SPEEDING UP TIME-TO-MARKET OF IT INVESTMENTS

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ABSTRACT

Speed is important as it helps organisations realising goals earlier and outperforming competition. In this paper we study drivers for time-to-market based on a ten year natural experiment in a large, IT intensive, commercial organisation. It is shown that the amount of projects and the cost per project are correlated positively to time-to-market. Furthermore different incentive structures hold clear influence on time-to-market; changing them has shown to be a good instrument to accelerate.

KEYWORDS

Information Technology; Information Management; Incentives; Time-To-Market, Stage-Gated Process.

1. INTRODUCTION

It takes effort and time to turn an idea into a launched IT investment. This time is called time-to-market or Speed-to-Market (comp. McNally et al. 2011, Feng et al. 2012) and is an important concept in new product development since speed can provide first mover advantage or the advantages of a fast follower (Rasmusen and Yoon 2012). Economic consequences of being late to market can be significant and include higher development and manufacturing cost, lower profit margin and lower market value (Hendricks and Singhal 1997 and 2008). A fast time-to-market is positively associated to the success of new products (Chen et al. 2005, McNally et al. 2011), or nonlinear for high uncertainty products (Chen et al. 2012).

Benefits of a fast time-to-market not only apply for revenue generating new products but also for investments reducing costs. In general the latter also hold advantages in case the savings materialise quickly and the project team is needed for a shorter period (comp. Pass and Ronen 2014). Furthermore a shorter time-to-market improves quality due to faster feedback cycles, pushes motivation since the work leads to a fast result and reduces risks due to new circumstances such as the availability of new technologies (comp. Reinertsen 2009). On top the longer a project runs the more the scope of a project can change. This so called requirements creep (Verhoef 2003) holds an average monthly growth rate of 1,1% (Jones 2000). Reducing the time-to-market reduces this requirements creep and its involved costs. Given these considerations it can be understood that time-to-market has become a management priority (Luftman et al. 2013).

Time-to-market can be measured using stage-gated processes where specific tasks are grouped into phases (Gee 1978, Griffin 1993, Kessler and Chakrabarti 1996). Chopping up work into packages and allocating them to phases can be traced back to the 15th century where the architect of the Santa Maria del Fiore in Florence divided his project into six steps (Chao and Ishii 2005). Over decades several models for stage-gated processes have been designed; these are not only applied for building cathedrals but also for creating chemical plants, building airplanes and creating new products. The models differ over the start point, end point, amount of phases and split of work packages between those phases. Several models start from the creation of an idea (Ali et al. 1995); alternative starting points are ‘project start’ or ‘analysing the requirements’ (Pass and Ronen 2014). Where some processes end with a ‘launch’ phase (Ali et al. 1995 and Baker and Bourne 2014), others include the ‘life cycle’ (e.g. Desouza et al. 2009). The process could even be extended to comprise the ‘decommissioning’ of the asset (Furneaux and Wade 2011). Between the start and end point multiple phases like ‘develop concept’, ‘scoping’, ‘requirements definition’, ‘determine feasibility’, ‘build business case’, ‘product design’, ‘development’, ‘implementation’, ‘testing and validation’ and ‘production’ are defined (Gee 1978, Griffin 1993, Cooper 2001, Reinertsen 2009). Decision points separating the phases are known as ‘gates’, ‘milestones’ and ‘tollgates’ (Cooper 2001, Chao and Ishii 2005) and determine whether a project migrates into the next stage or is terminated. Monitoring these decisions creates transparency on a lot of topics such as the amount of ideas captured, the number of launches in a certain timeframe and the amount of projects being executed at the same time. The decisions can also be used to calculate time-to-market. Subtracting the launch date e.g. from the starting date of the feasibility phase creates transparency on time-to-market (comp. Kessler and Chakrabarti 1996).

