The effectiveness of the IpOp model decision tree to calibrate projects at the pre-project stage

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Abstract: Literature supports the idea that projects delivering the target objective on time and within the anticipated budget represent less than 30% of all projects. Even though failure advances the learning curve, this low success rate equals a vast waste of resources. Based on practical experience, the authors hypothesise that: 1) low project success rates are linked to inadequate project selection methodologies or their inconsistent application; 2) the IpOp model decision tree could improve the selection of worthy projects. An online survey was carried out to determine: 1) project success rate; 2) links between project performance and selection parameters. Results show the importance of rigour in project selection in order to reduce waste of resources, while no clear correlation between the number of selection criteria could be proven. Further, the results indicate that practitioners consider the IpOp model decision tree to evaluate projects at pre-project stage an improvement over current practice.

Keywords: pre-project calibration; project success; project selection criteria; decision tree; target objectives; resource savings; online survey; IpOp model; allocation of resources; project governance.

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Raphaël H. Cohen has for many years been a serial entrepreneur, business angel, professor, lecturer, author, and member of several boards of directors. As expert in executive education and director of the entrepreneurial leadership specialisation of the University of Geneva eMBA, he teaches novel innovation and leadership tools. He has conceived the IpOp model, a roadmap for analyzing projects that numerous organisations use to optimise innovation processes. His latest bestseller maps the leadership levers that impact employee's level of engagement. He holds a PhD from the University of Geneva as well as the honorary title of Academic Fellow.

1 Introduction

1.1 Body of evidence on project selection

The majority of organisations waste time and money on projects: studies have shown that in 1995, project success rate was at an all-time low of 12% in the IT sector (The Standish Group, 1995), while even today still only 21–35% of projects, depending on sector, are successfully completed within the original timeframe and budget (The Standish Group, 2015). This means that 65–88% of the projects perform worse than expected, which translates into a huge waste of both time and money, both of which are scarce resources. Filippov et al. (2010) report similar results with an average of 33% of projects cancelled before their completion. In other words, a good portion of those cancelled projects should never have been launched if a more rigorous selection process had been in place. This implies that employees waste their time on 'bad' projects instead of using it on 'good' projects that contribute to an organisation's success. The consequence is that, while learnings from project failures are known to be considerate, inadequate project selection slows down the acquisition of competitive advantages.

If so many projects waste resources or do not deliver the expected result, the obvious question is why have they been launched in the first place and why the calibration of time and money has been so ineffective? It is possible that the problem has to do with the decision-making process for launching projects: are decision-makers thorough enough when evaluating projects or do they take shortcuts?

A significant body of literature has emphasised the fact that an effective selection process should be formal and structured. For instance, a survey-based study showed that 78% of organisations that had a standard process experienced more than twice as many project successes than organisations that did not have one (Pmsolutions, 2011). A study of 97 businesses by Cooper et al. (2001) substantiated these findings and showed that best performers have a formal selection process with clear rules which are applied consistently to all projects. Comparable studies found similar correlations, whereby the use of structured approaches was positively associated with given measures of performance (e.g., Artto et al., 2004; Dammer and Gemünden, 2007; Müller et al., 2008). The reverse mechanism was investigated by Le and Nguyen (2007) in their case study of Vietnamese companies: the authors found that projects selected based on an unstructured process did not yield the strategic goals desired by their companies.

Although it is scant, debate exists with respect to formal processes and project selection. Cooper et al. (2001) also demonstrated that a few companies were successful without a formal process. Koen et al. (2002) claimed that an informal selection process is more advantageous because it facilitates negotiation among decision-makers and promotes creativity. The described project selection method was, however, not proved empirically.

Recent studies have emphasised the fact that decision-makers should not only use a formal and structured approach but that this approach needs to be used consistently across all projects. Meredith and Mantel (2008) argued that a common appraisal approach must be adopted in order to compare different projects and select the right ones in a fair manner. In addition, Dutra et al. (2014) claimed that if decision-makers use different reasoning for each project, this can make competition between them unfair. It is for this reason that the model they developed contains generic criteria that are applicable to most projects and organisations. Montoya-Weiss and O'Driscoll (2000) shared the same argument and claimed that a consistent process enables fair selection as it ensures that consistent information is used to make fair and optimal decisions. Phillips and Costa (2007) emphasised the need for serious project evaluation from a different perspective. Their case study uncovered the existence of small teams that discreetly worked on unapproved projects, thus occupying valuable resources.

Recently, opposing views have emerged in the literature concerning the generalisability of selection practices to different project types. For instance, in their case study of nine companies, Blomquist and Müller (2006) concluded that different selection practices need to be used according to varying project types. This view is challenged by similar case studies that demonstrate that project type is irrelevant (Killen et al., 2008; Martinuso and Lehtonen, 2007).

A portion of the literature emphasises that decision-makers should focus on a wide range of criteria when selecting projects. For instance, in their book *Project Portfolio Management*, Rad and Levin (2006) advocate that decision-makers should implement selection processes that include the dimensions of resource, risk and strategy. Comparably, through the development of the financial appraisal profile (FAP) decision model, Lefley and Morgan (1998) have stressed the necessity of addressing the dimensions of cost, risk, return, strategy and time. As seen above, and as Dutra et al. (2014) highlighted, there is a lack of consensus about which criteria decision-makers should use. However, they all shared similar views regarding the use of many criteria that cover multiple dimensions. Furthermore, consultants also promoted the use of multiple criteria (e.g., Vargas, 2010).

