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Rick Mitchell, Rob Phaal, Nikoletta Athanassopoulou, Clare Farrukh & Christian Rassmussen

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How to Build a Customized Scoring Tool to Evaluate and Select Early-stage Projects

Companies can design a customized multi-factor scoring tool for early-stage projects to make the decision-making process as consistent and objective as possible.

Rick Mitchell, Rob Phaal, Nikoletta Athanassopoulou, Clare Farrukh, and Christian Rassmussen

OVERVIEW: In the early stages of technology or innovation projects, companies often need to make decisions about which projects to pursue when only scant information is available. In this article, we provide guidance on how to make the best use of the information available by assessing projects against several appropriate factors and allocating scores. Although companies have used this type of scoring method for many years, they have paid little attention to how to best design and configure scoring tools. We explain how to design a scoring tool specifically tailored for a particular situation and present the example of Grundfos to illustrate the efficacy of developing a customized scoring method that includes identifying factors under Opportunity and Feasibility. We suggest how to choose the factors to ensure that the scoring is as consistent and objective as possible and how to treat the inevitable uncertainty arising from early-stage projects.

KEYWORDS: Project scoring method, Portfolio, Innovation, Technology, Customized scoring tool

Companies have used scoring methods for many years (Souder and Mandakovic 1986; Cooper, Edgett, and Kleinschmidt 1997; Cooper 2006), but researchers and practitioners have given little attention to how to best build customized scoring tools for a particular application. We devised a design method for building a customized scoring tool based on our work with more than 25 small- and medium-sized enterprises, 10 startups, 4 multinational corporations, and 8 public organizations (Mitchell, Phaal, and Athanassopoulou 2014, 2018) over the last 10 years in a wide range of industries.

We describe a multi-factor scoring tool design method to create a customizable scoring tool that companies can use to evaluate and select innovation projects. While our method can be used for non-technical and technical

Rick Mitchell coauthored *Innovation Management: Effective Strategy and Implementation* (3rd ed, Palgrave Macmillan). He worked for 23 years at Philips in research, strategic planning, and general management before becoming group technical director of Domino Printing Sciences PLC. He has a degree in physics from the University of Cambridge and a PhD in engineering from the University of London. Until recently, he was RAE Visiting Professor of Innovation in Cambridge University's Engineering Department and Visiting Professor of Innovation Management at Cranfield School of Management. rickrosmitchell@gmail.com

Rob Phaal is a director of research at the Institute for Manufacturing in Cambridge University's Engineering Department in the area of Strategic Technology and Innovation Management (STIM). His interests include strategic roadmapping and the development of practical management tools and toolkits. He has a background in mechanical engineering, with a PhD in computational mechanics. He has industry experience in technical consulting, contract research, and software development. rp108@cam.ac.uk

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Nikoletta Athanassopoulou is the head of the solutions development team within IfM Engage at the University of Cambridge. She is a strategy and technology management specialist and works with business and innovation leaders within the high-value manufacturing community, universities, and government. As an experienced facilitator she has codeveloped, coauthored, and delivered tools and methodologies in innovation strategy, roadmapping, creativity, portfolio, and project selection. She has a BSc in physics from Athens University and an MPhil and PhD in solid state physics from the University of Cambridge. naa14@cam.ac.uk

Clare Farrukh is a senior research associate at the Institute for Manufacturing in Cambridge University's Engineering Department. She has worked on a wide range of applied technology management-related research projects with manufacturing companies, including fast-start roadmapping approaches. She has a BSc BEng in chemical engineering from the University of Nottingham and spent six years in industry in process plant and composites manufacturing environments. cjp22@cam.ac.uk

Christian Rasmussen is an innovation team member at Grundfos, based in Bjerringboro, Denmark. He is a member of the Danish Academy of Technical Sciences and cofounder of the AIRPLANE Alliance, the first open-source community for leaders and professionals who are pursuing data/AI industrialization. Grundfos is an industrial member of the University of Cambridge Strategic Technology and Innovation Management (STIM) industrial-academic consortium. Building on this association, he has customized and implemented roadmapping and project portfolio approaches within Grundfos. crasmussen@grundfos.com

projects, we have focused primarily on technology-intensive R&D projects. We developed this customizable scoring tool because we found companies needed to improve how they prioritize competing opportunities that arise during strategy and innovation workshops and how they evaluate and select innovation projects. Ideally such project evaluation would be done by building a full business plan for each project and then selecting those that would make the best contribution to the bottom line. Often though, and especially for early-stage projects, decision makers lack sufficient valid information to do so.

Relying on intuition is a common practice that can be effective if the decision maker has developed their intuition through confronting many examples of the problem at hand—as is the case for professionals like doctors and art historians. In unfamiliar circumstances, as is the case with many innovation projects, a decision marker's intuition can be misled surprisingly easily, as researchers such as Kahneman (2011) have shown. Intuition must be supplemented with as much of a logical structure as possible.

Companies want more robust approaches in which financial data are augmented or replaced by information about other factors—such as strategic fit and ability to leverage core competencies, risk, technological capability and timing—which are known to be indicators of success (Cooper, Edgett, and Kleinschmidt 1998). Using multiple factors rather than one enables decision makers to include many major influences. An added advantage is that the factors will be uncorrelated, at least to some extent, so estimation errors will tend to cancel out. The factors, once chosen, can simply be used as a checklist to ensure that no important considerations are overlooked. While there is great value in using a checklist to make a rough selection, it is possible to create a more complete and precise approach that can be tested and piloted quickly, with limited risk and cost, and then adapted and scaled up as the method's value gets demonstrated (Kerr et al. 2013).

