Using the CASSE Framework to assess the business viability of potential software projects: an empirical study

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Abstract

The opportunity cost decision of selecting a software project is dependent, among other things, on how a given project best meets a company's business goals and overall competitive strategy. Remaining competitive in the agile software market today requires selecting only those projects that position a business strategically in the market place and that render it competitive over time. Using an industrial case study, we demonstrate the role of the Complex Adaptive Systems Software Engineering (CASSE) framework in supporting value-based project selection. We apply Actor Object Dependencies (AOD) analysis and Functional Points (FP) sizing techniques to predict the overall project value before incurring any actual costs of implementing such a project. The overall contribution of this work therefore lies in demonstrating that alternative engineering approaches that analyze AODs can enhance how we select software projects and how we plan project schedules optimally so as to increase business value derived on projects.

Keywords: *Project Selection Techniques, CASSE Framework, Software Economics.*

1. Introduction

The software project value differentiator in a market place is primarily dependent on process engineering approaches that optimize the scope, schedule, cost and budget constraints of the project, thus ensuring that stakeholder benefit is realized on completion of the project [1].

Studies such as [2] and [3] have shown that project requirements are complex; they are volatile, they evolve, and they require deeper scrutiny to assess dependencies between them, and at the same time to gauge the right level of effort to deliver a product on time, within scope and within budget. Consequently, there is a clear need in this changeable software market for integrated approaches, tools and techniques that make it possible to select viable projects, based on their scope, their requirements, and their complexity.

This work draws from available literature in value-based software engineering, such as [4 and 5] to provide an integrated approach for assessing overall value on a software project. We perceive value as the benefit realised in terms of profit or long-term business benefit that the software vendor derives from a project, given the project's overheads.

2. Purpose

We aimed at examining how the emergent AOD analysis technique of the CASSE framework can be applied to support viable project selection. Such a mechanism would eventually enhance evaluation of the probability distribution of profits and losses on a software project before investment costs on such a project are incurred.

3. The CASSE Framework Approach

This technique is based on understanding and modeling the entire project as a complex adaptive system in which patterns of interrelationships emerge from local interrelationships between requirements and their artefacts. As modifications for value matrices on the project occur, new patterns are continuously emerging. These could have a huge impact on the profit-loss and distribution curve for the project. The belief is that the emerging patterns must be projected to a management dashboard so as to aid effective decision making in real time. This technique is built around the AOD modelling facets which we describe in our previous work [6 and 7].

We infer that as a time saving mechanism, the visibility of the project status must be projected in a simple format and must be easily interpretable. In this approach, we suggest a project value evaluator as a sufficient option. This mechanism was developed and tested as a feedback channel to management. Its overall aim is to highlight the business status of any potential project in comparison to the established business strategy in the company.

Over the years, our industrial experience has enabled us realize the growing need for informed feedback on projects especially when it comes to selling ideas to management or even convincing management about taking certain decisions that are strategic to business. Decisions makers often don't have much time to read long project reports prepared by the technical people. Rather, they only require brief information which at the same time is informed enough to give them a wider view of what is being presented.

3.1 The Project Value Evaluator

Our conviction is that the project value evaluator would offer this visibility. It is used to broadly asses projects and their value within a given project portfolio. It compares project benefit against investment in the project as illustrated in Fig. 1.

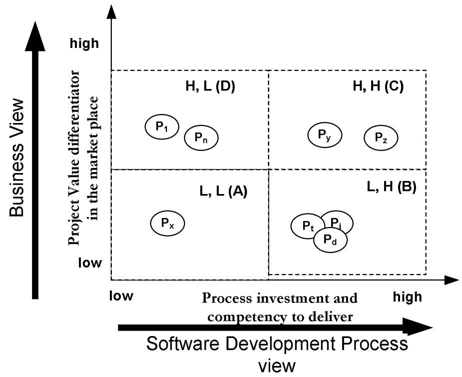

Figure 1: Project value evaluator

The X-axis represents the software process development view in which measurement is done on the process investment and competency required to deliver a project within time, scope and budget. The Y-axis represents the business view in which the project value differentiator in the market is evaluated.

Projects that have low value and low process investment to deliver are displayed in *L, L (A)*. This implies that such projects will yield low return on investment and may not necessarily be valuable to the business, both in the short and long run. They should therefore be exited and potential resources that would have been invested on such projects be channelled to other investment options. Projects that have high process investment to deliver yet with low business value are displayed in *L, H (B)*. This implies that the development process will be constrained with high investment required to implement and complete the project gracefully. This could be in terms of time or cost. The value axis in this quadrant indicates that there will be low value for that project in both the short term and in the long term. Therefore, projects in this quadrant are highly susceptible to project failure with high losses. However, they have significant promise and can easily be fixed.

