

Research Article

# Prioritization of Digital Innovation Team projects using a utility model and tradespace analysis

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## Abstract

Firms outside of traditional software and internet technology disciplines face unfamiliar challenges in managing portfolios of innovative digital products as their industries are reshaped by digital transformation. When rapid prototyping of proofs-of-concept (POCs) is the responsibility of a specialized Digital Innovation Team (DIT), the rate of idea creation can quickly outpace the capacity of this dedicated group. Systematically identifying and pursuing the highest-value ideas aligned with business needs, innovation goals, and enterprise strategy becomes both a vital and difficult technical challenge. This study examines a prioritization and selection (PAS) approach founded on systems engineering (SE) methods to manage the work progressed within a DIT. The assessment combines stakeholder analysis with surveys to characterize a multi-attribute utility function measuring POC benefit. POC resources are estimated from anticipated duration, development needs, validation requirements, and process change necessary for the technical solutions. These metrics characterize a cost-benefit trade-off, complemented by innovation measures associated with each POC. The proposed workflow supports portfolio shaping and work prioritization across different business segments while facilitating the stakeholder alignment and prototype visibility necessary to drive product commercialization. Future work will address a remaining gap in the consistent valuation of lower-benefit innovative work that is a foundational dependency for higher-value POCs.

**Keywords:** digital innovation teams, portfolio management, systems engineering, tradespace analysis, value engineering.

## 1. Introduction

Digital transformation is now a critical component of enterprise strategy across a multitude of industries, often requiring disruptive changes to corporate culture, organizational structures, and project management practices (Barthel et al., 2021; Berghaus & Back, 2017; Neumeier et al., 2017). Successful digital product and services companies demonstrate team structures that can facilitate a traditional firm's digital evolution, including the use of matrixed organizations with enough autonomy and flexibility to support agile product development (Kniberg & Ivarsson, 2012; Mankins & Garton, 2017). Firms are adopting a Software Product Line Engineering approach by grouping individual product teams into domain-centric product lines that deliver digital capabilities toward a common functional area (Klunder et al., 2019; Van der Linden et al., 2007). Product teams can follow Lean Startup principles by focusing on *minimum viable products* (MVPs) that, upon meeting a level of certainty for business value creation, will be commercialized in alignment with standards around security, scalability, and broader technical dependencies (Ximenes et al., 2015). Product team backlogs capture digital prototypes not yet under active development. These solutions address technical challenges with a proven but potentially non-optimized form, sometimes referred to as *proofs-of-concept* (POCs). At the fuzzy front end of product flow are innovative but unproven ideas, which must be investigated through rapid prototyping and run a substantial risk of failure. Figure 1 illustrates these stages as an innovation pipeline or value chain, building from idea to deployable technical capability.

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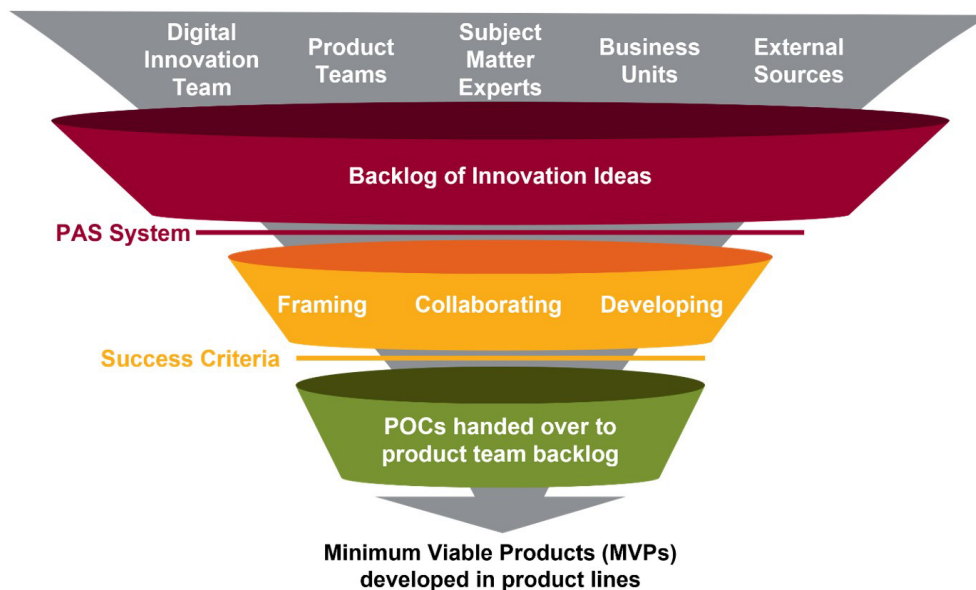
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**Figure 1.** Maturation flow for innovation concepts from initial idea to proof-of-concept to minimum viable product. Attributes and owners of the different innovation product stages are noted. Commercialization and product delivery (not shown) will follow after multiple iterations of MVPs.