We focus here on designing a tool for application-focused projects because similar factors and considerations will apply to many companies, especially when they agree upon a clear target application and judge projects in relation to their likely commercial success. As innovation projects progress, there should be enough information to prepare a business plan or similar financial justification, so scoring may no longer be appropriate.

Designing a Customized Scoring Tool

Designing a customized scoring tool involves several important decisions about the structure, the factors (subcategories) to be scored, the scaling statements, and risk and uncertainty. We summarize the scoring tool design process (Figure 1).

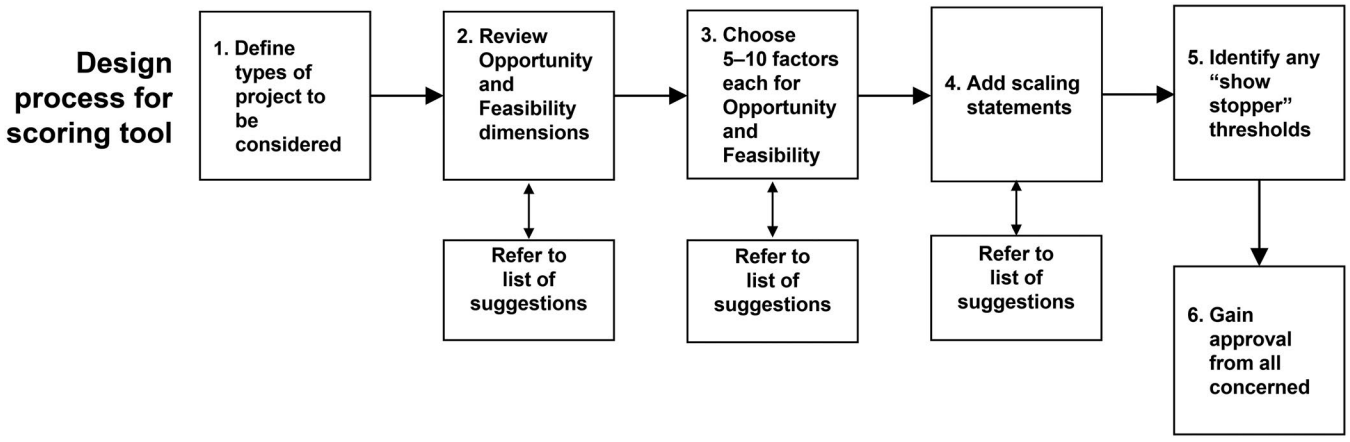

FIGURE 1. Summary of scoring tool design process

Multi-factor Scoring Tool Design Method

We worked with 25 small- and medium-sized enterprises, 10 startups, 4 multinational corporations, and 8 public organizations (Mitchell, Phaal, and Athanassopoulou 2014, 2018) over the last 10 years to design, test, implement, and refine a multi-factor scoring tool design method for building a customizable scoring tool. The scoring tool has helped these entities evaluate product/services and technology developments, assess research programs and venture opportunities, and analyze potential public sector initiatives for improving the wellbeing of local citizens. Workshop participants have consistently delivered positive feedback regarding our design method, and company feedback highlights the method's logic, objectivity, and structure.

We undertook a review of 40 published portfolio management matrices and found that 60 percent were of the general form Opportunity vs. Feasibility. This review highlighted the importance of considering these two dimensions *separately* (Phaal, Farrukh, and Probert 2006; Phaal and Mitchell 2009). We carried out an extensive period of piloting during 2005–2015, until the factors and method stabilized.

We present an example of a typical project scoring tool based on one used by DuPont for prioritizing new product introduction (NPI) projects (Cooper, Edgett, and Kleinschmidt 2001) (Table 1). Scores are allocated against seven factors and guided by explanatory comments (Scaling Statements). The results are added to give an overall score for the project. The principle is that, other things being equal, the highest-scoring projects will be the ones chosen for implementation.

Structuring the Tool

Adding the scores from different factors implies that a high level of one factor can compensate for a low level of another, which may not always be the case. For example, a fundamentally uninteresting opportunity is not better simply because it is easier to do; and the size of the opportunity is irrelevant if it requires competencies that the organization lacks or that would prove difficult to acquire. Companies need to consider the factors that describe the size of the Opportunity presented by a project separately from those that describe its Feasibility. We define *Opportunity* as the magnitude of opportunity plausibly available to the organization and *Feasibility* as how well-prepared the organization is to grasp the opportunity. In other words, Opportunity is a rough measure of the value that may result from the project, while Feasibility indicates the effort or investment that may be required to bring it to fruition. The distinction between Opportunity and Feasibility is implicit in many appraisal tools, such as the GE-McKinsey market-attractiveness versus business-strength (McKinsey 2008) and A. D. Little's risk versus reward matrices (Cooper, Edgett, and Kleinschmidt 2001), which assess and display Opportunity and Feasibility separately.

Choosing the Factors

The factors used in the tool should be as independent, precise, and objective as possible. One might aim for a relatively large number of factors in total so that the uncertainties tend to cancel out. However, our experience shows that the more factors there are, the less attention will actually be given to each one during the scoring process. We have found from experience that seven factors for each of the two dimensions (Opportunity and Feasibility) should be the maximum.

We have found from experience that seven factors for each of the two dimensions (Opportunity and Feasibility) should be the maximum.

In application-focused phases of development, the approach and criteria may be similar for many different companies and applications. We list frequently used factors, taken from the literature and our own experience of applying the multi-factor scoring tool design method (Table 2 and Table 3). These examples serve as a good starting point for managers designing their own tool, but we emphasize the need to select a limited number and be ready to modify those outlined. Different scoring factors will be required for different types of innovation projects or for projects at different phases of innovation.