While the above publications suggest promising methods, most were not tested empirically and hence their reliability is difficult to judge. Some studies have, however, provided empirical evidence to support their methods. For example, Eilat et al. (2008) developed a model that considers multiple criteria. They illustrated the success of this approach through a case study in which their model was tested. Similarly, Cooper et al. (2001) found that companies with the best project portfolios use a combination of criteria including financial, strategic and other criteria. In fact, their findings demonstrated that the worst performing decision-makers focused on only one criterion. This criterion was often profitability. More recently, through the development of their empirically-tested models, various researchers (Eilat et al., 2008; Cohen, 2011; Dutra et al., 2014) determined that decision-makers should consider at least ten criteria to ensure rigor in their analysis and make effective decisions.

In summary, the literature has put forward three dominant views regarding project selection. It should be structured and formal, consistently applied to all projects and include a comprehensive set of criteria.

Although diverse models exist (Stawicki and Müller, 2007) and would enable decision-makers to select projects effectively, they are, in reality, rarely applied (Calantone et al., 1999; Varma, 1999). One reason for the lack of use is that many models are elaborate, not tested empirically and are rarely practically applicable (Shane and Ulrich, 2004). Recent research tends to agree and claims that models actually rely on assumptions that may not be valid in real life and that project selection is messier and less rational than such models would suggest (Blichfeldt and Eskerod, 2008; Christiansen and Varnes, 2008). Cooper and Kleinschmidt (1986) found that in more than 83% of new projects, an informal procedure was used for selection. Others indicate that about half used an informal process (Barklay, 1992; Page, 1993). Comparably, the findings of Cooper et al. (2001) demonstrate that 34% of decision-makers use an informal method for prioritising projects. While a vast number of publications on the use of specific selection models for single projects or companies are available (e.g., Mohanty, 1992; San Cristóbal, 2011), meta-analyses on the project selection decision criteria that decision-makers most often use are rare. One of the earlier studies discussing an extensive investigation of project screening methods was that of Cooper and De Brentani (1984). It examined the criteria used by most managers and found that the dominant criteria were profitability, strategy, synergy with current operations and business attractiveness. These findings conflicted with a later study that found that the dominant criteria were strategy, profitability, risk and timing (Cooper et al., 2001). When examining the most dominant criteria that decision-makers use, these studies have suspected that the dominance of a limited subset could mean that decision-makers might oversimplify their set of criteria (Cooper and De Brentani, 1984; Cooper et al., 2001; Chui, 2009). Comparably, Balachandra et al. (1996) found that most decision-makers consider between four and seven criteria.

More recent research has delved deeper into the subject by arguing that decision-makers' choices are directed by other principles. For instance, a study by Kester et al. (2009) uncovered the presence of intuitive and political processes in decision-making. Adopting a similar approach, the examination by Christiansen and

Varnes (2008) of management meetings to select new projects revealed the existence of informal negotiations. Within a similar context, Varma (1999) argues that salesmanship sometimes plays a key role in project selection. Although some of these characteristics can be considered positive (e.g., Koen et al., 2002), they characterise the selection process as informal and unstructured.

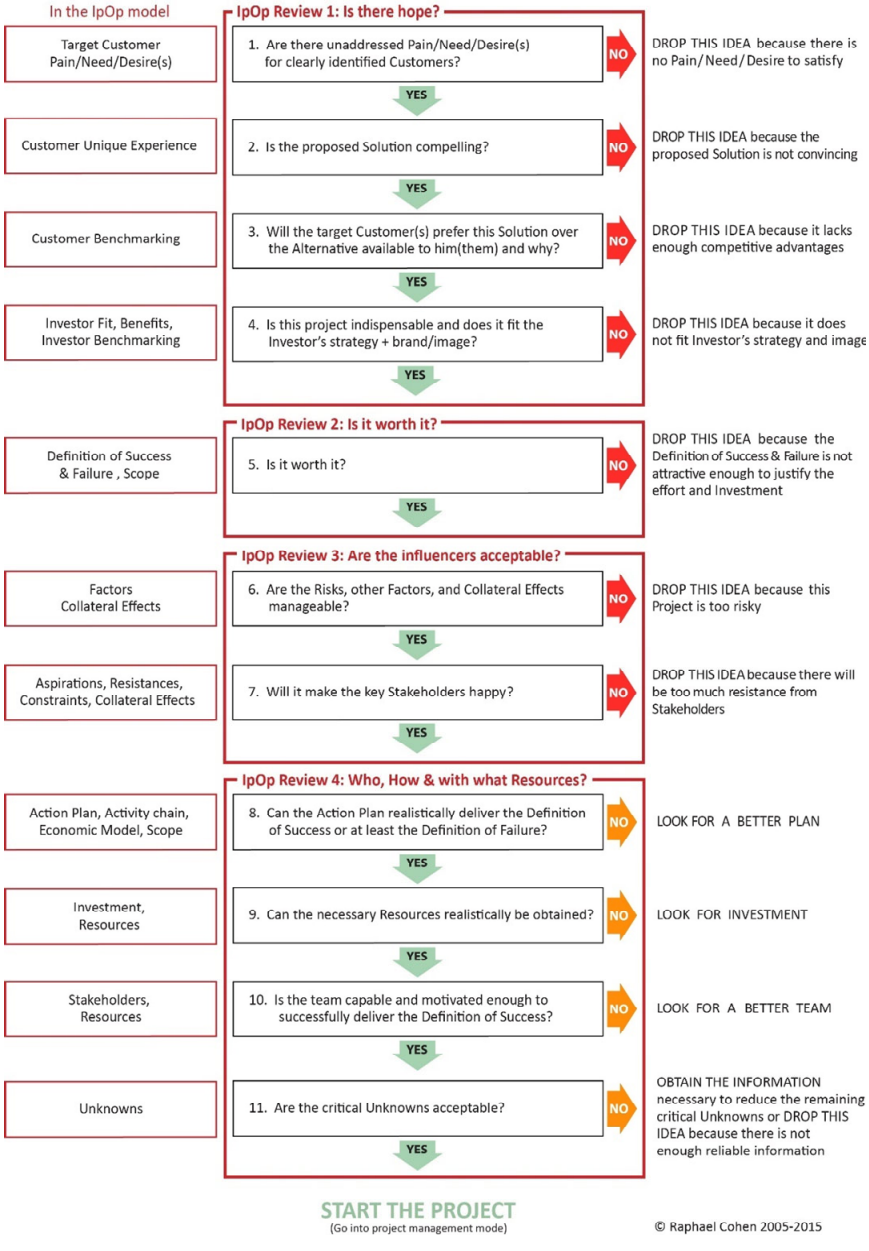
1.2 The IpOp model decision tree and the IpOp model