More and more products contain significant IT components or are even completely IT based such as mobile apps, online payment systems, on-demand streaming media and blockchain based currencies. Software development lifecycles (e.g. Balaji and Sundararajan Murugaiyan 2012) also apply stage-gated processes regularly (e.g. Vavpotic and Bajec 2009, Guntamukkala et al. 2006). An early example comes from Royce who detailed in 1970 the basic activities of ‘analysis’ and ‘coding’ into an eight step waterfall. Later more enhanced processes like Merise (e.g. Fitzgerald 1998) and System Analysis and Design, Structured System Analysis and Design Method (e.g. Ramakrishnan 2012) where defined and recently work is split up using scrum and agile techniques (Pass and Ronen 2014). This area is so extensive that it initiated several meta studies and models were developed to select an adequate process (Khan and Suyfan Beg 2013 and Siau and Ross 2011).

This paper works from a portfolio of stage-gated decisions for IT investments and its research question is: what drives the optimisation of time-to-market in a stage-gated environment? The work is important for better understanding and managing efforts to accelerate. This effort is presented in the following sections, commencing with a discussion of our theoretical foundations and the associated hypotheses. We then outline our research method and present our results. Finally, we conclude with a discussion of the research, its limitations, and its significance for research and practice.

2. THEORY AND HYPOTHESES

Time-to-market can be influenced by several factors such as the legacy IT infrastructure, capabilities, governance, experience and education level. Also the industry and even the structure of the stage-gated process can influence time-to-market. In this research we focus on three topics to better understand their impact on time-to-market: first the amount of projects running at the same time, second the size of the project budget and third the incentive structure.

Executing too many projects at the same time is a recurring complaint in the industry (Zika-Viktorsson et al. 2006, De Reyck 2005). An oversized portfolio (Blichfeldt and Eskerod 2008) is not only very common it also triggers ‘multitasking’ which is seen as one of the core competencies for managing multiple projects (Patanakul and Milosevic 2008 and Aaltonen 2006). Multitasking can reduce time-to-market (e.g. Robinson and Richards 2009, Pass and Ronen 2014) as can easily be illustrated over two projects (comp. Anavi-Isakow and Golany 2003). The first project, project *a*, has a time-to-market of t_a and the second project (*b*) of t_b. The average time-to-market when *b* is executed after finishing *a* is:

$$(t_a + t_a + t_b) / 2 = t_a + 0.5\ t_b$$

The average time-to-market in a multitasking case, where project *a* is first semi-finished, after that half of project *b* is delivered, then *a* is fully completed and finally *b* is finalised, is:

$$(0.5\ t_a + 0.5\ t_b + 0.5\ t_a + 0.5\ t_a + 0.5\ t_b + 0.5\ t_a + 0.5\ t_b) / 2 = t_a + 0.75\ t_b$$

Whilst t_b is a positive figure the average time-to-market in the first situation is faster than in the multi tasking alternative (assuming that reordering the projects does not change t_a nor t_b). On top additional time is lost due to switching activities (Rubinstein et al. 2001) and due to correcting the failures resulting from task switching (Gilbert and Shallice 2002, Monsell 2003). A higher work in progress also increases queues in the system which will increase leadtime and variability (Reinertsen 2009). This leads to the conclusion that executing more projects at the same time decelerates time-to-market given existing resources. In case the resources can be scaled then this effect can be mitigated; but since it is an on-going complaint of IT managers we nevertheless expect time-to-market to slow down with an increasing amount of projects.

H1. The amount of projects is correlated positively with time-to-market.