Firms can promote a healthy and active innovation pipeline by building the necessary work culture and organizational support, sometimes characterized by balancing exploratory and exploitative work (Birkinshaw & Gibson, 2004; O’Reilly & Tushman, 2013). One end-member option relies on fully dedicated innovation teams for identifying, engineering, and validating POC solutions, pairing cross-disciplinarity of team expertise with an uninterrupted focus on innovation over core business activities (Clark & Wheelwright, 1992; Edmondson & Nembhard, 2009). Because information technology (IT) is central to defining novel products and services for digital innovation (Frey et al., 2020), innovation teams focused on digital solutions require members with strong IT skills in addition to subject matter experience in traditional science and engineering fields. These Digital Innovation Teams (DITs) embody the *people* dimension of front-end innovation, using their knowledge of organizational processes, existing technologies, and potential customers to find the opportunity space for digital solutions (Oliveira et al., 2019). However, under the constraints of limited resources and time, DITs must also maintain a backlog of innovation ideas to work on and periodically select ideas from the backlog as capacity allows.

Figure 2 illustrates the POC development process as a funnel capturing innovative ideas from various sources. Between the red and yellow rings, a backlog prioritization and selection (PAS) system filters out some ideas and allows others to pass into the framing and active stages of POC development for a DIT. The underlying selection methodologies can vary from ad hoc team choices, to the use of simple heuristics, to the maximization of a well-defined objective function. Portfolio managers responsible for multi-year R&D projects may require decision analysis and financial figures of merit for prioritization (Kolm et al., 2014). The Scaled Agile Framework relies on a duration-scaled cost of delay (i.e., *weighted shortest job first*) metric for prioritization, typically calculated using proxies like stakeholder preference, value erosion, and value enabled by new opportunities (Scaled Agile, Inc., 2021). The Department of Energy demonstrated an alternate approach, using a non-financial multi-attribute value optimization for funding allocations given the challenges in characterizing the eventual monetary benefits of projects with low technical readiness (Kurth et al., 2017).



**Figure 2.** Innovation funnel for a Digital Innovation Team. Untested ideas start at the top, are selected using a Prioritization and Selection system, are prototyped, and move into a product line backlog if they prove successful. The funnel shape depicts the progressive reduction in number of potential products that make it through each stage.

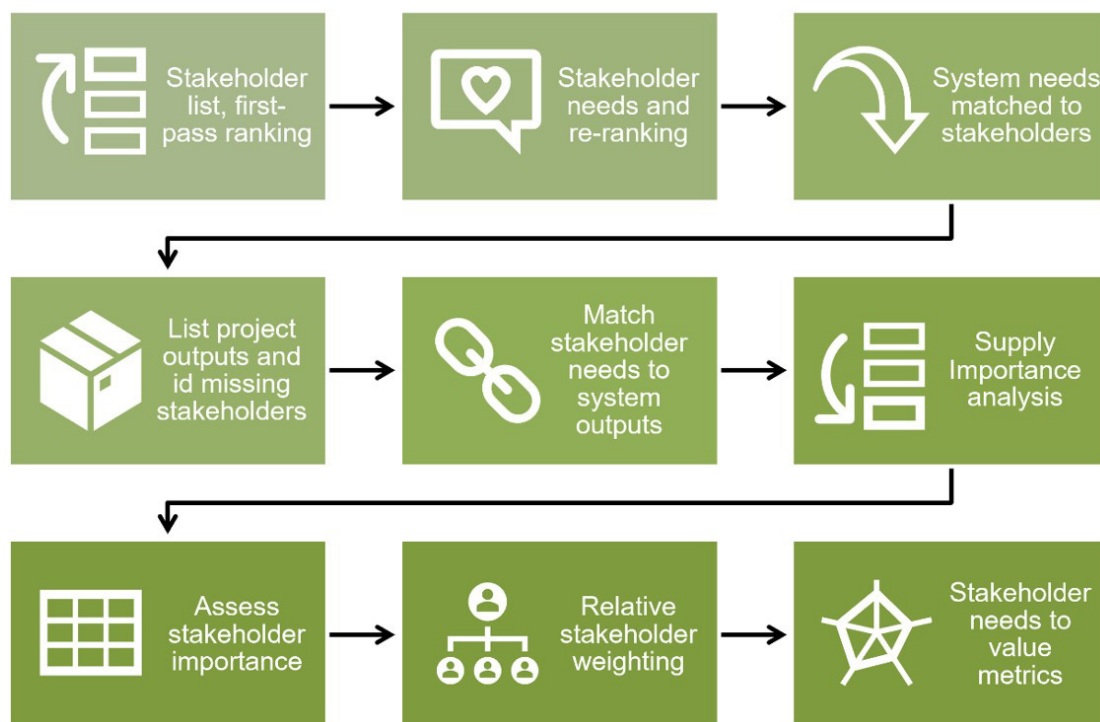
This study considers an environment supporting a spectrum of innovation work, including visionary or radical innovation that, given the relative immaturity of product ideas being prototyped, tend to be poorly suited for financial value metrics (Kristiansen & Ritala, 2018). Innovations are developed by a small DIT assigned to a digital product delivery organization for one division of a major energy firm. Members represent a diverse cross-section of subject matter experts (SMEs) covering many branches of science, engineering, and IT capabilities, and the group has the autonomy to fully focus on innovative work. However, instead of long-duration R&D, team members target POC efforts taking 3–6 months to build validated prototypes. A systems engineering methodology is used to guide decisions on which ideas should be pursued. The process defines a multivariate optimization of cost-benefit trade-offs for assessing both active work and opportunities in the innovation backlog. When combined with additional innovation metrics and portfolio visualizations, this PAS system empowers the DIT to simultaneously account for stakeholder feedback, resource constraints, and the strategic balance of the team’s POC portfolio.