One decision-making model in use in corporate settings is the innovation per opportunity (IpOp) model including a decision tree (Cohen, 2006, 2011, 2016). Developed in corporate settings from the early 2000s, the focus of the model is to help decision-makers assess which projects should actually be launched. The IpOp model was built from the empirical observation of both how decision-makers in successful projects make their decisions, as well as looking at projects that have failed and identifying which issues decision-makers forgot to take into account. Following years of evaluation, the IpOp model and decision tree were further developed into a very robust procedure based on 11 core questions representing all key criteria necessary for a solid pre-project assessment with a track record of accomplishment in industry (Cohen, 2010; Gruson, 2011; Hisrich and Al-Dabbagh, 2012; Bauer, 2013; Cohen, 2015; Gandel, 2015). The IpOp model decision tree is shown in Figure 1.

Each of the 11 questions of the IpOp model decision tree for decision-makers is important in order to take into account all key dimensions of a project idea while there is a good chance that, for each project, the relative importance of the questions might be different. Executives will therefore have to exercise judgement on how to interpret the response to each question relative to the other answers. As the 11 questions of the IpOp model decision tree for decision-makers are generic, they are applicable to any project in any industry. They can nevertheless be complemented by industry-specific questions. These 11 questions should, as a consequence, be the absolute minimum aspects that a decision-maker should check before giving the green light to any project. The IpOp model decision tree is not designed to be used on existing or mature projects. It is only a guide for the decision-makers who must make a final decision as to whether to pursue or reject a new project.

In order to answer the 11 questions before launching a project, both for decision-makers and for themselves, the innovators must ensure that they address all the parameters which make a project successful or not successful. The global and holistic view of the IpOp model serves as a checklist to avoid forgetting something important. The sequential approach of the model and the decision tree allows managers and innovators to manage their resources in an optimal manner by eliminating at an early stage possible projects that will unnecessarily consume valuable resources.

Figure 1 The IpOp model decision tree for decision-makers is based on 11 questions which take into account all key dimensions needed to rigorously evaluate a project idea before deciding to launch it (see online version for colours)



For this purpose, the entire set of 11 questions forming the IpOp model decision tree for decision-makers have, as of 2015, been grouped into four fundamental subgroups of questions (see Figure 1), each forming a review moment when the project might be stopped during the analysis. IpOp model review 1 verifies whether there is hope with the customer and the investor. In this review section, both strategic fit for investor (this can

be the corporation) and customer fit are confirmed. For the latter, a consumer-centric approach is applied to ensure that the intended idea meets a customer pain, need or desire and, hence, eliminates ideas that are purely driven by an enamoration with a service, solution or technology that does not match consumer desire. If the answer to IpOp model review 1 is not satisfactory, there is no need to continue with the next review. IpOp model review 2 checks whether the opportunity is 'worth it' by comparing the outcome of the project with the effort and resources needed to deliver this outcome. IpOp model review 3 verifies whether the parameters that can influence the feasibility and success of the project are acceptable. This review focuses on influencers (i.e., risks, stakeholders, but also unknowns), some of which are often under considered by other models. Since cataloguing identifiable unknowns, which explicitly express lack of knowledge (and which is not the same as risks that have a probability), is essential for evaluating the resources (time, skills and money) required to obtain the missing knowledge, they allow decision-makers to know how long the project will last, what resources will be needed and also know the blind spots of the project. The last IpOp model review, review 4, describes who will do what to first deal with the critical unknowns and to then implement the project. These two action plans will determine the necessary investment (monetary, skills and personal resources).

During the complete IpOp model analysis, each IpOp model review is revisited multiple times because each one is impacted by the content of all other reviews. After these iterations, the project promoters should be able to answer the 11 questions that address the decision-makers' concerns. The IpOp model decision tree for decision-makers, thus, forms the decision basis for allocating resources to reduce the remaining critical unknowns. A second allocation of resources to actually launch and implement the project will only be made after the critical unknowns have been satisfactorily reduced.

Since this process provides decision-makers a clear view of resources needed to first obtain the missing knowledge and to then launch the project, they are expected to have a more reliable calibration of the project. This means a more accurate understanding of the time, money and skills required to deliver the expected outcome. With a more thorough calibration of the required effort, decision-makers should be better equipped to eliminate projects that should not be pursued and make a wiser use of their resources in selecting worthy projects. This improved selection is expected to improve the success ratio of projects delivering the expected outcome on time and on budget. The other benefit is that by blocking very early projects that should not be launched, this rigorous selection process should reduce the number of projects that are launched but stopped before completion. As a result, there will be more resources (particularly time) available for the worthy projects, which usually allows project teams to deliver the expected outcome faster. This automatically improves the success ratio of projects delivered on time. Such an approach creates a virtuous circle. This improved governance of the process and resources explains the success of the IpOp model with an increasingly large audience.