Using Scaling Statements: Descriptors for the Factor Scores

Coherent scaling statements are the key to an effective scoring tool. Creating scaling statements is worthwhile because they define what the factors actually mean in practice and ensure consistency when several people collaborate in the scoring.

Scaling statements should ideally be quantitative and as concrete as possible, which means avoiding vague terms such as "large," "significant," and "important." Opt for statements that could, at least in principle, be observed, checked, and demonstrated.

The outer scaling statements should not be too extreme because the scores for most projects will group in the middle of the scale and not be well differentiated. Choose statements that are achievable in practice, not ones that represent the outer extremes of what is possible. For example, the statement "Sales over 100 million" means there is a reasonable likelihood that sales could reach 100 million in practice. This

TABLE 1. Project scoring tool based on that used by DuPont (adapted from Cooper, Edgett, and Kleinschmidt 2001)

Rating scale	10	3	1	Score
Factor				
Strategic alignment	Close fit to Strategy	Supports Strategy	Not fully in line with strategy	
Value differentiation	Significant differentiation	Moderate	Slight	
Competitive advantage	Strong	Moderate	Low	
Market attractiveness	Highly profitable	Moderately profitable	Low profitability	
Fit to supply existing chain	Fits current channels	Some change required	Significant change required	
Technical uncertainty	High	Medium	Low	
NPV	>$50m	$10–50m	<$10m	
			Average:	

TABLE 2. Suggested Opportunity factors for application-focused projects

Opportunity Factor Categories	Opportunity Factors	Explanation
Volume	Market size	Size of potential market, or number of potential adoptions, reasonably available to us
	Our sales potential in a given time	Sales volume or number of adoptions anticipated in a defined time (for example, five years)
	Synergy opportunities	Possible additional benefits to other projects or activities, or the possibility of new opportunities in combination
	Customer benefit	Identifiable benefit to customers (internal or external) or potential adopters
	Competitive intensity in market	Number or significance of the competition
Margin	Increased margin, or benefit per unit	Improvement in product margin (for example, by cost reduction or price premium) compared to existing products, or benefit to us per adoption
	Business cost reduction or simplification	Contributes towards cost reduction or simplification of business process
	Industry/market readiness	How easy it will be for customers or adopters to take up the product without having to change their behavior or processes
Platform for future growth	Market growth	Anticipated growth rate of market
	Future potential	Product is a platform for future products or could open new markets beyond the project timeframe
Intangibles	Learning potential	Will improve the knowledge or competence of the business
	Brand image	Will improve the image of the company with investors, customers or other stakeholders
	Customer relations	Project is important for retaining key customers

TABLE 3. Suggested Feasibility factors for application-focused projects

Feasibility Factor Categories	Feasibility Factors	Explanation
Product characteristics	Product differentiation	How well the product is differentiated from those of major competitors
	Sustainability of competitive advantage	Ability to sustain the competitive position over time (for example, intellectual property rights [IPR], brand strength)
	Technical challenge	Confidence that the proposed product is technically feasible
Skills and knowledge	Market knowledge	Level of understanding of size and requirements of the market
	Technical capability	Extent to which the required technical competences are available to complete the project
Business processes	Fit to sales and/or distribution	Fit to our sales competences and/or distribution chain
	Fit to manufacturing and/or supply chain	Ability to manufacture or supply the product
	Finance	Availability of finance for the project
Organizational backing	Strategic fit	How well the project fits the company strategy
	Organizational backing	Level of staff or management backing at an appropriate level

statement would be a bad choice if the maximum actually expected in practice was only 20 million.

Three scaling statements is a minimum; five can give more precision. More than five may imply more precision than this tool can provide because the appropriate number of scaling statements depends on how accurately scorers could expect to estimate a factor's value. For instance, 20 scaling statements would imply that the scores could be estimated within 5 percent, which is unlikely for early-stage projects. People often want to choose a value midway between the scaling statements, and a scale of 0 to 8 with a midpoint of 4 (or 0–12 as an alternative giving higher resolution with a midpoint of 6) allows them to do this while keeping to integer values.

Aligning Scaling Statements

Sometimes the factors used in a scoring tool are allocated different weightings to reflect their relative importance.

However, this complication is unnecessary if the scaling statements for the various factors are aligned with each other. For example, a score of 5 for one factor is an equally good indicator to the likely success of the project as a score of 5 for another. This alignment may not be easy, but it is vital. Any attempt to compare projects (formal or informal) involves considering the projects from different perspectives and assessing how one aspect compares with another.

Scale alignment is easiest if the statements can be expressed numerically. For example, for an improvement to a product line, the financial impact of an increase in sales may be compared directly with the impact of a cost reduction. Comparison of non-numerical statements is more complex. These five steps can help:

1. Start by choosing one factor, the *base* factor, which clearly has significant impact and for which managers can design clear and objective scaling statements.
2. Choose the midpoint, or "pivot" statement, for this factor. The pivot statement should indicate an unexceptional or "middle of the road" case such that if this were the only measure available to judge a project it would be difficult to decide whether to accept or reject it.
3. Choose scaling statements for the other scoring levels of the base factor, remembering not to make the outer ones too extreme.
4. Choose the pivot statements for the other factors in the same way as in Step 2.
5. Select each factor in turn and, for each scoring level, choose a scaling statement that is equivalent to that of the base factor. Imagine two projects, one for which the only information available is the scaling statement for the base factor, and one where only information for the second factor is available. For each scaling statement of the base factor, choose one for the second factor that is equivalent, such that it would make the projects equally attractive.

Since innovative projects are by definition uncertain, the key is to try and understand what the range of possible outcomes is before making a decision.