In the second hypothesis we shift our attention from the amount of projects to the average project cost. The basic assumption is that the higher the project cost, the more work needs to be done which will prolong time-to-market (comp. Lavazza et al. 2013). So if project *a* from the H1 example holds less budget than project *b* then we would expect $t_a < t_b$. Verhoef (2002) even defined a benchmark confirming a relationship between function points (Garmus and Herron 2001) and time-to-market: the project duration equals the amount of function points to the power 0.32. Although this seems plausible there are at least three reasons to doubt this. First cost of commercial of the shelf software can form a significant part of an IT investment. The fees charged for this software is only partially determined by the initial cost to create the software whilst this fixed cost can be reimbursed over all paying customers. Nevertheless the actual price of the software does not need to correlate to this cost calculation as it can be determined by other factors (such as the profit targets of the supplier and the benefits for the customer). This model further is expected to accelerate time-to-market since the software is already created when it is purchased (Schulz 2000 and Julian et al. 2011). Second a relation between the project cost and the amount of work is assumed. This relationship is not always present and can often not be validated due to the absence of a unity on the amount of IT delivered like function points. When the amount of function points is known, then the project cost can be calculated by multiplying them with the cost per function point. In daily praxis the appliance of function points for this purpose is limited as measuring function points is costly (Lavazza et al. 2013) and only a few organisations are using them (e.g. Bok and Raman 2000). The absence of these units limits organisations' capabilities to monitor the relationship between cost and amount of work and for that the relationship of cost to time-to-market as defined by Verhoef. Third project cost can be increased with the purpose of speeding up time-to-market, this can be done over additional staff and by minimising procedures like skipping negotiation time in the purchase processes. Verhoefs' power function makes clear that speeding up time-to-market can be costly as the efficiency of software creation reduces exponentially (comp. McNally et al. 2011). But when executed successfully it would lead to both higher project costs as well as faster time-to-market. Despite these considerations we expect time-to-market to be related to the average project cost.
H2. The cost of a project is correlated positively with time-to-market.

The incentive structure is the third and final parameter studied in this paper. IT supported incentives have shown to generate disproportionate productivity gains (Aral 2012) and in daily praxis numerous incentives have been created for IT. Examples for the latter are the availability of the IT-infrastructure, the amount and impact of IT-security breaches and the customer satisfaction of the IT-helpdesk. In this study we focus on three time-to-market related incentives for the IT investment portfolio: plan accuracy, efficiency and impact. These three are described in the next sections.
Plan accuracy, or delivering projects according to the planned cost, time and quality, has been an important topic in IT for decades (Atkinson 1999, The Standish Group 2004 and Flyvbjerg and Budzier 2011). It is so meaningful that project managers have turned plan accuracy into a de facto 'honor code'; they do not want their projects to be late nor to overrun budget. Plan accuracy is valued by organisations too, since numerous project managers and their management are rewarded monetarily for compliance. These plan accuracy incentives are focussed on e.g. the percentage of projects delivered on time and in budget or the forecast to actual ratio (e.g. Eveleens et al. 2012). Alternatively the EQF (Estimated Forecast Quality), a more advanced time weighted approach calculating the difference between the forecasts and the actuals, can be used to measure plan accuracy (DeMarco 1982).
Besides plan accuracy organisations also hold an interest in efficiency. The speed of execution and the cost to produce software are the key concepts for efficiency. Optimal efficiency is defined as 'technical efficiency' and measured over the distance between the maximum output of the available resources and the actual output (Shao and Lin 2002). Where plan accuracy can be calculated over simple performance indicators, measuring efficiency is more challenging since the maximum output is a theoretical concept normally unknown in IT and the usage of function points is limited in daily praxis. But efficiency incentives can be focussed on lowering the cost per function point and also on, especially relevant for this study, speeding up time-to-market. The latter can be calculated more easily using the timestamps of stage-gate decisions.
The impact of an IT investment is the effect of that investment. The impact can be financial such as cash, Internal Rate of Return (IRR) or Net Present Value (NPV) (e.g. Van der Pas and Furneaux 2015) but can also be on customer experience such as Net Promoter Score (Reichheld 2003) and the Customer Effort Score

(Dixon et al. 2010) or on compliance to new legislation. An example for an impact incentive is to maximise the total delivered NPV of the IT investment portfolio.

The three incentives, plan accuracy, efficiency and impact can push for contradictory decisions. Improving efficiency can reduce the portfolio impact and plan accuracy can be optimised at the cost of efficiency. These conflicting effects are described in the next two sections.