The sequential approach of the IpOp model differentiates itself from the stage-gate process (Stage Gate, 2000–2020) because the latter was built to reduce consumption of resources: as long as a 'review' has not been validated, it is not possible to ask for additional resources for the next pre-project phase. The problem with stage-gate is that if a project is stopped at gates 2, 3 or 4, this means that resources spent in earlier gates were spent for nothing. To avoid this waste of resources, it is important to identify all the critical unknowns as early as possible and reduce them in a sequence that is the most

cost-effective, which could possibly be different from the preset, one-size-fits-all sequence of stage-gate. As the IpOp model can be used before any resources are consumed, the four IpOp model reviews can be analysed by barely consuming significant resources. Companies that use stage-gate are therefore invited to start the IpOp model before using stage-gate. This should allow them to waste fewer resources.

The IpOp model has been successfully field tested with more than 250 intrapreneurial projects in real corporate environments. It has also been used by many start-ups but no data is available to quantify how many of these have applied the model. The IpOp model that includes the IpOp model decision tree for decision-makers has, for the last 18 years, been taught in several MBA programs, such as those of the University of Geneva, the Baltic Management Institute or ESCP-Europe in Paris and used by several multinationals, banks, hospitals, SMEs and start-ups.

Since the 11 questions of the IpOp model decisions tree for decision-makers take into account all the key dimensions of a project (Figure 1), the model has become a governance tool for allocating resources in a more responsible manner. The latest version of the IpOp model decision tree for decision-makers is presented in detail in Chapter 17 of Cohen (2016).

2 Hypotheses

A survey with 199 respondents trained in using the IpOp model was done to test the following hypotheses which were derived based on decades of practical experience in pre-project selection, project success and project failure:

Hypothesis 1 Projects are not performing as well as they should, i.e., projects delivering the anticipated outcome on time and within budget represent less than 30% of all projects.

Hypothesis 2 Low project performance is associated with unclear selection criteria.

Hypothesis 3 People trained to think in terms of the IpOp model decision tree pre-project analysis believe that the model is useful to improve the selection of projects and their performance.

Hypothesis 4 In regard to Hypothesis 3, women are more likely to use and recommend the IpOp model decision tree than men.

3 Methods

An invitation for a survey was sent to approximately 1,400 people from various industry segments including food, processing equipment, health and banking, among others. Since the objective was to verify the relevance of the IpOp model, the survey only targeted people who had attended a 1 to 3 days training course on the IpOp model during a period of 16 years. The survey was shared online via a link setup by SurveyMonkey. The online questionnaires (see Table 1) contained 27 questions with ordinal and binary pre-set answers plus a comment option. Respondents were free to answer all or only a subset of questions. The final set of respondents was 199 adults who sent in the filled-in questionnaire, corresponding to a participation rate of close to 15%. Assuming that

questions answered with 'you do not know' or 'not answered' both meant that the responder did not know, they were not considered further for data analysis. Data were primarily assessed in a descriptive manner. Additionally, for correlations between questions, Spearman was applied using R software (version 3.4.1 for Windows, R Foundation for Statistical Computing, Vienna, Austria). To calculate correlations, answers from respondents were only considered if both corresponding questions were answered. The number of respondents considered for analysis is noted in each figure or comparison of data.

Table 1 Subset of survey questions which were asked through the online survey with SurveyMonkey and which were relevant for the hypotheses discussed in this research study

Question		*Set of possible answers*
Q1	Is your employer/organisation doing better or worse than the following averages [as shown in a research paper (The Standish Group, 1995)]: 30% of all projects are cancelled before completion/30% experience schedule delays/50% exceed original cost estimates/ 12% completed on time and on budget?	Better than that/more or less the same/worse than that/you do not know
Q2	Does your organisation use a defined list of criteria to formally calibrate projects and decide which ones should be launched?	Yes/no/you do not know
Q3	How many criteria are included in this formal evaluation process?	More than 16/between 14 and 16/between 11 and 13/between 8 and 10/between 5 and 7/fewer than 5/no criteria/you do not know
Q4	Are these formal criteria published and available to anyone in your organisation?	Yes to everyone/only to a limited number of people/no/you do not know
Q5	Are projects in your organisation truly only evaluated on these formal criteria or when decisions are made are there other informal or unlisted criteria taken into account?	Only with these formal criteria/sometimes with these criteria but also with other criteria/never with these criteria and only with other criteria/you do not know
Q9	What is your opinion on the efficiency of the process that is used to calibrate projects in your organisation?	Excellent/good/fair/weak/very weak/you do not know
Q10	Have you used the IpOp model decision tree to evaluate projects and initiatives? Reminder: the IpOp model decision tree is the set of 11 questions that helps investors and decision-makers finally decide if they should launch a project or not.	Yes/no
Q11	If you have not used the IpOp model decision tree, it is because…	… you did not have to evaluate projects/… you had a better model (if yes, please name the model)/… the IpOp model decision tree is too demanding/… you consider that it is not necessary to address all the parameters of the IpOp model decision tree/… you prefer to trust your gut feeling

Table 1 Subset of survey questions which were asked through the online survey with SurveyMonkey and which were relevant for the hypotheses discussed in this research study (continued)