It may turn out that for some factors, managers cannot find a scoring level that has as great an impact as the base factor. For such factors the upper scaling statement(s) should be left blank.

We present examples of scaling statements for Opportunity and Feasibility factors for new product introduction (NPI) projects (Table 4 and Table 5). These examples may be helpful for reference; in practice, scaling statements must always be customized for the particular circumstances.

Risk, Uncertainty, and Threshold levels

The term "risky" often gets used to describe projects whose outcome is not known precisely and has negative associations. By contrast, the term "uncertainty" is more neutral and hence preferable. Since innovative projects are by definition uncertain, the key is to try and understand what the range of possible outcomes is before making a decision. The upside opportunity may outweigh the downside, and the information gained during the scoring process points to where actions may be taken to improve the prospects.

TABLE 4. Examples of scaling statements for Opportunity

Opportunity Factor Score	Scaling Statements				
	0	2	4	6	8
Market size	<5,000 units	25,000 units	50,000 units	100,000 units	200,000 units
Our sales potential in a given time	>1,000 units in 5 years (gross margin £300,000)	3,000 units in 5 years (gross margin £1 million)	10,000 units in 5 years (gross margin £3 million)	20,000 units in 5 years (gross margin £6 million)	50,000 units in 5 years (gross margin £15 million)
Synergy opportunities	None	Little	Will help to complete product portfolio	Important	A key part of a major initiative
Customer benefit	No obvious benefit to customers	Some benefit to some customers	Clear customer benefits within existing norms; work visiting existing customers to promote	A significant advance in more than one key feature of interest to customers	Eye-catching new benefits; a talking point at shows; entry to competitor accounts
Competitive intensity in market	4 or more strong competitors	2 strong competitors	Usual competition, or 1 strong competitor	We will be alone in the market	
Increased margin, or benefit per unit	Benefit worth <£300,000	Benefit worth £1 million	Benefit worth £3 million	Benefit worth £6 million	Benefit worth £15 million

TABLE 5. Examples of scaling statements for Feasibility

Feasibility Factor Score	Scaling Statements				
	0	2	4	6	8
Product differentiation	No features that are better than competition	At least one feature is better than that offered by the competition	Some minor features are better than the competition	At least one important feature is significantly better than the competition	Several important features are much better than the competition
Sustainability of competitive advantage	Key differentiating features will be easy to copy, or serious concerns about IP against us	We are 6–12 months ahead of the competition; no serious IPR concerns	Competitive advantage can be maintained with continuous effort	We are at least two years ahead of the competition	Key features are protected by IPR or unique capabilities that are not easy to copy
Technical challenge	Key features not yet demonstrated by us or others, or >3x change in an important parameter	Step change in at least one important parameter, or some key features not demonstrated but we're confident they can be	Key features have been demonstrated in prototype, but others remain	All features have been demonstrated in prototype	
Market knowledge	Market size not supported by data and requirements not yet checked with customers	Market estimated within a factor of 2 or 3 with some data support	Enough data to size the market to +/–50% and requirements are supported by discussions with sales force	Market size known to +/–20% and customer view established by formal survey	
Technical capability	We will have to buy new major capabilities, or recruit a new technical team, or rely on a partner	We lack some important capabilities and a plan is needed to acquire them	Existing staff can acquire capabilities in three months or less, or by recruiting one or two new people	Some new skills required but they can be acquired in time	Well within our capability; no new skills or knowledge required
Fit to sales and/or distribution	Entirely new distribution channel required; or requires new sales skills that at least half the sales force will struggle with	Changes to sales or distribution will need special attention	>75% of sales force could sell it with training or >75% of existing distribution applicable	Some changes to sales or distribution but within our capabilities in the time	Well within competence of existing sales and distribution

Decision makers should ask participants in the scoring process to select upper and lower extreme scores for each factor—that is, the plausibly best and worst-case values, to define confidence limits, rather than a single point value. This scoring range retains important information that would otherwise be lost. We have found that in the group discussion people often find it easier to agree on confidence limits than on a single value. However, it may be that projects should be rejected regardless of other considerations if they do not meet a threshold level (a minimum standard or condition) for certain factors. For example, decision makers should note in the tool any "showstopper" thresholds like health and safety, security of supply, or adverse impact on the brand image.

Using the Customized Scoring Tool and Managing the Scoring Process

Once decision makers have designed and customized the scoring tool, they can apply it. We summarize the project scoring process (Figure 2) and scoring components (Figure 3).

Preparation

Preparation for using the scoring tool includes looking at project briefs, reviewing the projects for compatibility, and choosing the scoring team.

Project Briefs—Multi-factor scoring best suits projects where information is imperfect. The first step is to create a project brief for each project that is as complete as possible and includes all the relevant factual information. Descriptions should be as objective as possible. At least one other person should review each project brief. The whole scoring process is only as good as the information available.

Review Projects for Compatibility—Remove any projects that do not fall within the scope adopted for the particular scoring tool. Reject any essential projects that are outside the decision process.

Choose the Scoring Team—Select individuals with different experiences and knowledge to diversify the range of relevant expertise and to avoid relying too heavily on a small number of experts, particularly if some are already deeply involved with some projects. All participants chosen must know enough about the topic to provide valid input.