## 2. Methodology

### 2.1. Stakeholder Analysis

Establishing the appropriate value framework to apply to an innovation backlog begins with understanding the stakeholders. Here, the term *stakeholder* refers broadly to the spectrum of people who provide resources toward a PAS system for a DIT and those who benefit from such a system. The output or outcome of the system meets the needs of both *charitable beneficiaries* and *beneficial stakeholders*, but only the latter contribute toward meeting the system’s needs. The system provides little value for *problem stakeholders*, but this group supplies essential contributions to the system (Crawley et al., 2015). This terminology establishes a comparative model for assessing stakeholder significance based on stakeholder importance to the system and its importance to them.

Figure 3 illustrates the workflow used to identify, rationalize, and rank the system stakeholders in this study. First, a small, dedicated team constructed an initial list capturing those internal and external to the firm with interests that intersect the activities of the DIT. These individuals or entities were labeled by stakeholder type, then ordered from highest to lowest importance by the team. Rank-ordering allows the team to focus on a manageable subset for needs analysis, targeting approximately  $7 \pm 2$  stakeholders per the typical limits of human cognitive load (Miller, 1956). Relevant needs for each shortlisted stakeholder were documented, and the team performed a second ranking exercise to ensure alignment on the stakeholder order.

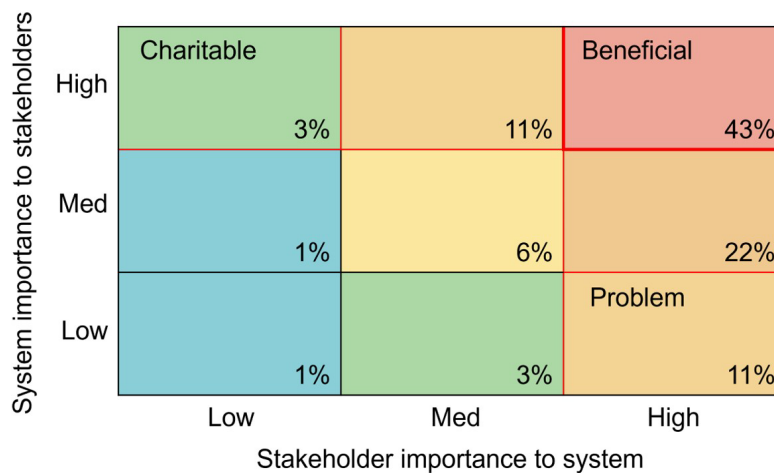


**Figure 3.** Proposed series of tasks for the Prioritization and Selection system stakeholder analysis, ending in defining the influence of different stakeholders and establishing metrics that contribute to system value. The method is adapted from the needs-to-goals framework in **Figure 11.1** of (Crawley et al., 2015).

The required inputs and resources for the PAS system were itemized and checked for consistency against the identified stakeholders. The analysis team ranked the importance of each input, and an associated score was defined by calculating the reciprocal of the sum of squared team member rankings. Stakeholder importance was approximated by adding together the scores for all system inputs provided by a stakeholder. These importance totals naturally separated into three clusters, from which high, medium, and low labels were mapped to the stakeholders.

Stakeholder needs were matched to system outputs, and the strength of each connection was tested based on supply availability, differentiating needs uniquely met by the system from needs with accessible alternative means of fulfillment (Crawley et al., 2015). Using group consensus, the analysis team applied high, medium, or low-importance labels for the system to each stakeholder following this needs and supply analysis.

All stakeholders were then placed within a 3×3 matrix covering combinations of stakeholder-system and system-stakeholder importances. Figure 4 depicts the matrix with labels indicating where the three representative stakeholder types would plot. Also included are percentages based on theoretical network modeling for complex stakeholder environments (Cameron et al., 2011). The percentages specify the relative weight teams should place on the stakeholders, i.e., the degree to which their voices should contribute to system decisions.



**Figure 4.** Stakeholder value matrix that maps stakeholder-system and system-stakeholder importance to relative stakeholder influence (percentages) on innovation idea and proof-of-concept value assessments. Percentages are approximated from an idealized stakeholder value network following the method described in (Cameron et al., 2011).

The stakeholder analysis step also aims to define a comprehensive list of value metrics that collectively differentiate innovation opportunities, highlighting which among a collection of ideas most satisfies stakeholder needs. The simplest process for deriving this list only considers the value perspective of the highest-priority stakeholders, while more complex approaches analyze the flow of needs and resources throughout a stakeholder network model (Crawley et al., 2015). This study identified matching patterns or clusters among the relevant needs of the shortlisted stakeholders. Critically, if a need could be expressed neutrally and applied to more than one stakeholder, it was added to the collection of final metrics. Additional considerations for the distillation of needs-based metrics were i) did the final metrics set cover the primary needs of the beneficial stakeholders and ii) were the final metrics suitably independent to describe a meaningful multidimensional space for investigating benefit trade-offs. A categorical list of value options was also defined for each value metric to standardize the value framework, ensure an appropriately wide range of value representation, and simplify the process of defining the value of innovation ideas for a DIT.