Question		*Set of possible answers*
Q13	Do you think that using the IpOp model decision tree would reduce the waste of resources due to insufficient calibration of projects before they are launched?	Yes/maybe/no/you do not know
Q15	Would you recommend the use of the IpOp model decision tree to others?	Yes/most likely/probably not/certainly not/you do not know
Q16	Do you believe that analysing a project with the IpOp model helps reduce the risk of failure of start-ups or innovation projects?	Certainly/most likely/probably not/certainly not/you do not know
Q20	Have you used the IpOp model to analyse new projects?	Yes in an existing organisation/yes in a start-up/yes in both a start-up and in an existing organisation/no
Q21	If you have already used the IpOp model, what is your opinion of its level of usefulness?	Very useful/rather useful/fairly useful/moderately useful/not useful
Q22	Are you a sole or joint decision-maker for allocating resources to projects (level D)? Are you…?	… at level D and one of the decision makers/… at level D but not as a decision maker/… at D-1/ … at D-2/… at D-3 or more
Q25	Gender	Male/female/gender neutral

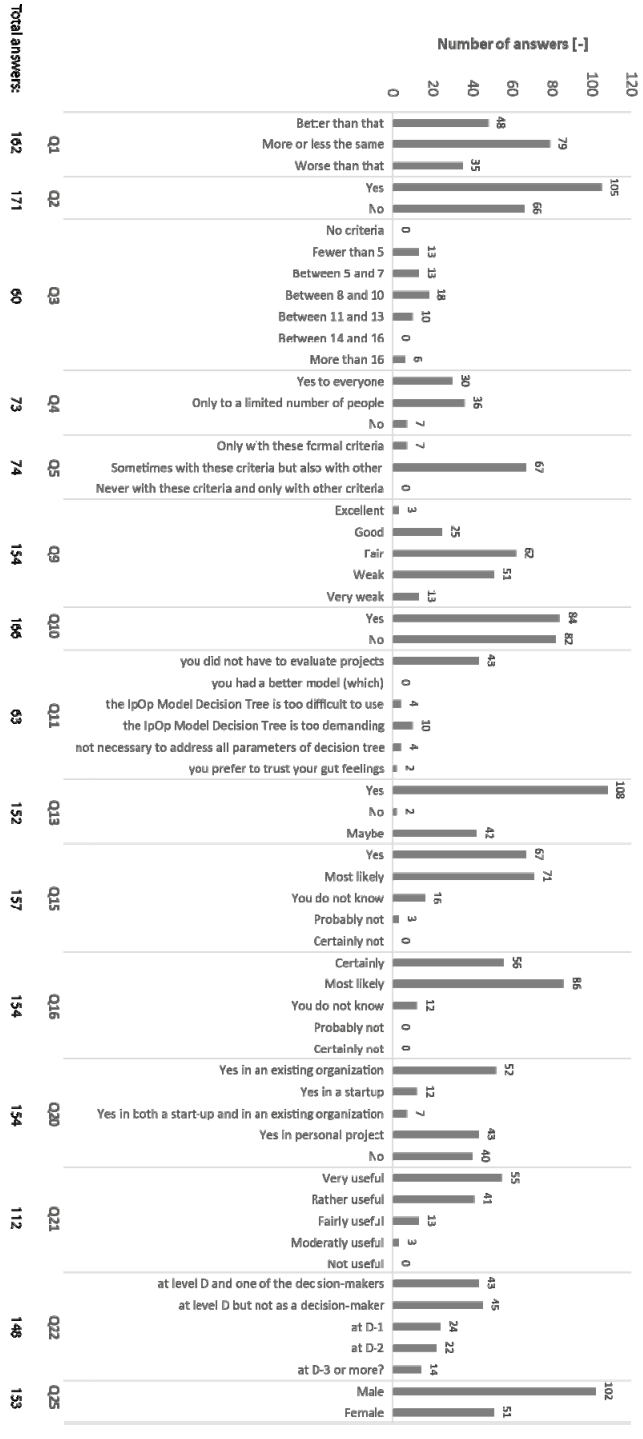
Results of selected questions were analysed applying Kruskal-Wallis to determine level of significance of different results at $*p < 0.05$ to link answers to the subcategories of decision level and years familiar with the IpOp model decision tree. Further, U-testing based on Wilcoxon was applied to determine whether differences in results were achieved for female and male respondents ($*p < 0.05$).

4 Results and discussion

4.1 Description of study respondents

The present study included 199 respondents with a gender split of 33.3% female and 66.7% male respondents, a majority thereof at decision-making level (level D) in their organisation (29.1% level D and decision-maker, 30.4% level D but not decision-maker, 16.2% level D-1, 14.9% level D-2, 9.5% level D-3 or more). 38.2% of the respondents were employed in multinational corporations with 10,000 or more employees, 18.4% in companies with 1,001 to 10,000 employees, 37.5% in SMEs (thereof 20.4% with 101 to 1,000 employees, 17.1% with 11 to 100 employees) and 5.9% in small companies with 10 or fewer employees. Most of the respondents had discovered the IpOp model and IpOp model decision tree 2 to 5 years before the survey was conducted (60.4%), 24% for less than one year and 14.6% for more than 6 years. The number of decisive answers per question differed strongly and ranged between 60 and 171. Original answers to selected questions relevant to our hypotheses are shown in Figure 2.