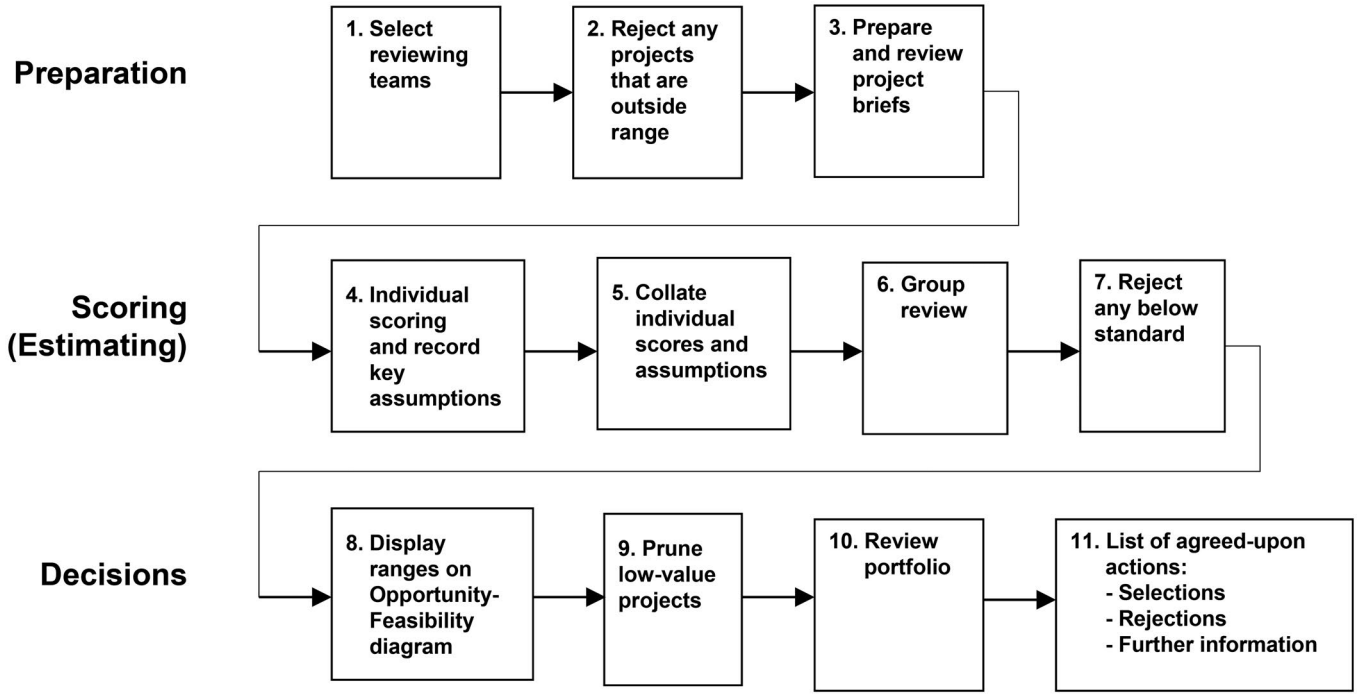

FIGURE 2. Summary of the scoring process after design of scoring tool

FIGURE 3. Scoring tool components

Completing the Scoring

Companies should complete the individual scoring first, followed by a group discussion, then selection. Companies should use a generic project description template to standardize information for each project.

Individual Scoring—Participants must be able and willing to allocate time and care to project selection. Following a short presentation based on the standardized project description template, individual team members should first form their own opinions and record their ratings for each factor prior to

any group discussion. Individuals need time to read and absorb the briefing documents and, if necessary, to look up relevant facts. Any group may be biased by knowledgeable, assertive, or talkative individuals, or even by those who are the first to speak. For each project, the team members should choose upper and lower scores for each factor and calculate the average values for the project as a whole. We determined that averaging is best after trialing three different methods of calculating and visualizing the final project scores. In practice, using several different visualization screens can create confusion when participants are scoring more than one project.

Group Discussion—After individual scoring, participants should meet in a small group or workshop to discuss and review their scores and assumptions, factor by factor. The goal is to arrive at agreed upon upper and lower values for each factor and for the project as a whole. This discussion is particularly important for projects where individual scores differ significantly. Where the standard deviation is large, further discussions (especially between the MIN and MAX scorers) should be held in plenary to understand the difference in scorers' opinions. Up to three outputs per project are possible from this process:

1. Agreed upon plausible best-case and worst-case scores for both Opportunity and Feasibility factors overall—that is, Opportunity max-min range and Feasibility max-min range.
2. A note of any project that is likely to violate one of the threshold conditions and therefore is a candidate for immediate rejection.
3. A note of any factors for which the range of scores is particularly wide, indicating that more information is needed.

Selection

Each project now has four scores: the best- and worst-case Opportunity and the best- and worst-case Feasibility, which may be displayed on an Opportunity-Feasibility diagram as a rectangle (Figure 4). However, these scores tend to obscure each other, making the diagram difficult to interpret. The key information is retained by plotting only the best-case (max Opportunity, max Feasibility) and worst-case (min Opportunity, min Feasibility) points (Figure 5), where a straight line between the two marked points represents the range of possible outcomes for one project.