**2.2. Model construction**

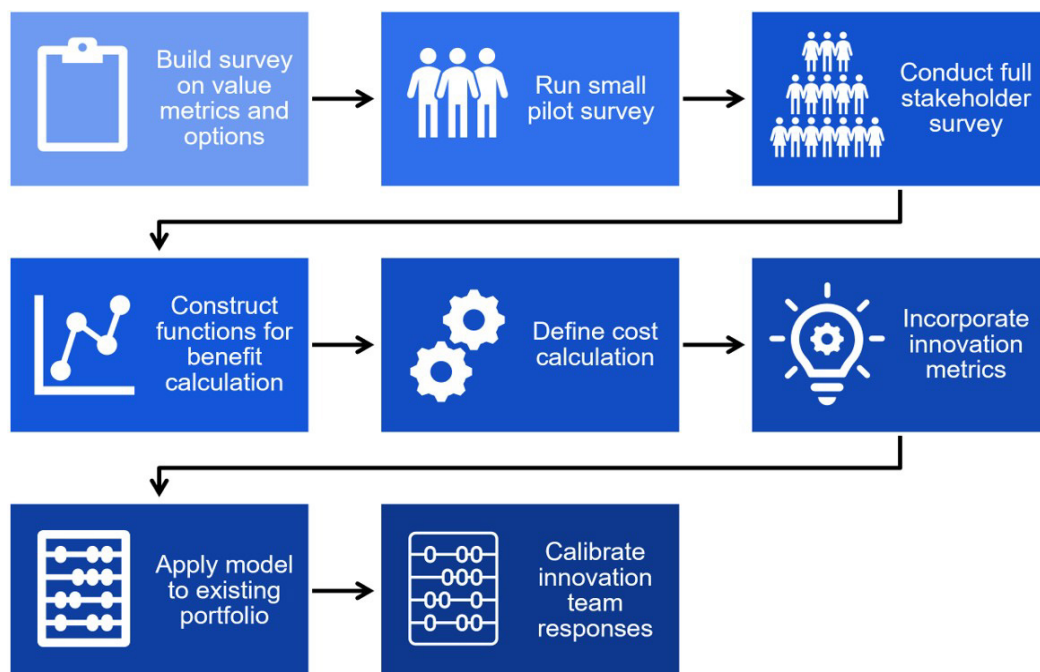
At the heart of the SE PAS system is the ability to compare innovation ideas in a portfolio based on a single characterization of benefit or utility. The final collection of value metrics and their associated value options can be converted into a compound measure of benefit using the concept of a multi-attribute utility function (MAU):

$$MAU = \frac{1}{w_{tot}} \sum_{i=1}^N w_i U_i = \frac{w_1 U_1 + w_2 U_2 + w_3 U_3 \dots + w_N U_N}{w_{tot}} \tag{1}$$

where:  $N$  is the number of value metrics,  $w_i$  are weights providing a relative scaling to each metric,  $w_{tot}$  is the sum of all  $w_i$ , and  $U_i$  are utility functions that convert a chosen value metric option to a value between 0 and 1, representing low and high utility, respectively (Ross & Hastings, 2005).

Utility acts as a numerical benefit assessment derived directly from the system stakeholders. The process fundamentally relies on a survey of the stakeholders, first on the relative importance of the value metrics for determining benefit, then on the ranked value of different metric options. The latter forms the basis of the utility functions ( $U_i$ ) in (1) that map value metric options to decimal utility values for categorical variables. To reinforce the terminology: the benefit associated with an innovation idea is characterized by the weighted combination of utility scores across multiple value metrics. The weights and scoring functions come from the stakeholder survey, and they get applied to innovation ideas based on the option-mapping of those ideas to the value metrics.

Figure 5 depicts the workflow used for collecting stakeholder feedback and building the multi-attribute utility model in this study. First, a survey was constructed for determining the metric weights and utility functions. The design of the survey as short in length and understandable even to those unfamiliar with SE concepts is fundamental to securing a high response rate and reliable results across all stakeholders. For this study, an initial pilot among the DIT members was used to validate the survey mechanics and user experience before sending it to over 100 targeted stakeholders.

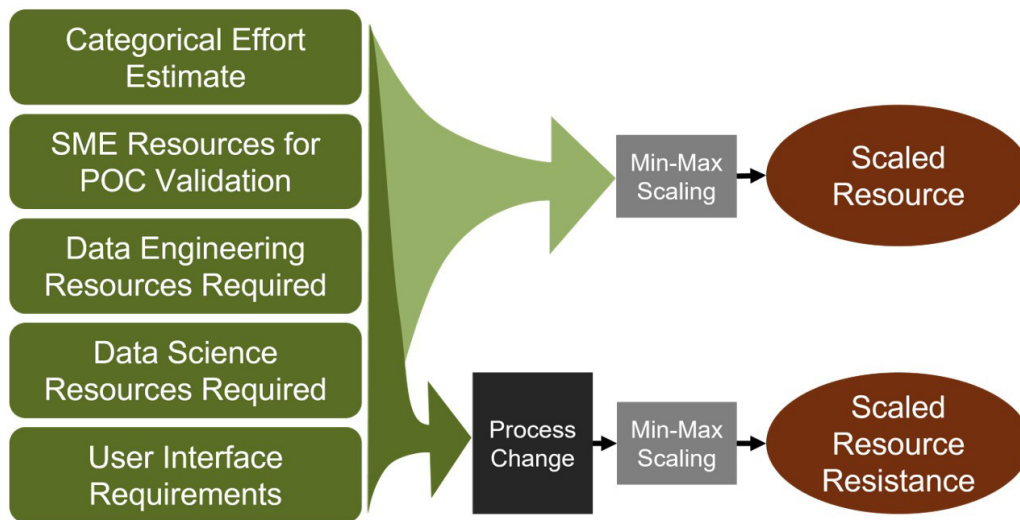


**Figure 5.** Proposed model-building workflow for formally defining benefit, cost, and innovation measures for the Prioritization and Selection system. Once defined and calibrated, these metric calculations can be applied to the entire portfolio of work items for a Digital Innovation Team, including innovation ideas not yet being pursued.