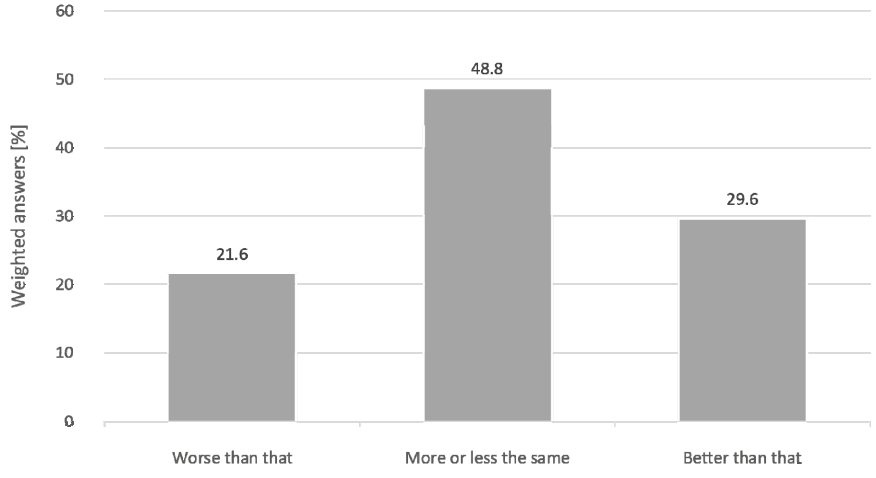
Figure 2 Original answers to all questions discussed in the study including number of answers per answer option and total number of answers per question



4.2 Project success rate and quality of pre-project assessments

In this section, relevant results to assess project success rate and the quality of pre-project assessment are presented in order to answer Hypotheses 1 and 2.

Figure 3 Answer to question 1 "Is your employer/organisation doing better or worse than the following averages: 30% of all projects are cancelled before completion, 30% experience schedule delays, 50% exceed original cost estimates, 12% are completed on time and on budget?"



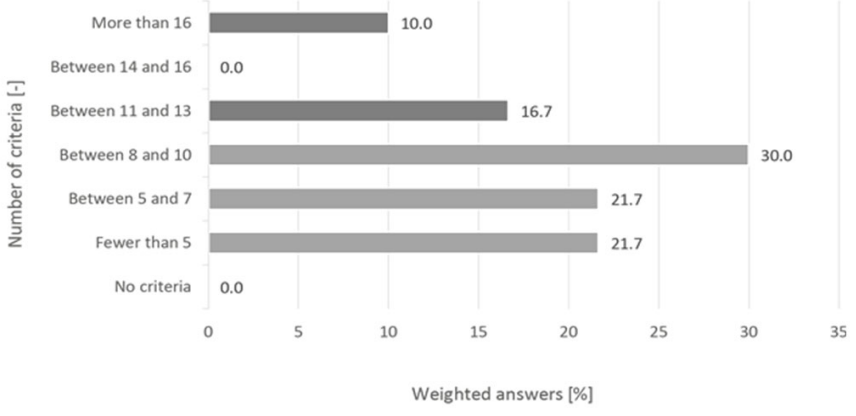
Note: n = 162.

Figure 3 shows the estimation of respondents regarding their company's project success rate compared to literature data, the latter estimating that only 12% of projects (The Standish Group, 1995) are completed on time and on budget while all other projects are either cancelled, experience delays or exceed costs. Results show a slight trend to the positive for the survey respondents' organisations with 29.6% of respondents stating better project success rates, 48.8% comparable success rates and 21.6% worse success rates. Considering that a 12% success rate is not satisfactory, these findings clearly confirm our first hypothesis that most projects (70.4%) are not performing as well as they should.

Out of the 162 people who answered question 1, 61.4% work for a company which uses formal criteria to decide for or against projects (Q2). Comparing only the subset of those 143 people who answered both questions 1 and 2, 45 or 31.5% of respondents said that their employer/organisation performs better on project success than what is reported from literature. Interestingly enough, two thirds thereof, i.e., 30 respondents of better performing companies, apply a defined set of criteria to evaluate projects. Similarly, 61% of all respondents stating that their companies perform worse answered that no defined set of answers is applied to select projects. These answers imply that applying a clearly defined set of criteria to evaluate projects positively affects project success rate which supports our Hypothesis 2 that low project performance is associated with unclear selection criteria. This finding is also in line with various studies (Cooper et al., 2001; Artto et al., 2004; Dammer and Gemünden, 2007; Müller et al., 2008) which indicated that companies with formal selection processes showed best project performance.

This said, the survey further showed that while criteria are paramount to project success, those preset criteria are only available to select people in some companies (Q4). Out of 73 people who answered question 4, 41.1% said that criteria are available in their organisations, while the employers of 49.3% survey respondents only show their criteria to some employees, if at all (9%). This result is further supported by the low number of people (n = 60) aware of the number of criteria applied for project selection in their company (Q3, see Figure 4). The lack of communication of existing preset criteria suggests that there is a desire to be thorough which is undermined by that lack of rigour in implementing and communicating the selection criteria. Additionally, only 9.5% report that the formal criteria are used at all times to select projects, while according to 90.5% of the answers projects are sometimes evaluated with these criteria but often also with other criteria (Q5). This implies without ambiguity that the set of criteria used by their organisation is not complete: if it were, there would be no need to use criteria not included in the list of preset criteria. This awareness that existing sets of criteria are not complete may also be the reason why companies are shy in communicating them throughout the organisation. It further supports Hypothesis 2 that unclear or incomplete selection criteria negatively affect project performance.

Figure 4 Answers to question 3 "How many criteria are included in this formal evaluation process?"



Note: n = 60.