On the other hand, projects that have high development process investment as well as high business value will be displayed in *H, H (C*). This could be for both the short and long run time frames. This quadrant characterises new technology development projects which requires time to mature but have high value in the long run. Thus, these projects must be managed and exploited for the fact that cash flow from these projects can be used to fund more attractive investments. Projects that have high value and low process investment will be displayed in *H, L (D)*. This is the most viable quadrant that every business would want to operate in. It reflects maturity in the software development process. It may imply that you have the right competency to deliver and that most of the features proposed already exist in your project database or software platform. It is very favorable for customizable software products. Whence, such projects exhibiting significant opportunity for growth must be given first priority as such projects hold the greatest potential for value creation.

As a profitability objective function, the framework requires that at project selection, the entire project is scored against the business value threshold. This threshold is always described in the business operations model. The output of this assessment and prediction is in turn projected to this dashboard.

4. Case Study Evaluation

4.1 Case Study Description

This specific case study entailed evaluating system needs as presented in the Request For Proposal (RFP) document for the development of an on-campus crime management system for Joliet Junior College**,** Illinois. The RFP call described it as a police records management system. This system would fulfil the College's need for documenting and managing crime records as well as overall crime control on the premises. By using a formal RFP process, Joliet Junior College management thus sent out an RFP to interested software companies that would provide a useful software solution to this problem. A copy of this RFP is available here [8].

This project had the following characteristics. The RFP was issued on March 7, 2008 and the deadline for interested companies to submit their questions in relation to the project, was set for March 14, 2008. This particular scenario meant that the client expected companies to investigate the proposal needs and submit the required quotation within 7 days after issuing the RFP. The anticipated announcement of the award was April 9, 2008. Any successful applicant for this job (based upon the lowest cost and the criteria set forth under the Evaluation section of the RFP) was expected to install the system by June 30, 2008. This would allow for a maximum of only 50 production days (about 400 man hours, excluding overtime) to analyse, design, implement, test and install the entire system. The client was strict on the final product delivery deadline. This meant that the project schedule was inflexible, requiring the optimisation of resources in order to meet the deadline.

This project thus assumed that any interested company would have the necessary capacity to deliver such a system within such a short period of time. It was assumed that vendors whose product-line fell within this ambit would only need to customise existing features to suit the desired functionality. New players in the market, if successful, would have to develop everything from scratch or to adapt existing open-source libraries to suit the desired functionality.

Having been a systems analyst employed by a company that was interested in responding to this RFP call, one of us was required by management to submit a quotation for this project proposal. This quotation had to take into account the high-level requirements given in the RFP document as well as other budgetary concerns. The company was initially using heuristic ways of quoting for projects without any major metric or tool used for estimation, but rather basing it on project characterises and experience.

As a result, the CASSE framework was particularly useful at this stage. The original estimate using traditional means was a round figure of R195, 000 (taking $1 = R10). The CASSE approach, however, came to a different result, although it was not far off from the estimated result.

The quoting process for this project was based on the last scenario describe above (new players) since this company had never developed any solution of this kind before. However, the company believed that it had the right competency to deliver the desired solution within the specified schedule. The results obtained by the CASSE approach were not final; they were only suggested to management as guidelines for informed decision making. They were thus forwarded to management who would make the final recommendation on the viability of the project. This eliminated bias in analysis, and gave management an opportunity to compare the suggested approach with the traditional means in order to ascertain if such an approach was worth integrating in the development process.

Given this background and using CASSE analytics (a tool born out of the framework), viability of the project based on the preliminary requirements in the RFP document was analysed. The idea for using this tool was that the results obtained would be benchmarked with the heuristic figure obtained using the traditional quoting methods adopted by the company. This would create a favourable situation to obtaining a reconcilable quotation for the envisaged project based on the two approaches. The biggest threat here was that the requirements were incomplete and lacking in clarity in the initial stage, thus any modelling and subsequent estimation would only be indicative of the likely project status. There was a significant chance that the project requirements would change as the client began more fully to understand the needs of the system. This would ultimately have cascading effects on the overall project budget, timelines and scope.

Consequently, CASSE analytics was specifically applied to illustrate how a company can fine-tune the project constraints to ensure that a viable project is selected, to predict a viable implementation time, to rank the project value and to prioritise the features in order to optimise a given production process.

4.2 Analysis Parameters

In this analysis, parameters of interest included the following: A UML Actor Object Graphical model (as a conceptual static structure) generated from the high-level requirements provided; the overall anticipated budget that would be obtained as a sum of expected development costs and other expenses on the project; expected income as derived from the overall project figure; expected net profit after budgetary expenses; overall time span as provided for in the RFP document; predicted time according to the CASSE analytics; and expected slack/overrun time as a difference between available and predicted time.

The highest investment value of R700 (as the hourly rate for this project) per functional point was proposed. This value represents the actual costs incurred in analysing, designing, developing and testing each functional point on an hourly basis. Conversely, the proposed highest return on investment was R2,500 per functional point. This meant that anticipated profit per Functional Point (FP) amounting to R1,800 would be realised as a mark-up difference between high return on investment and high investment.

Making any adjustments of any of these parameters would result in assessing the most suitable operating point. This point would be used in making investment decisions on this project.

4.3 Case Study Analysis Results

The following results were obtained, as shown in Table 3 (the figures have been adjusted for confidentiality purposes but do reflect the project status).

