality offered by provider (*FSo* = *FS*min), meaning sufficient *expected* effectiveness of functionality requirements execution, that is:

$$CDFSo(\min) = (FS\min \,/\, FS\max) \times 100\%,$$

   - *CDFSo*(max) – maximum accepted compatibility degree of functionality offered by provider (*FSo* = *FS*max), that is:

$$CDFSo(\max) = (FS\max \,/\, FS\max) \times 100\% = 100\%.$$

2. *CDEo* is within the allowed range, that is:

$$CDEo(\min) \le CDEo \le CDEo(\max),$$

   where:
   - *CDEo*(min) – minimum accepted compatibility degree of work effort offered by provider (*Eo* = *E*max), meaning sufficient *expected* effectiveness of work effort requirements execution, that is:

$$CDEo(\min) = (E\min \,/\, E\max) \times 100\%,$$

   - *CDEo*(max) – maximum accepted compatibility degree of work effort offered by provider (*Eo* = *E*min), that is:

$$CDEo(\max) = (E\min \,/\, E\min) \times 100\% = 100\%.$$

3. *CDPo* is within the allowed range, that is:

$$CDPo(\min) \le CDPo \le CDPo(\max),$$

   where:
   - *CDPo*(min) – minimum accepted compatibility degree of functional productivity offered by provider (*Po* = *P*min), meaning sufficient *expected* effectiveness of functional productivity requirements execution, that is:

$$CDPo(\min) = (P\min \,/\, P\max) \times 100\%,$$

   - *CDPo*(max) – maximum accepted compatibility degree of functional productivity offered by provider (*Po* = *P*max), that is:

$$CDPo(\max) = (P\max \,/\, P\max) \times 100\% = 100\%.$$

Among offers of BSS providers meeting the above conditions, this is the offer with the highest *CDPo* that is best suited to client's requirements with regard to the criteria of FA – since it stands for the highest offered

allowed functional productivity, or the lowest offered allowed work effort per functionality unit, which decides on unit work cost measured with regard to the functional size unit. This cost, along with the required functional size (*FSr*), should constitute basis for the formal *ex ante* pricing of project product (for more details see [21]).

Meeting the functional assessment conditions presented in section 2 means that the following conditions for the *realized effectiveness* indicators are also fulfilled:

1. *CDFSre* is within the allowed range, that is:

$$CDFSre(\min) \le CDFSre \le CDFSre(\max),$$

where:

- *CDFSre*(min) – minimum accepted compatibility degree of functionality realized by provider (*FSre* = *FS*min), meaning sufficient *actual* effectiveness of functionality requirements execution, that is:

$$CDFSre(\min) = (FS\min / FS\max) \times 100\%,$$

- *CDFSre*(max) – maximum accepted compatibility degree of functionality realized by provider (*FSre* = *FS*max), that is:

$$CDFSre(\max) = (FS\max / FS\max) \times 100\% = 100\%.$$

2. *CDEre* is within the allowed range, that is:

$$CDEre(\min) \le CDEre \le CDEre(\max),$$

where:

- *CDEre*(min) – minimum accepted compatibility degree of work effort realized by provider (*Ere* = *E*max), meaning sufficient *actual* effectiveness of work effort requirements execution, that is:

$$CDEre(\min) = (E\min / E\max) \times 100\%,$$

- *CDEre*(max) – maximum accepted compatibility degree of work effort realized by provider (*Ere* = *E*min), that is:

$$CDEre(\max) = (E\min / E\min) \times 100\% = 100\%.$$

3. *CDPre* is within the allowed range, that is:

$$CDPre(\min) \le CDPre \le CDPre(\max),$$

where:

- *CDPre*(min) – minimum accepted compatibility degree of functional productivity realized by provider (*Pre* = *P*min), meaning sufficient *actual* effectiveness of productivity requirements execution, that is:

$$CDPre(\min) = (P\min / P\max) \times 100\%,$$

- *CDPre*(max) – maximum accepted compatibility degree of functional productivity realized by provider (*Pre* = *P*max), that is:

$$CDPre(\max) = (P\max / P\max) \times 100\% = 100\%.$$

These conditions allow to verify accuracy of prognoses and the execution level of provider's commitments to a client. From client's point of view, they enable to make rational *ex post* pricing of project product based on measurement of the realized functional size (*FSre*) and work cost per functionality unit formally agreed at the stage of provider selection (for more details see [21]). Thus client will pay for the actually delivered product functional size – and not for the functionality that was offered yet not realized by the provider.