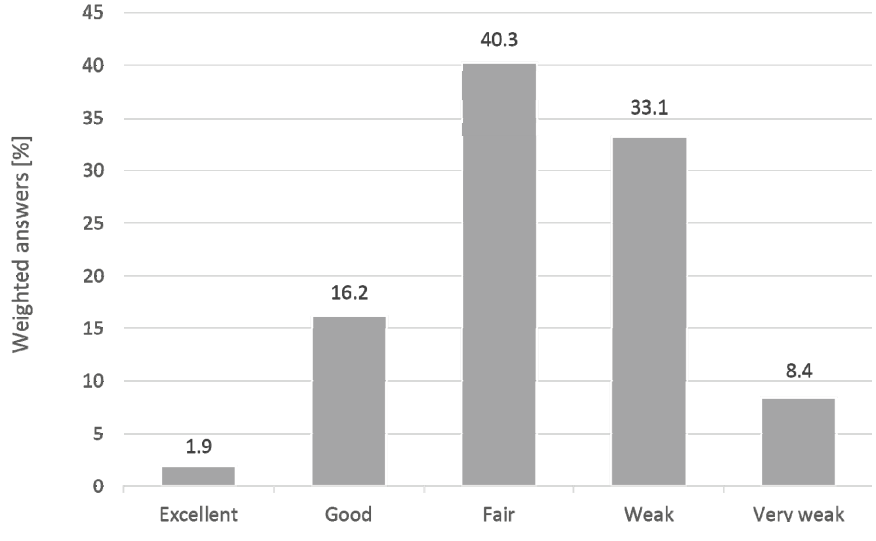
As Figure 4 shows, 26.7% of companies apply a set of criteria of 11 or more (Q3). These results are higher than reports from literature show (Moses, 2014) but are in line with our expectations as all respondents of the survey were familiarised with the IpOp model and some companies had already implemented IpOp model into their system. The number of companies using a set of 11 criteria is expected to increase further in the next few years as 24% of the survey respondents had learnt about IpOp model only within one year before the survey was conducted. Being new to a model usually means a high individual motivation to employ it, while the full integration of a new model into a standard company evaluation process usually takes years.

A weak negative correlation between the number of companies with better project success rates and the number of criteria in the formal evaluation process was found (Spearman correlation: –0.324 at p-value 0.015). This result is not in line with other

earlier studies which showed a clear correlation between number of criteria and project success rate (Dutra et al., 2014; Eilat et al., 2018). However, looking at the small number of respondents who answered question 3 (number of criteria in formal evaluation process) with n = 60 versus the much larger number of respondents answering question 1 on project success rate (n = 162) and the high number of respondents (n = 43) stating that criteria for project selection are only available to some employees or not available at all (Q4), it is clear that many respondents answering question 1 were simply not aware of the selection system. On this basis, it was possible to correctly determine a correlation between project success and number of criteria for the sixty respondents answering both questions, but the correlation might not reflect the status quo for all other respondents and their respective employers. Comparing answers from respondents with different levels of decision-making power (Q22) showed no significant differences in answers regarding the number of criteria applied in their respective evaluation processes (p-value = 0.7231). This is an indication that the subset of respondents who answered question 3 knew the selection criteria used in their company's project evaluation processes.

An alternative and more realistic explanation for the weak negative correlation between project success rates and number of selection criteria found through the survey might be that measuring the number of criteria is not enough because the relevance of the questions is much more important than their number. Assuming for the sake of this demonstration that the 11 questions of the IpOp model decision tree for decision-makers are relevant, what should have been checked is how many of these 11 questions are included in the set of formal criteria being used. If an organisation has been using 15 criteria but none of the 11 questions of the IpOp model are included in these 15 criteria, it means that 15 criteria are, in themselves, meaningless. This survey was unfortunately not designed to verify the relevance of the criteria being used, but this question deserves to be researched in a future study.

Figure 5 Answers to question 9 "Efficiency of process applied to select projects?"



Note: n = 154.

The need for further improvement in the decision process can be extracted from the 154 answers to question 9 judging the efficiency of project decision processes in the respondents' companies (see Figure 5): only 18.1% judged the efficiency as 'good' or 'excellent' and 40.3% as 'fair', while 41.5% stated that the decision process is, in their eyes, weak or very weak. Explanations ranged from

1 a lack in standardised process framework leading to a strong dependency on the quality of the project leader

2 to the slowness of the system

3 to politics and projects following personal opinions or agendas

4 to point-to-point checks of project steps without consideration of the entire project.

As several of these comments point to issues that are not addressed by stage-gate, they confirm the need to use a more holistic approach before consuming resources. All of these challenges can be addressed through a more rigorously applied consistent project evaluation governance. The comparison of percentages of successful projects (Q1) and the respondents' opinion of the efficiency of the process used to calibrate projects in their organisation (Q9) correlates positively with a coefficient of 0.437 (p-value < 0.01). This gives a further indication that efficient project selection results in higher project success rates and substantiates the validity of Hypothesis 2.

4.3 Evaluation of the usefulness of the IpOp model decision tree and IpOp model

In this section, relevant results to assess the applicability and usefulness of the IpOp model decision tree and IpOp model in the eyes of the survey respondents are presented in order to address Hypotheses 3 and 4.

Out of 166 answers to question 10, 84 people (or 50.9%) stated that they had previously used the IpOp model decision tree (see Figure 2). There was no significant difference in answers between male and female respondents ($p = 0.2542$). Out of the 82 respondents who did not use the IpOp model, 63 gave a reason (Q11): 68% thereof stated that they did not need to evaluate projects in their current role, 6.3% found the model too difficult to apply, 16% found it too demanding, 6.3% considered it unnecessary to address all the parameters of the IpOp model decision tree and 3.2% preferred to trust their gut feeling. From the additional comments section, it can be further deduced that some companies have other models in place and are reluctant to switch to a new model.