Results were compiled for analysis after three weeks of engaging with potential respondents. Each surveyed stakeholder was assigned to one or more of the previously identified stakeholder groups depending on their roles and responsibilities. The relative weights for each of the value metrics ( $w_i$ ) were then determined by first averaging within each stakeholder group, then applying a weighted average across groups using the respective stakeholder percentiles defined in Figure 4. This method preserves the importances determined in the original stakeholder analysis. A similar procedure was used to derive value metric utility functions; the ranking of metric options in the surveys was averaged within stakeholder groups, then combined by weighted averaging across groups. The final list of metric option utility values was min-max scaled such that the highest-ranked option received a utility value of 1.0, and the lowest-ranked option was assigned a utility of 0.0.

A separate model determined the cost of each innovation idea to balance against its MAU-defined benefit. The cost calculation was standardized by reframing it as a scaled resource intensity, derived from the expected effort (time) and the number of individuals required to complete a POC for each idea. These project attributes were combined using internal estimates of fractional time dedicated to innovation projects and the labor rates for contributors from different work functions.

Figure 6 illustrates the combination of inputs and min-max scaling step needed to build the resource intensity metric. In addition, a separate scaled resource resistance metric was created by applying a multiplier for the anticipated process change needed to move a particular POC into MVP development after its handover to a product line.



**Figure 6.** Elements integrated into a scaled resource "cost" calculation for innovation ideas. The model combines categorical values and whole number headcount requirements (green boxes) with labor rates and fractional time commitments to estimate resource needs. Resource resistance includes a process change multiplier.

Innovation metrics offer another dimension for portfolio shaping and analysis to match the strategy of a DIT (Wheelwright & Clark, 1992). However, the tie between stakeholder needs and the benefit supplied by specific categories of innovation cannot be well-defined without focusing on specific technologies or processes that might be implemented. Rather than surveying stakeholders to derive utility functions for innovation levels, the analysis team introduced three categorical innovation metrics to track as ideas are cataloged in the DIT backlog (Table 1). These metrics offer an alternative way to decompose and evaluate the portfolio, extending the SE PAS system beyond simple benefit-at-cost trade-offs to include innovation portfolio balance decisions.

**Table 1.** Innovation metrics recorded for each idea added to the innovation team POC backlog.

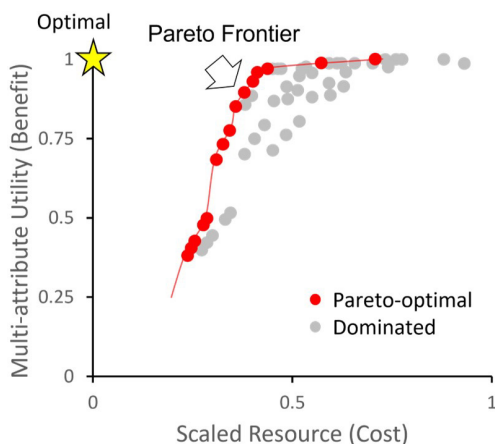
Metric	Description
Innovation Level	Levels that separate existing technology support from quick-win enhancements and emerging transformational solutions not yet seen or implemented in the target domain. Defined along a 4-tier scale based on (Wheelwright & Clark, 1992).
Novelty Level	Novelty with respect to intellectual property, e.g., is the idea in published records, and if not, does it meet the threshold for publication or patenting? Measured on a 5-tier scale.
Process Innovation	The required process change and effort needed to align others around MVP development and deployment if POC is successful. Defined along a 4-tier scale.

The value framework, resource cost calculations, and innovation metrics collectively enable direct comparison of the entire DIT portfolio, including all backlogged innovation ideas and active POC work. Team members for the DIT were asked to independently submit their current and future work into the PAS system through a digital intake form. While this form facilitated consistency by restricting the range of selections for each required intake question, further calibration was required to verify and validate the categorical metric options selected by different team members. When all the POCs were in the system, the DIT met for a round-table group share and feedback session to both seek team alignment and elevate a PAS system owner responsible for regularly reviewing the idea and POC entries for future consistency.