Thus, functional assessment of BSS D&EP is conducive to making investment decisions that meet the criterion of effectiveness in the area of functional attributes, that is those contributing to delivering product compatible with client's rational requirements with regard to these attributes. This is possible thanks to:

- The possibility of determining sufficient expected effectiveness of functional attributes execution (indicators: *CDFSo*(min), *CDEo*(min), *CDPo*(min)).
- The possibility to eliminate providers' offers that do not meet conditions of the sufficient expected effectiveness of functional attributes execution on the basis of the offered effectiveness indicators (*CDFSo*, *CDEo* and *CDPo*).
- The possibility to choose offer being best suited to client's rational requirements with regard to functional attributes, that is having the highest allowed offered effectiveness of required productivity execution (having the highest *CDPo*).

Thanks to the realized effectiveness indicators (*CDFSre*, *CDEre*, *CDPre*) and to comparing them against indicators of sufficient execution effectiveness (*CDFSre*(min), *CDEre*(min), *CDPre*(min)), functional assessment allows also for the evaluation of the realized project effectiveness in terms of functional attributes.

4 Using Functional Assessment to the BSS D&EP economic efficiency evaluation

Assuming that the major benefit of the BSS D&EP execution to a client is functionality brought by the project, which is measurable with the use of product functional size for every BSS, then, without excessive simplification, it may be presumed that:

1. Fundamental effect arising from the BSS D&EP execution is the value of product functional size, that is the value of functional benefits brought about by project ($Efec_f$), being the product of this size (*FS*) and the value delivering by functionality unit (*V*(*fu*)).
2. Fundamental costs required for the BSS D&EP execution are total work costs of the project execution (*WC*), being the product of effort (*E*) and unit work cost calculated with regard to effort unit (*C*(*eu*)).

Therefore, in accordance with the formula (1), we will receive the following:

$$Ef = Efec_f / WC = (FS \times V(fu))/(E \times C(eu)).$$

On the whole, if a project was economically efficient the value of benefits coming from its execution would have to be higher than its costs and therefore general condition of BSS D&EP economic efficiency with the adopted assumptions will read as follows:

$$(FS \times V(fu))/(E \times C(eu)) > 1,$$

which means that:

$$P > C(eu)/V(fu).$$

Hence if functional productivity (*P*) is higher than the ratio of unit work cost calculated with regard to effort unit (*C*(*eu*)) to the value delivering by functionality unit (*V*(*fu*)) than, following the adopted assumptions, project having such productivity will be considered economically efficient. Value delivering by functionality unit must be therefore higher than the quotient of this unit work cost and productivity.

In the situation where in the market work costs for projects of similar characteristics are evened out, i.e., where unit work cost calculated with regard to effort unit ($C(eu)$) does not constitute factor differentiating offers of potential providers, minimum value delivering by functionality unit ($V(fu)$) necessary to ensure project efficiency depends on the productivity (P): the higher the productivity, the lower this minimum value. In this sense higher productivity allows for working out lower value by functionality unit to ensure project efficiency. When product functional size (FS) is known, determining minimum $V(fu)$ allows to determine minimum value of functional benefits necessary to ensure project efficiency.

5 Relationships between Functional Assessment and the BSS D&EP effectiveness and economic efficiency evaluation

Based on the adopted assumptions the following conclusions may be drawn:

1. Project execution variant consistent with functional assessment criteria will be also economically efficient if the value delivering by functionality unit ($V(fu)$) will be higher than work cost per functionality unit ($C(fu)$) offered in this variant, being determined by the offered work effort per functionality unit ($E(fu)$). It means that variant consistent with functional assessment criteria may not be economically efficient since there is no possibility for it to guarantee that functionality unit will produce value being sufficient to it – as this value depends on usage the realized functionality by client.
2. Economically efficient variant of project execution also will be consistent with functional assessment criteria if work cost per functionality unit ($C(fu)$) offered in this variant will be within the allowed range of values, resulting from the allowed range for functional productivity (see condition 3 in section 2), as well as it will meet adequate conditions concerning the offered product functional size (see condition 1 in section 2) and offered work effort (see condition 2 in section 2). It means that variant not consistent with FA criteria may in fact be economically efficient.
3. Among project execution variants consistent with FA criteria what proves being optimum variant with regard to this assessment is the one characterised by the highest offered functional productivity being within the allowed range, i.e., with the highest $CDPo$.
4. What proves being optimum variant in terms of economic efficiency in the case of efficient variants is variant having the lowest value delivering by functionality unit ($V(fu)$) necessary to ensure project efficiency, so the variant having the highest offered functional productivity (P), which means the lowest offered work effort per functionality unit ($E(fu)$).
5. Project execution variant being optimum with regard to functional assessment and economically efficient will also be optimum in terms of economic efficiency if the highest functional productivity offered in economically efficient variants is not higher than maximum allowed functional productivity (Pmax). Otherwise such variant will not be optimum in terms of economic efficiency – as the optimum variant will be the one characterised by the highest offered functional productivity, exceeding maximum allowed functional productivity.
6. Project execution variant being optimum with regard to economic efficiency and meeting criteria of FA will also be optimum in terms of functional assessment.