Prioritising efficiency can reduce impact and vice versa. This can be illustrated over the sequence of executing projects where optimising time-to-market can require a different queueing discipline than maximising impact. Again we use the two projects from Hypothesis 1 to illustrate this. In case project *a* holds a shorter time-to-market than project *b*, then the average time-to-market is improved by first executing *a* and then *b*. So if t_a is shorter than t_b then:

$$t_a + 0.5\ t_b < t_b + 0.5\ t_a$$

The overall impact of the portfolio can also be optimised over the row order of the investments. If project *b* is executed after project *a* then the total NPV of the portfolio using a discount rate of *i* equals:

$$NPV_a + NPV_b / (1+ i)^{t(a)}$$

To maximise the total impact the projects should be prioritised based on the combination of NPV, time-to-market and discount rate. Project *b* should be started before project *a* if:

$$NPV_b + NPV_a / (1+ i)^{t(b)} > NPV_a + NPV_b / (1+ i)^{t(a)}$$

This is also correct when $t_a < t_b$ (assuming that reordering the projects does not change the input variables). We conclude that the optimal queueing discipline depends on the chosen incentives.

Some activities to optimise plan accuracy reduce efficiency. A project leader could consider improving plan accuracy by including more risks into the estimation. If he expects that a task can normally be done in two days then he could plan three or perhaps even more days to protect himself for schedule overrun. This extra time is reserved for unexpected additional complexity, requirements creep or for the non-compliance of preconditions such as required input not being delivered on time or with the right quality. It also protects, besides tons of other reasons, against non-availability of important expertise holders, or resources like testing environments being reprioritised. Adding additional contingency is well accepted; the lack of it is even considered as one of the reasons for overruns (Flyvbjerg et al. 2003). This strong focus on plan accuracy could go at the cost of efficiency in case the task is delivered in three days whilst only two days were needed. This is not unlikely due to the new plan of three days, because of procrastination problems (Ariely and Wertenbroch 2002) and since delivering in two days would indicate an inaccurate plan. So in case contingencies are planned that do not occur and the plan is nevertheless consumed completely, then plan accuracy is optimised at the cost of efficiency.

Due to the absence of efficiency units for a lot of organisations, the limited availability of impact KPIs and the strong pressure on plan accuracy we expect that plan accuracy is optimised at the cost of fast impact focused time-to-market. Changing the incentive structure towards efficiency and impact will change the queueing discipline as well as the tons of small decisions (so not only a few big ones) that optimise efficiency or impact. This leads to hypothesis 3 where we expect that the time-to-market is influenced by the incentive structure. Plan accuracy based incentive structures will hold the slowest time-to-market; the fastest time-to-market is expected for an efficiency based incentive structure. Hypothesis 3 is defined as:

H3. Time-to-market is correlated with the existing incentive structure.

3. METHOD

The hypotheses are tested using data from a natural experiment. The data was offered by a large commercial organisation and cover a time span of 10 years (March 2004 – April 2014) and more than $1bn investments. The organisation used a gated process and calculated the time-to-market from the start of the feasibility phase until the (commercial) launch of the asset. There was a high process discipline, which was also enforced by their portfolio management tool using a workflow to approve or reject gates. The gated process was updated with minor changes over the 10 years, but the related milestones nor the division of work over the stages changed.

In this study we focus on projects that benefit from a fast time-to-market and excluded investments that should not be speeded up such as 47 legal projects with a prescribed launch date as the only instrument to improve their time-to-market is a late project start which could add unnecessary risks and cost. We excluded these projects and the cancelled projects, that never got launched, from the study and used a remaining data set of 1595 launched projects. The average project cost in the data set were 579k. Whereas 88% of the projects held a budget of less than $1m, 185 projects held a larger budget. The 17 projects with a budget over $10m consumed 29% of the total investment.