### 2.3. Portfolio visualization

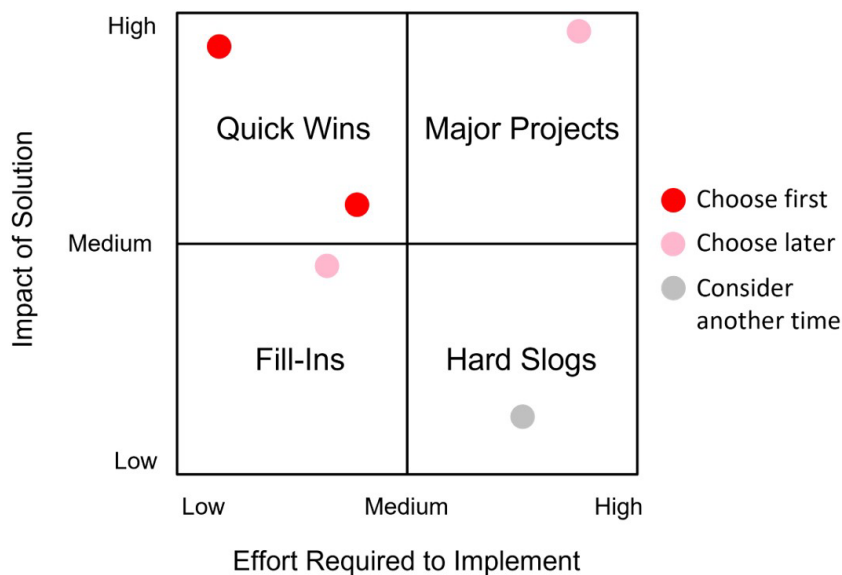
The success of a PAS system largely depends on data transparency paired with effective communication through intuitive and insightful visualizations. However, users vary in their preferences on graphical formats, color palettes, and favorite metric trade-off combinations. Balancing user input with progress toward a decision dashboard is possible using a progressive approach of rapid design ideation, starting with simple scripted plotting tools, followed by formal dashboard design, and finally constructing a cloud-computing pipeline to establish a real-time end-to-end solution. In this study, a scatterplot of the innovation portfolio was built first, placing the MAU metric on the vertical axis and scaled resource on the horizontal axis. This plot describes a tradespace, or "trade-off play space," illustrating the cost-benefit tension for innovation opportunities (Figure 7). Optimally, an

innovation activity would have perfect utility at no cost as noted in the upper left corner of the plot. A curve connecting the lowest scaled resource activity for each benefit level describes the Pareto frontier, with all intersecting solutions considered Pareto-efficient options. Those plotting to the right of the Pareto frontier are dominated by other options and hence considered less efficient choices for prioritization and selection.



**Figure 7.** Tradespace plot illustrating cost-benefit trade-offs for a Digital Innovation Team's active and backlogged portfolio. Red markers define the Pareto-optimal choices.

An alternate portfolio view plots impact versus effort (Figure 8). Due to the potential ambiguity of these key terms, impact scores were strictly defined using the scaled sum of utility values for value metrics associated with the projected user community and business value realization timeline (metrics 6, 7, and 9 in Table 2: Value metrics identified from stakeholder analysis and used for a multi-attribute assessment of utility or benefit based on surveyed feedback. The listed weights are from the results of the stakeholder value survey.). The scaled resource resistance metric noted in



**Figure 8.** Impact/Effort chart that clusters work activities for rapid prioritization. The legend notes typical guidance based on plot placement of individual projects. Actual decisions should balance insights from all trade-off plots.

Figure 6 served as a proxy for effort.

The final dashboard incorporated additional plots, tables, and filter options. Feedback on these displays was critical to addressing the needs of key stakeholders, so this approach required iteration and user engagement to refine appropriately. In a parallel effort, a user application for editing existing PAS system entries, pipeline triggers to automatically apply MAU and resource cost models on the idea collection, and self-refreshing capabilities for the published dashboard were added to the solution. The final system supports rapid ingestion of new innovation ideas and evergreen communication of the entire portfolio with a consistent model and custom displays.

### 3. Results

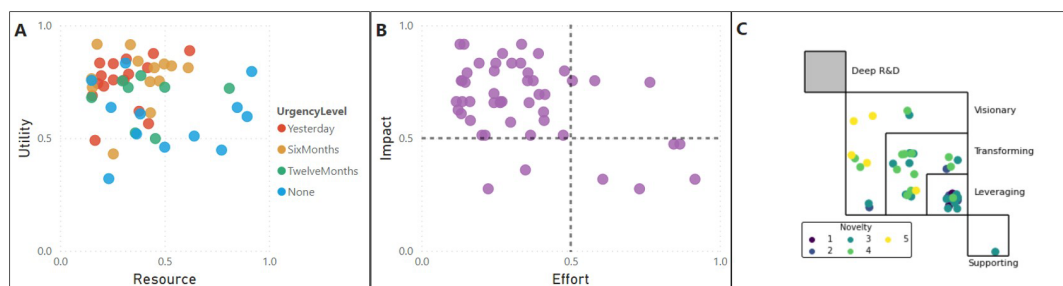
Stakeholder analysis for the PAS system initially considered eighteen stakeholder groups. Early ranking exercises reduced the list to ten, although an eleventh was later added when mapping system deliverables to stakeholders revealed a missing beneficiary. The needs of these stakeholder groups are clustered into nine categories, reframed as value metrics for the stakeholder survey and MAU calculation (Table 2). All metrics were associated with no more than five categorical choices (not listed here) to simplify and standardize the option-mapping of innovation ideas to metrics.

**Table 2.** Value metrics identified from stakeholder analysis and used for a multi-attribute assessment of utility or benefit based on surveyed feedback. The listed weights are from the results of the stakeholder value survey.