As indicated by the analysis, variant being optimum in terms of economic efficiency does not have to be optimum in terms of FA – and vice versa, but also economically efficient variant does not have to be the variant consistent with FA criteria, either – and vice versa. While functional assessment imposes additional limitations on the execution variants, having fundamental character from client's point of view as they concern the effectiveness of meeting his requirements with regard to FA attributes.

Hence taking into account only the criterion of economic efficiency, which with the given assumptions is boiled down to the evaluation of the offered functional productivity without considering the allowed range of values, client faces the risk of the lack of effectiveness in project execution. As the same productivity may be offered by execution variants that differ with regard to the offered functional size and offered work effort, being the attributes that may not correspond with client's rational requirements. If project product was to meet the required functions, it is necessary to deliver adequate functional size, being within the allowed tolerance interval, which on the other hand requires paying corresponding work effort, also with some tolerance.

Moreover, the author is of opinion that the chance for the execution of economically efficient project without ensuring its compatibility with the required product functionality, being the source of the expected benefits, as well as with the expected work costs, goes down. Hence one may formulate hypothesis that this is project effectiveness that decides on its efficiency. In addition, not taking into account the allowed ranges of values for the offered functional productivity increases the risk of overstating or understating the effort per functionality unit, which as a result may cause some negative consequences. From the viewpoint of economic efficiency, the most important among such consequences would be failure to deliver required functional size, caused by the overstated productivity, that is by the understated unit work effort ($E(fu)$), which in the situation where the unit work cost is independent on the product size will result in the necessity to increase the value delivering by functionality unit ($V(fu)$) necessary to ensure project efficiency. Therefore, despite the fact that work effort per functionality unit was understated by a provider, this is client who pays the consequences of such understating.

In addition, evaluation of economic efficiency in no way contributes to the reduction of negative phenomena, being common to the Polish BSS D&EP practice, which consist in: deliberate lowering of planned BSS execution costs by offerors in order to win the contract, uncontrolled increase in client's functional requirements as to the product not being correspondingly reflected in the costs of project as well as in non-rational *ex ante* and *ex post* product pricing. Since these phenomena promote exceeding of project execution costs and delivering of functionality lower than the required one, the chance for achieving expected economic efficiency drops. The FA approach verification proved that using this concept

allows limiting these negative phenomena (for more details see [20] and [21]).

Functional assessment, on the other hand, does not serve as a substitute for the evaluation of project economic efficiency as it does not allow to state unconditionally whether given execution variant is economically efficient, however it supports efficiency analysis. And this is because it allows for *ex ante* and *ex post* determining of project execution work costs, comparing them against the offered costs as well as determining – with the adopted assumptions at all its stages – of the project efficiency condition, i.e., the lowest value, which should be delivered by functionality unit to ensure project economic efficiency. This allows for determining minimum value of functional benefits being necessary to achieve this efficiency for the required product functional size. These activities enable to:

- Compare thus calculated value of benefits with potential value assumed by client
- Make it easier to assess the possibility to achieve value of functional benefits being necessary to ensure economic efficiency
- Compare execution variants from the point of view of expected and offered work costs and economic efficiency condition
- Select execution variant having the highest potential economic efficiency
- Compare expected value of functional benefits and work cost of the chosen execution variant against the value of actual benefits and costs.

Therefore estimation of BSS D&EP *economic efficiency should be supplemented with functional assessment, comprising also the evaluation of project effectiveness with regard to functional attributes and additionally, promoting the reduction of negative phenomena mentioned above*. Thus the two measurable criteria of the rational investment decision made with regard to the BSS D&EP will be fulfilled, which as a result should satisfy both the management of an investor and the users of future product.

6 Concluding remarks

Summing up it should be stated that the concept of BSS D&EP functional assessment proposed by the author, based on the FSM concept and methods, allows for:

- *Ex ante* and *ex post* evaluation of BSS D&EP effectiveness – thanks to the possibility of estimating compatibility degree of FA attributes offered by provider and possibility of measuring compatibility degree of FA attributes realized by provider with FA attributes required by client.
- Supporting evaluation of BSS D&EP economic efficiency – thanks to the possibility of *ex ante* and *ex post* determining of project work costs, comparing them against the costs offered by provider as well as determining of the project economic efficiency condition.