Out of the 84 survey respondents who had previously used the IpOp model decision tree, the vast majority, i.e., 94%, would recommend or most likely recommend this to others (Q15) and 78.6% of the same 84 people believe that using the IpOp model would certainly or most certainly reduce the risk of failure of start-ups or innovation projects (Q16). We consider this result a strong indication of the high level of usefulness of the tool which confirms our Hypothesis 3 that people trained to think in terms of the IpOp model decision tree pre-project analysis believe the model is useful. The high applicability of the IpOp model is a clear differentiator from many other models which are described by Ulrich and Shane (2004) as elaborate but rarely practically applicable.

Lastly, 71.1% of 152 respondents answering question 13 confirmed that the IpOp model decision tree has the potential to reduce resource wastage with a clear yes, 27.6%

with a maybe and only 1.3% said no. This highly positive feedback reinforces the respondents' conviction of the usefulness of the IpOp model decision tree to evaluate projects. When asked for their comments, positive replies included that IpOp model decision tree

1 brings criteria such as a consumer-centric view of pain, need and desire that a classical business case does not fill

2 a clear definition of success and failure

3 a logical approach

4 a better understanding of stakeholders' aspirations, resistances and constraints of stakeholders

5 the cataloguing of unknowns and their reduction.

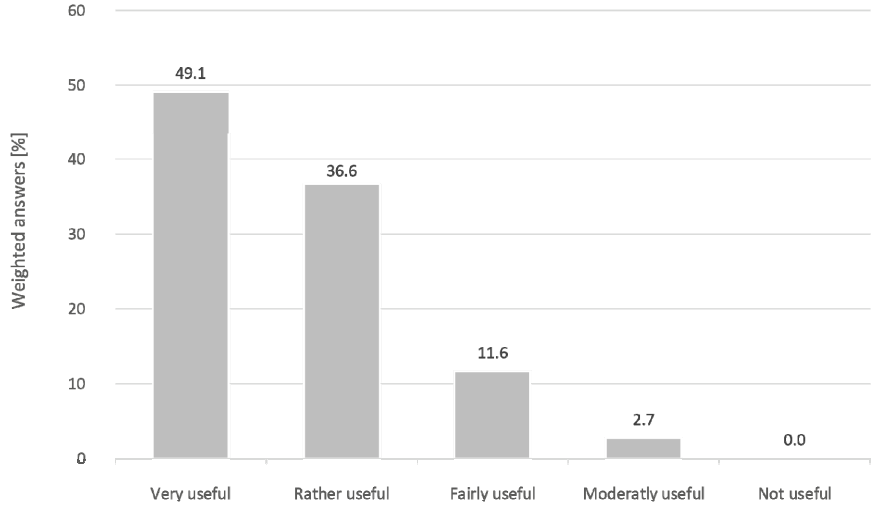
The challenges in the use of the IpOp model decision tree that were mentioned included

1 anticipating all the unknowns

2 the lack of a quick model for reducing the effort required at each review.

The latter criticism has in the meantime been addressed through the development of an IpOp model canvas for quick evaluation of project ideas. This canvas was not yet available when the survey was conducted.

Figure 6 Answers to question 21 "If you have already used the IpOp model, what is your opinion on its level of usefulness?"



Note: n = 112.

Results for question 20, where respondents were asked whether they had previously applied the IpOp model (versus the IpOp model decision tree), show that 114 respondents (or 74%) answered positively. Of these, 43 respondents had applied the IpOp model in a personal project only.

Out of these 112 participants who had applied the IpOp model personally, either in the work environment or in their private lives, and answered question 21 on their estimation of the model's usefulness, 85.7% consider the IpOp model to be 'rather' or 'very useful' (49.1% judged the IpOp model as 'very useful' and another 36.6% as 'rather useful'; Q21, see Figure 6). None believed that the model is not useful. This result once more confirms our Hypothesis 3 that people trained to think in terms of the IpOp model tree pre-project analysis believe that the model is useful. Further, we found a positive correlation between female participants and the estimated level of usefulness of the IpOp model with a significance level of 0.0098 which supports our Hypothesis 4. This said, we cannot yet explain why women seem to have a special affinity to the model and believe this aspect is worth a more in-depth assessment in a future survey.

5 Conclusions

The presented survey completed with business people shows that there is room for vast improvement in project success rates. It also confirms the usefulness of the IpOp model and its decision tree for decision-makers to calibrate projects at the pre-project stage in the eyes of these practitioners. Survey results give a strong indication of a high level of applicability and guidance of the IpOp model and its decision tree to evaluate projects in a consistent manner in the field. Answers and statements by participants support the hypothesis that clear criteria are one of the pre-requisites for a consistent selection of best project proposals. Furthermore, the same data reinforces the importance of rigour in the application of a defined project selection methodology to reduce a waste in resources. Based on a relatively small subset of participants elucidating the number of criteria applied in their companies, it was not possible to link project success to the number of selection criteria that are applied to rate project ideas. This may simply suggest that the number of criteria alone is not a relevant enough parameter. As it nevertheless showed that the number of criteria used by most companies is lower than the 11 questions of the IpOp model decision tree, and assuming that each of these questions is important, the survey confirmed that current decision-making governance is not good enough to prevent waste of resources due to insufficient rigour in selecting projects. It was, however, shown very clearly that participants familiar with the IpOp model are highly likely to recommend this model to colleagues and are convinced of its usefulness and applicability.

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