No.	Metric	Definition	Wt.
1	Domain Knowledge	The expertise of the innovation team member who owns the innovative idea, specifically regarding the investigated technical challenge.	0.125
2	Community Awareness	The breadth of community awareness regarding the technical challenge targeted by the innovation idea.	0.102
3	Deployment Pathway	Vision for how a successful POC would be matured as an MVP and deployed (e.g., a stand-alone app or as part of a pre-existing platform).	0.116
4	Asset Class Alignment	Level of alignment around the innovative idea with focus areas defined by the technology customers within the business (i.e., asset classes).	0.121
5	Strategic Initiative Alignment	Level of alignment of the innovative idea with published strategic initiatives for the parent organization of the innovation team.	0.127
6	Urgency	The expressed stakeholder urgency for the solution provided by the technology being proven as a POC.	0.129
7	Breadth of Use	The best estimate for the size of the end-user community after the technology matures and is deployed.	0.108
8	Innovation Source	The organizational source(s) from which the innovative idea originated.	0.067
9	Value Realization Timeline	The lag time between innovation technology deployment and business value realization if the idea was proven, matured, and deployed today.	0.105

The value survey was sent out in two waves, with repeated follow-ups from the project team and innovation team manager over a period of three weeks. The results tallied 68 unique responses, although the distribution across stakeholder groups was noticeably imbalanced. This outcome highlights why within-stakeholder group averaging precedes across-group averaging for the metric weights and utility functions; a large response rate for one group can benefit the group’s representative statistics without artificially boosting that group’s perspective in the MAU model. The final weights for each value metric based on the full set of responses are noted in Table 2.

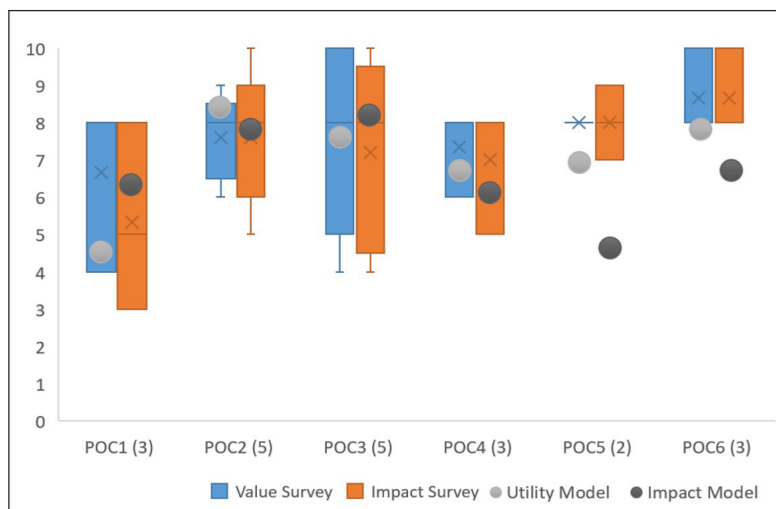
Figure 9 depicts example dashboard displays generated by running the entire DIT backlog and active project portfolio through the value model, calculating MAU, impact, and resource costs as well as capturing innovation metrics during the PAS system intake process. These only cover a subset of many displays designed and in use today, giving a flavor for the kind of portfolio analytics and decision support possible with a SE PAS system.



**Figure 9.** Example digital dashboard plots illustrating A. a cost-benefit tradespace as utility vs. resource, B. an impact/effort plot, and C. an innovation plot for portfolio analysis adapted from (Wheelwright & Clark, 1992). The spread in values within each plot aids in differentiating projects from one another, which supports the ability to make prioritization decisions based on the depicted trade-offs.



Stakeholder feedback on a subset of POCs in the DIT portfolio was collected and directly compared to the MAU and multi-attribute impact model results as a means of validating the quantitative value assessment model approach. POC owners presented their work in the context of a dedicated showcase event, where audience members were encouraged to submit an online vote of their assessed value (benefit) and impact using a 10-point scale. Although the response count was generally low, Figure 10 illustrates a reasonable match between showcase value assessments and the PAS system-determined utility and impact metrics. Included in these responses are votes for impact and value of 10/10 for several POCs. Three of these high scores were submitted by individuals directly involved in the development of those POCs, illustrating the potential for valuation bias by those closest to the innovation work. The difference between survey results and the PAS model is most pronounced for POC5, which focuses primarily on data engineering that will support future innovative work. POC6 similarly enables value by generating alternatives for decision-makers developing business plans. The mismatch between the model and survey results for both POCs suggests the PAS model and stakeholders may be assessing the value of enabling technologies differently from those that directly result in a tangible benefit.



**Figure 10.** Comparison of the Prioritization and Selection (PAS) model with direct valuation feedback from surveyed stakeholders. The horizontal axis notes individual proofs-of-concept (POC) pitched to a stakeholder audience, with numbers in parentheses indicating the count of survey responses received from the audience on that POC. Survey results for Value (blue) and Impact (orange) are shown using a box-and-whisker representation, with the median noted by an X, the central box covering the middle 50% of the responses, and the whiskers showing the min/max responses. Light gray and dark gray circular markers illustrate the assigned values from the multi-attribute utility and impact measures developed for the PAS system.