This is possible thanks to the FA capabilities, being proved in the verification carried out in practice on the basis of case study (see [20] and [21]), which revealed that FA allows, among others, for:

- Identification of functional benefits coming from the BSS D&EP execution and expressing these benefits quantitatively in the form of required, offered and realized product functional size.
- Identification of BSS D&EP work costs and expressing them quantitatively in the form of required, offered and realized project work effort.
- Justification of investment costs for BSS D&EP that need to be paid by client.
- Determining client's FA attributes requirements towards BSS D&EP provider in a way that is not only measurable, but also rational, which means that the expected FA attributes will be neither unrealistically overstated (product functional size, productivity) nor understated (work effort).
- Making rational investment decision by a client on engaging in the execution of BSS D&EP on the basis of initially estimated FA attributes.
- Making rational decision by potential providers on the offered work cost per functionality unit, that is on offering it on the level that is neither understated (the risk of exceeding this cost is passed to the provider) nor overstated (inflated level reduces the chance of choosing given provider's offer), what needs awareness of own productivity and proper productivity management, thus needs improvement of software processes.
- Client's evaluation of the submitted offers for BSS D&EP execution and selection of offer (offers) being most suited to his requirements in terms of FA attributes.
- Comparing variants of BSS D&EP execution from the viewpoint of the estimated work costs and economic efficiency condition as well as selecting variant having the highest potential efficiency.
- Formal *ex ante* pricing of BSS based on the estimated required functional size and on the work cost per functionality unit offered by the chosen provider and approved by client, therefore mutually agreed.
- *Ex post* pricing of the delivered BSS on the basis of actually realized product functional size and work cost per functionality unit, having been mutually and formally agreed by client and provider at the stage of choosing provider.
- Evaluation of the realized BSS D&EP with regard to the compatibility with client requirements concerning FA attributes and verification of accuracy of prognoses concerning FA attributes along with determining of the potential causes of discrepancies between the actual and estimated values.
- Collecting own benchmarking data, expressing dependencies being specific to the given provider, what allows to reduce the risk of insufficiently accurate estimation for the FA attributes of BSS D&EP that are going to be realized in future.
- Improving of FSM methods and effort estimation models and thus software development and enhancement processes.

In the case of projects for which it is possible to make objective and reliable economic efficiency estimation, functional assessment, concerning first of all effectiveness of the functional requirements execution, should be treated as supplementary – thus the two measurable criteria of rational investment decision will be fulfilled. This is because the efficiency evaluation does not allow for

assessing the effectiveness of functional requirements execution, neither it contributes to reducing the mentioned above negative phenomena occurring in the practice of BSS D&EP execution. What is more, in view of these negative phenomena, actual project efficiency probably will be below the estimated one.

Functional assessment, on the other hand, is not a substitute for the evaluation of economic efficiency although it does support its analysis. This is because it allows for *ex ante* and *ex post* determining of project work costs and, having adequate assumption adopted, it also enables to answer the question about the condition, which should be fulfilled so that a specified execution variant is economically efficient. As a result it enables to determine values of functional benefits being necessary to ensure economic efficiency of the required functionality execution. Thus it makes it easier to evaluate the chance of achieving such benefits as well as it enables to assess particular execution variants in this respect and indicate variant characterized by the highest potential economic efficiency. What is more, project product's compatibility with required functionality increases the chance to achieve assumed benefits whereas project's compatibility with the expected work effort with taking into account assumed benefits – to execute project that is economically efficient. However, it does not allow to state categorically *whether* or not given execution variant is economically efficient but only to specify *when* it is going to be economically efficient. Thus the usefulness of FA comes into view particularly in the case of these projects for which objective and reliable *ex ante* proving of their economic efficiency is very hard or controversial, or it is not of key importance (e.g., some projects which are executed in public administration) or not justified (e.g., the so-called obligatory projects, being undertaken to make it possible for a company to survive on the market).

Conclusions coming from the above analysis clearly indicate, that BSS D&EP FA concept can constitute the basis for rational decisions not only for BSS providers, but also for BSS clients. Thus this paper, by linking the FSM issues with economic aspects through the FA concept, may contribute to better understanding of the FSM importance, still being underestimated by business managers, as in the subject literature these issues are usually considered from the technical perspective.

The surveys on these issues will be continued while the research area will be extended to other economic BSS D&EP aspects.

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