The organisation used three incentive structures in the ten-year time-period. Up to 2007 the involved management and staff was incentivised for plan accuracy; projects needed to be delivered on time and in budget. The target was to keep the amount of projects with a budget overrun of more than 10% below a predefined percentage of projects. That percentage increased over the years due to the good performance against this plan accuracy target. From 2007 up to 2011 the incentive was on delivering value fast, a combination of impact (NPV) and efficiency (time-to-market). This was measured with a formula that weighted the time-to-market of the delivered project with their NPV; the time-to-market of a high NPV project was weighted stronger in to the incentive than the time-to-market of a lower NPV project. The organisation accomplished to outperform this target and it was raised every year because of that performance. As from 2011 none of the three incentive structures were applied; the incentives of IT staff and management were not related to plan accuracy nor to the efficiency or the impact of the IT investments. The projects are allocated to the period in which they are launched; this is consistent to the incentives of organisation in this study.

4. RESULTS

The goals that were set through the incentives showed an improved performance over the years. Plan accuracy improved year on year during the time the incentive on plan accuracy was active. The organisation achieved a relatively high plan accuracy with a median EQF of 6.0. This EQF is a blended value made up out of an unprecedented median EQF of 10.3 for cost optimisation projects and a median EQF of 4.7 for new product development projects (Eveleens et al. 2012). The higher uncertainty of new products as compared to optimising existing and known processes could explain the difference in EQF between these two categories. Also the new target, the combination of value and time-to-market, showed a year on year improvement as it was incentivised as from 2007. Although the longitudinal development was positive the absolute performance could not be compared since no benchmarks are known to the author.

The hypotheses were tested with regression analyses combining categorical and continuous predictors. The categorical predictors are needed for H3 and were combined with dummy coding with reference groups on incentives.

H1 and H2 are tested with a Pearson's product-moment correlation and both are significant (***). The project budget explains 12% of the proportionate variance in time-to-market ($R^2 = 0.12$). The explaining power of the amount of projects is much lower; less than 1% of the proportionate variance. A model combining both predictors in a multiple regression is significantly better than both models with single predictors (* as compared to the model used for H1 on the amount of projects and *** as compared to the model using project budget). The combination of project budget and amount of projects explains 12% of the time-to-market variance.

In H3 the three incentive structures were tested as categorical predictors for the dependent variable time-to-market in a regression analysis. The three categories differ significantly (***) and the average time-to-market dropped with 30% when switching from plan accuracy to the combined efficiency and impact incentive. This improvement in time-to-market can be based on dropping the plan accuracy incentive as the latter can be optimised at the cost of time-to-market as well as on the work done by IT management and staff to improve the performance against the new target. The actual time-to-market in the absence of an incentive was 7% below the time-to-market with the efficiency and impact incentive. Since the amount of projects reduced with 3% and the average project cost reduced even with 34% the expected time-to-market would have accelerated faster in case the incentive was remained.

Combining the three variables into one model improves the prediction of time-to-market. Overall 15,4% (R^2) of the variance in time-to-market can be explained by the variables project cost, amount of projects at the same time and incentive structure.

5. CONCLUSION

Time-to-market is an important performance indicator for the process of developing new products as well as cost optimisation IT investments. A faster time-to-market enables the benefits to hit the profit and loss statement of a company earlier and helps to outperform competition.
Practitioners aiming to improve the performance of their IT investment portfolio can use the results of this study to determine the goals they want to accomplish with their portfolio as well as the usage of the three instruments (project cost, work in progress and incentive) to improve their goal accomplishment. Overall the 10 years natural experiment showed an improvement of more than 40% on time-to-market, which was, amongst others, driven by the amount of projects running at the same time (work in progress), the average project cost and the incentive structure. Impressive was the change from plan accuracy to a combined impact and efficiency incentive, which was accompanied by an improvement of 31%.

Further research on time-to-market of IT investments could be focused on benchmarking both time-to-market performance as well as the impact of IT investments. This would allow organisations to compare their performance in these arena's with other organisations and is expected to be relevant since large differences in time-to-market have been seen in daily praxis by the author. A second topic for future research could be on the IT investments that do not use a stage gated approach. Especially agile development is gaining attention and although the duration of a sprint does not really express the time-to-market of an IT investment, the time it takes for a described idea to be available for (new) customers or internal staff to benefit from the process improvements could be used as a proxy.

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