#### 4. Discussion

Early feedback from applying the SE PAS methodology to a DIT’s portfolio highlights its rigor, repeatability, and stakeholder involvement as key benefits. As noted with the highest-value survey results in Figure 10, the underlying stakeholder-calibrated value model helps reduce the risk of familiarity bias as well as conformity bias that can influence assessments made within the context of group meetings. Furthermore, the metrics for product and process innovation and intellectual novelty provide alternative levers for tuning the strategic balance of innovations being pursued.

Greater process efficiency is also an advantage of applying the SE PAS method. Consider 100 surveyed stakeholders coming together once a quarter to evaluate and rank all ideas in a DIT’s innovation portfolio. Assuming meetings last  $\approx 3$  hours, 1200 person-hours/year would be dedicated to value and ranking discussions. By contrast, the value survey noted in Figure 5 lasts  $\approx 10$  minutes per respondent, followed by the near-instantaneous valuation and dashboard refresh. The method represents an overall 90% reduction in stakeholder time committed to valuation.

Instead of lengthy ranking meetings, richer alignment conversations are emerging from the use of the SE PAS system dashboard. Stakeholders and team members can rapidly view portfolio segmentation by completion status, asset class association, business focus, target product lines, or linkage to defined Agile epics. Conversations focus on the connections between POCs, MVP development for technology delivery, and future collaboration opportunities with SMEs and business unit partners. Initial managerial feedback indicates greater transparency of the team’s work and portfolio balance improves perceptions of the team’s performance. Management satisfaction is expected to similarly grow with this formalized approach to measuring, strategically shaping, and reporting innovative efforts (Lerch & Spieth, 2012).

Innovation management literature offers a variety of alternate tools and models to help firms better organize for innovation. Bassi Padilha et al. (2017) propose a spreadsheet-based tool that formalizes the review of innovative design alternatives early in the product design process using a framework of six criteria and fifteen sub-criteria. Barthel et al. (2021) follow a similar approach for digital innovation projects, grading innovation effectiveness with a three-horizon model comprised of thirteen impact metrics. Both methodologies require the innovation team to evaluate all project or design alternatives with their respective questionnaires, raising the question of scalability when applied to tens to hundreds of innovation ideas in the portfolio of a DIT. In their review of published innovation diagnostic tools, Bagno et al. (2015) observed that each innovation management model is founded on specific assumptions or biases that may be incongruous with the needs of any individual organization. This caution is particularly salient for digital innovation as consensus on digital product and service valuation continues to evolve (Barthel et al., 2021; Frey et al., 2020; Neumeier et al., 2017). Rather than using a fixed framework with a set number of value metrics, the SE PAS methodology effectively tailors the solution to the organization, allowing the initial stakeholder analysis to determine which value elements should be captured and how those elements combine to define a comprehensive utility model. To this extent, the methodology presented in this study has flexibility enough to be applied beyond a DIT, including at the level of a product line or the greater digital organization.

Importantly, the SE PAS methodology cannot rely on a single initial stakeholder value survey in perpetuity. System stakeholders may vary over time due to organizational changes. Additionally, the value judgments of all stakeholders will shift as both internal and external forces reshape business objectives, as illustrated by broader digital transformation and energy transition trends within the energy industry over the past several years. It is critical to revisit the survey with regularity, e.g., an annual feedback cycle, to ensure the underlying model does not exhibit significant drift. Furthermore, periodic calibration exercises with stakeholder value and impact assessments on a subset of the portfolio (e.g., Figure 10) can provide intermediate feedback on model performance and reinforce the credibility of the system for stakeholders who view MAU approaches with skepticism.

Lastly, a well-calibrated utility model paired with verified cost estimates should not supplant the decision authority of the innovation team. Tradespaces fundamentally highlight a subset of options that most efficiently balance two metrics, but decision-makers must also consider factors like delivery timelines, available resources, and innovation goals and strategy when selecting the ideas to pursue. Instead of promising an automated scheduling system, the SE PAS methodology delivers visualizations that facilitate discussions where even Pareto-inefficient ideas in the cost-benefit space could be elevated due to better alignment with an underserved asset class or high-level enterprise goals. Future work will focus on standardizing value adjustments to POCs that are dependencies or enabling technologies for other POCs, incorporating uncertainty into the utility and cost models, supporting tiered or higher-dimensional tradespaces, and integration with popular digital project management systems in wide use across multiple industries.

## 5. Conclusions

This study describes a novel decision support system that promotes targeted discussions and balanced options when managing the portfolio of a Digital Innovation Team. Applying concepts from systems engineering, new innovative ideas and active proof-of-concept work are assigned value metrics tuned to stakeholder feedback, and additional measures characterize estimated resource cost and relative innovation levels. The intake of new ideas is streamlined using a digital pipeline to automatically apply a multi-attribute cost-benefit model and update a live dashboard customized to aid in work item prioritization and selection. This method has successfully been developed and deployed for a dedicated multi-disciplinary Digital Innovation Team within an energy firm, enhancing the decision-making process as the innovation demands of the firm outpace resource availability. This pilot revealed that stakeholder-derived value assessments are fundamental to building satisfaction with the prioritization and selection system performance. Furthermore, the system promotes efficient stakeholder alignment meetings, consistent comparisons of different work opportunities, and transparency of the entire portfolio a Digital Innovation Team delivers to a firm. Opportunities for future research include investigating value adjustments for proof-of-concept work on enabling technologies and defining value and cost uncertainties for improved trade-off displays.

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