Table 1: Project viability status

Item	Quantity
Total project costs (budget)	R125,000
Expected development costs	R50,760
Other project expenses	R74,240
Expected project income	R211,500
Expected gross profit	R160,740
Net profit expected	R86,500
Time span	400hrs
Predicted time	194hrs
Expected slack/overrun	206hrs

With a budget estimate of R125,000 (as the sum of development costs of R50,760 and other budgetary expenses of R74,240), the model predicted 194 hours of project time out of the expected 400 hours derived from the RFP document. This left 206 hours of slack time. The expected income in this regard (as the overall quoted figure) was R211,500. The difference between expected income and expected development costs resulted in R160,740 as profit, before the deduction of other budgetary expenses. The net income would thus be R86,500 being the difference between the expected project income and the anticipated total project budget. This was the expected profit on this project.

4.4 The Quadrant Analysis

Mapping this project to the project value evaluator revealed that this project fell into Block A, the risky quadrant of low investments and low returns, as illustrated in Fig.2.

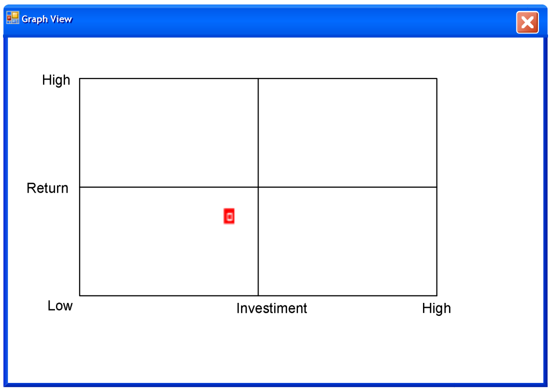

Figure 2: RFP project mapping

The red dot on the graph above shows the position of the project on the value graph. This implies that this given project was likely to be risky in that it attracted fewer profits than the expected profitability threshold for any project taken on by this company. As illustrated above, given the current budget, this project would yield only 51.81% profitability levels on the overall (R86,500 of R160,740), yet the targeted profit on any project for this company must be above 70%. Although this can be considered as a very high level profit margin in the commercial arena, it was highly likely that these projected profits would be eroded by change management bottlenecks and evolving project needs, among others. Overcoming such fixed price quotation issues would entail having good project management skills (which were lacking in this regard), which would limit changes or charge for them separately.

4.5 Case Study Implications

According to the project data published on the college website, the tender for this project was awarded to the successful vendor for about R400,000 and was completed on time. However, the basis for awarding this tender to the successful company was not published. Comparing the analysis results against the amount awarded resulted in the following observations. When the anticipated profitability was adjusted in accordance with the award amount, the project status shifted into a different quadrant of the project value evaluator, as illustrated in Fig. 3.

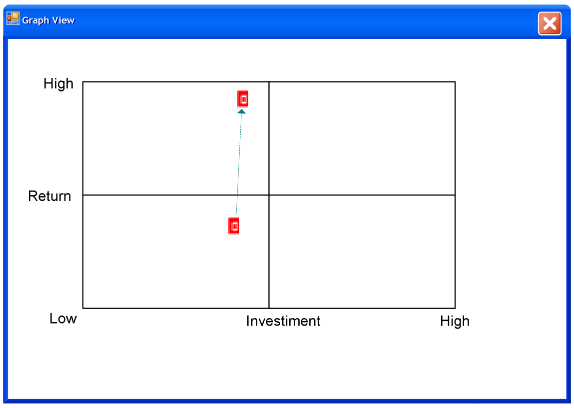

Figure 3: Quadrant shifting

If this R400, 000 was the original amount quoted on this project, this project would be located in quadrant D, which is a favourable quadrant for investment. In this regard, if the company had submitted an even higher quotation (up to the award amount of R400,000), then they might not only have been awarded the contract, but they would also have been more profitable.

These results demonstrate that various investment questions can be answered by means of guiding tools such as CASSE Analytics. Business viability assessments of potential software projects require such tools if informed decisions are to be made. Information provided by such tools not only aids business case assessment and evaluation of the project, but it also identifies risky projects before investment commitments are made.

5. Conclusion and Future Work

This study therefore offers a capability for increasing the predictability and evaluation of a viable risk-balanced favourable operating point on any project before this project is added to a potfolio. This in return would lead to minimizing the selection of unprofitable projects. Therefore, alternative engineering approaches such as these can enhance how we select software projects and how we plan project schedules optimally so as to increase business value derived on projects.

In future we intend to investigate how any given project that has been scored against the business threshold at the initial selection stage is tracked through the lifetime of the project. Such trends would make it possible to analyse the lessons learnt on a project and to assess whether the anticipated profitability could be sustained or not. The patterns detected in this way would provide a mechanism for improving both the estimation process on projects as well as the quoting process over time.

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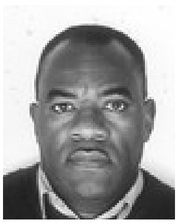

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