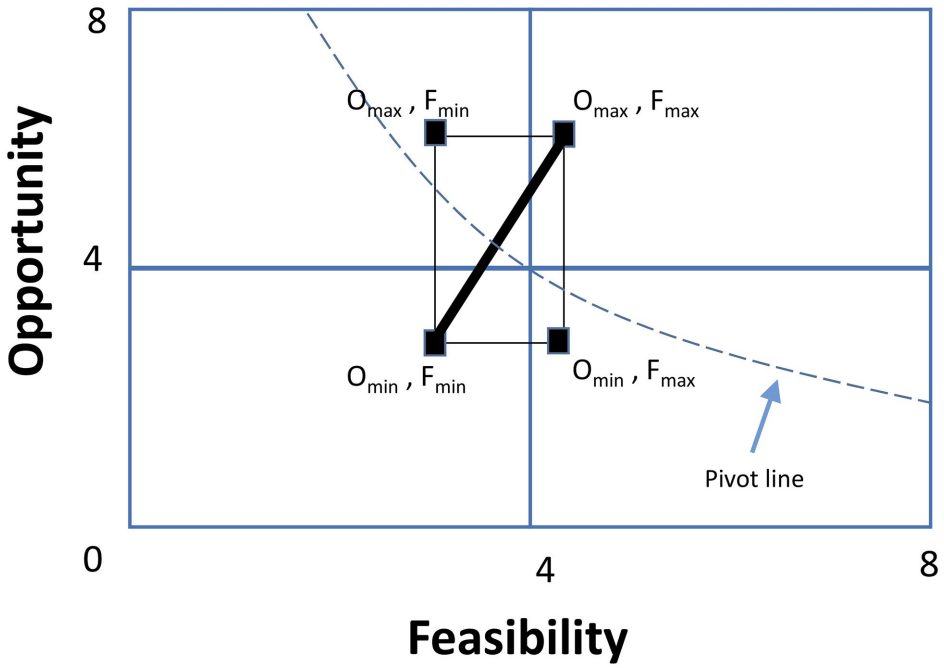

FIGURE 4. Single project on matrix plot: Opportunity-Feasibility scoring visualized to show range (rectangle) of uncertainty

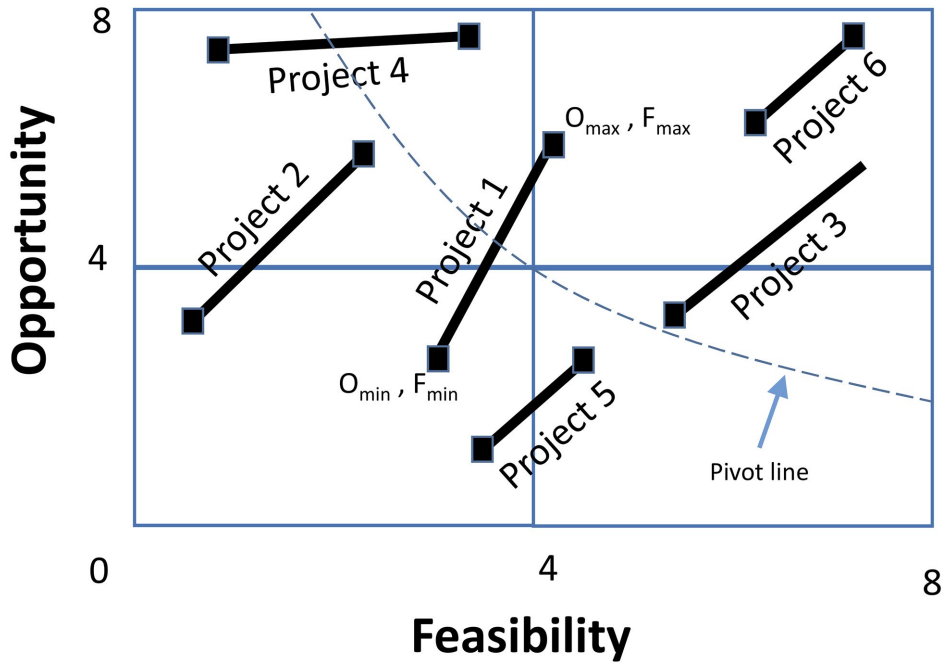

FIGURE 5. Multiple projects on matrix plot: Opportunity-Feasibility scoring visualized to show range (line) of uncertainty

The dotted curve shown is one of many possible, showing where the product of Opportunity x Feasibility is constant. The one illustrated passes through the midpoint of the diagram where O = 4 and F = 4. If the scaling statements are well chosen, the dotted curve is the "pivot line" that separates the diagrams into two regions representing, roughly, projects whose estimated return on investment is acceptable or unacceptable. The projects represented by straight lines that span the dotted curve may need further investigation to reduce their range of uncertainty before firmer decisions can be made. Looking back at the details of the scoring for each factor will show where the key uncertainties lie. This illustration presents the core scoring and uncertainty information about each project clearly, allowing comparisons between projects, and in particular emphasizing which dimension, Feasibility or Opportunity, needs more attention as the project moves forward.

Outputs of Process

The first review of a group of projects is unlikely to result in clear-cut choices. Some firm decisions may be made, but the balance of the portfolio will need to be reviewed, and there may still be a need for further work to clarify uncertainties. Even for those projects where confidence is high, acceptance is likely only to mean permission to proceed to the next stage of investigation. Therefore, apart from clear rejections or acceptances, the key outputs of the scoring process will often be lists of actions to be taken to address risks and further reduce uncertainty in each project.

Grundfos' Experience Developing a Customized Scoring Tool

Grundfos, based in Bjerringboro, Denmark, is the world's largest manufacturer of pumps. It employs 18,000 people and manufactures more than 12 million pump units a year. The company spends over €7 million each year on R&D. Grundfos wanted to improve its project selection process as many of its projects had been running late due to technical issues. Previously, Grundfos used an externally sourced scoring tool for project selection, but the company decided to design its own scoring tool to align with its unique requirements. The Technology Department typically reviews 15 project ideas per month, and it needed an efficient way to make an initial decision on whether to progress an idea.

In 2013, Grundfos created a new Front-Loading Department within its technology organization to close the gap between technology and business aspects for technologies that would not go directly into the core business. The goal was to ensure that all major technical and marketing issues got resolved before a technology moved into the main product development process. "We decided that the recently formed Front-Loading Department was the place to start because their projects had to be evaluated against a broad range of criteria, not only technical," said Christian Rasmussen, then manager of Grundfos' Technology Department. "It is not about getting the business processes perfect. It is about flexibility and ability to build 'good enough' business processes fast. The scoring tool creation method is powerful in this context because it creates data very fast, and it supports the dialogue between new people organized in new settings."

To develop its own scoring tool, Grundfos started to follow our multi-factor scoring tool design method, with the help of external facilitators. However, the company encountered an obstacle that stopped the process. Grundfos distinguishes between longer-term strategic projects and shorter-term tactical ones. The company quickly realized that before moving forward to look at project selection it needed to be able to make quick and objective decisions on whether a project was tactical or strategic. Grundfos created six questions to distinguish between these two distinct types of projects, looking at elements such as product design and fit with existing production networks and distribution channels. It took two days to design this process to distinguish the types of projects, and it required several technology managers to develop the process and subsequently train employees.

Grundfos was then ready to use our multi-factor scoring tool design method to develop two detailed scoring tools—one for tactical projects and one for strategic projects. These scoring tools would be used to select projects that were ready for main-line development, some of which came from the Front-Loading Department. Decision makers chose from the Opportunity and Feasibility factors provided and then adapted the related scaling statements to fit their company. This exercise took one person approximately two hours per tool, including testing it on a project. We provide some examples of the factors and scaling statements used (Table 6).

Once Grundfos created the scoring tools, scoring was the next step. Scoring typically took team members about 30 minutes per project, which the company indicated was very efficient compared with the time normally spent debating which projects to choose. Grundfos did not disclose the exact amount of time, but the company indicated the quality of decisions at quarterly portfolio decision meetings was higher due to the structure provided by the customized scoring tools. Grundfos successfully evaluated projects such as a novel level sensor for deep well pumps and a test that can quantify motor bearings' resistance to bearing current.

During this time, Grundfos also developed and used a Technology Points (TP) system in the technology planning area that illustrates the value of the multi-factor scoring

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tool design method. Grundfos adapted our method to develop a separate scoring tool that uses different dimensions (for example, business value, platform value, and/or development efficiency value) relevant to the technologies the company evaluates. The TP system allocates points to technologies coming out of a completed development project and registers which technologies are being transferred to product development. The TP system makes it possible to follow the value of the technology development in the Technology Point currency (Figure 6) and between 2014 and 2016, Grundfos evaluated 85 technologies. Christian Rasmussen explained, "The financial reporting on the effect of technology projects chosen with or without the multi-factor scoring tool design method is not something we have or aimed to have. When I was in the technology organization we used a graph showing Technology Point scores over 9 quarters. What we improved over time was the count of Technology Points that go into product development. We celebrate that as success in Grundfos."

Grundfos found the scoring approach to be highly effective in terms of both design and application. The company highlighted four specific learning points from its experience in project selection using its customized scoring tools:

1. Only use the method to design a scoring tool when project selection is complex and dialogue is needed, as it takes preparation and effort, but the results are worth it.
2. Separating Opportunity and Feasibility factors provides additional clarity. Previously, when these dimensions were mixed together, decision makers experienced difficulties during discussion and project selection.
3. Only use this method when you control selection decisions. In one area of the company in which different departments had joint responsibility, we found that 50 percent of projects were not within the department's control.
4. Using the scoring tool on a portfolio over time works as a key performance indicator for the organization's performance.

TABLE 6. Examples of factors and scaling statements from Grundfos

Opportunity Factor	**0**	**3**	**6**	**9**	**12**
Industry and market readiness	The product or offering includes new features that has been introduced to the market without success	The product or offering includes features new to the market	Market is buying these products today and features are known	Product will serve an unmet need in the market	Customer insight confirms that the product will serve an unmet need in the market
Growing market or expected annual growth over 10 years	Market decline	Market growth >2.5%	Market growth >5%	Market growth >7.5%	Market growth >10%
Future Synergies Technology platform	Technology leads to a single product	Can be used in other products	Can be used in other products and for business expansion	Potential for use throughout several businesses	Opens up entirely new market
Feasibility Factor	**0**	**3**	**6**	**9**	**12**
Competitive distance due to product performance	Same performance as major competitors	Performance is better than major competitors in a limited geographic area	Some features are better than major competitors	Some features that are important to customers are better than major competitors	Several features that are important to customers are significantly better than any major competitor
How sustainable is our competitive advantage (for example, do we have IPR and are the features readily copied)?	Features could be copied with little effort and no IPR	Features can be copied with little effort after 3–5 years	Features can allow us to maintain competitive advantage, but it will require continuous effort	The effort to copy key competitive features will be much higher than our effort to maintain the lead	Key competitive features are covered by IPR or unique capabilities that are not easy to copy
Ability to handle complexity of the product program	Building blocks are interacting, but we have no experience in linking the functions	Building blocks are interacting and we have access to competences on both side of the link	Complexity is low or we have tools in place to link building blocks	Complexity is low or we have tools in place to link building blocks, and we create an overview of the product program	Complexity is low or we have tools in place to link building blocks, and we optimize the product program across building blocks

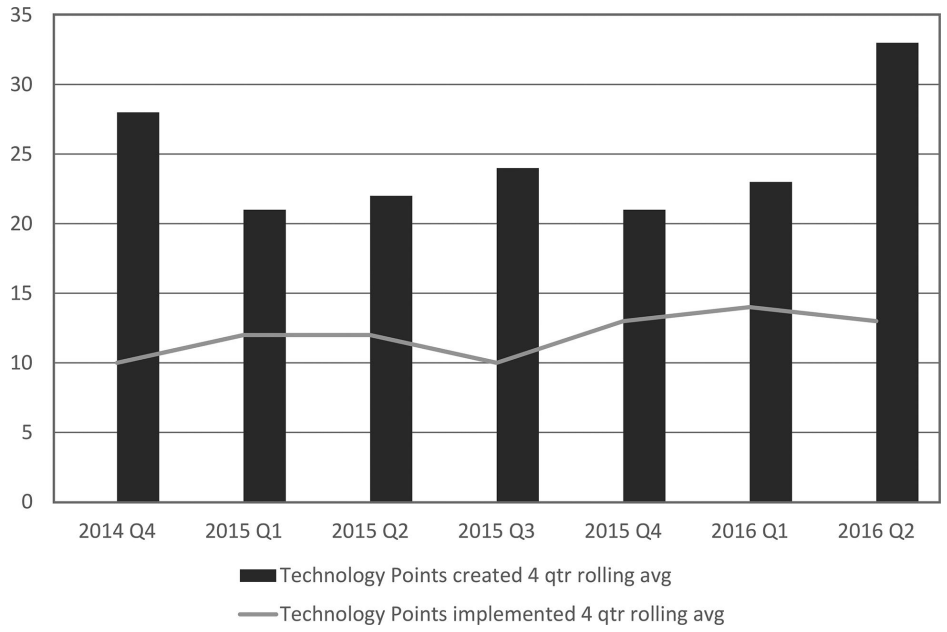

FIGURE 6. Improvement in value of technology transferred to product development at Grundfos (4 quarters rolling average)

General Guidance for Multi-factor Scoring Tool Design Method

Based on our experience developing, testing, evaluating, and refining the multi-factor scoring tool design method, we devised some general guidance for others looking to apply it.

The Design Process

Managers need to give careful thought when aligning company-specific factors to the scoring tool. For example, one multinational corporation (MNC) we worked with wanted to include Market Regulation as a factor because it had a clear competitive advantage when it operated in highly regulated environments. Regulation is not part of the current illustrative list of factors for either Opportunity or Feasibility, so the MNC introduced it as a new factor important in its business context. The director in charge of the particular domain and senior commercial and technical leads from that business unit made the decision to include Market Regulation in the Opportunity list, although the company's clear expertise in understanding, operating, and adhering to strict regulations could have been thought of as contributing to Feasibility. Decision makers need to agree on allocation of factors: to avoid wasted effort during the scoring process and to avoid changing the relative positioning of the projects scored without due cause, it is important to work out how each factor makes its contribution.

In cases where a customized scoring tool is used to select technologies rather than products, different types of factors may be needed for Opportunity and Feasibility. For example, when identifying materials required for low carbon production of hydrogen and related energy carriers and chemical feedstock, one company's participants had a 2–3 hour discussion to decide what constituted an Opportunity versus what defined Feasibility. Application-focused projects, which is the focus of this paper, may require different factors than pre-commercial projects, for example.

Specific scaling statements (descriptors for factor scores) are necessary to provide a clear perception of each factor during scoring. They need to be as context-specific and precise as possible, as they are "anchors" for discussion. The illustrative lists we provided from other applications help demonstrate the level of detail required for companies designing their own scaling statements.

For Grundfos, and other organizations we have worked with, the scoring tool design process revealed an unclear Opportunity description, so the companies developed their own template. Having a standard way to describe each project opportunity is important to ensure consistency. Using a template provides the group with a standard set of data for each project under review. The template should include an image from the project (photo, diagram), a summary of the opportunity, the market needs or opportunities addressed, the expected performance (if known), key technologies needed, and any knowledge gaps and risks.

The Scoring Process

The scoring team must include a range of people in terms of diversity and knowledge. The participants must also understand that the design process involves learning by doing, which requires being flexible and ready to go through several iterations, as necessary. Ideally, the scoring team should comprise people who are knowledgeable about all the projects that are being scored. Participants may include, for example, technical experts, product development experts, finance experts, logistics experts, and sales and marketing experts.

To reduce bias, the initial scoring should be done individually before the group meets, so that the group assesses only large deviations in individual scores (rather than to rescore everything). Without this step, we witnessed the emergence of "group think" or scores being manipulated to make certain projects more appealing.

Managers need to give careful thought when aligning company-specific factors to the scoring tool.

There tend to be two types of reactions: confirmation of priorities as considered by the group or the emergence of surprising projects as priorities. The output of the scoring method also provides technology/portfolio managers with the right data to be able to justify decisions to senior management.

Outputs of the Process

Tool development in industrial companies in live situations involves elements of process-based action research (Platts 1993). No control group exists in such a development, but as the process gets reused and refined, it stabilizes and delivers reliable results. Both the multi-factor scoring tool design method and the use of the scoring tool help guide dialogue and discussion in a more focused and structured way than general discussion. Grundfos and other organizations have confirmed that the process helps to identify and create consensus regarding what the important selection factors are; that defining factors through scaling statements improves consistency and clarity; and that it creates a shared recognition of potential risks or knowledge gaps. At least four MNCs and two SMEs continue to use the multi-factor scoring tool design method widely across their organizations.

Conclusion

Multi-factor scoring is a valuable way to bring clarity to the decision-making process when information is sparse. Our multi-factor scoring tool design method facilitates discussion about the key factors by providing objectivity around something that is essentially subjective. A fully developed scoring process, such as the one described here, adds further precision and clarity to project selection, but it takes time and effort. Our multi-factor scoring tool design method is most suitable for repeated use as part of a regular process. The results are somewhat imprecise because decision makers are dealing with estimates of the future state of novel projects, so they should not be applied blindly. Decision-making should include more financial analysis as soon as enough information is available.

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