Major elements of the stage-gate process

- The stage-gate process includes a series of formal stages where project ideas are examined, developed, and advanced (Tavares-Quinhoes & Velez-Lapão, 2023). At the end of each stage, there is a gate to decide on whether to proceed to the next stage.
- The model has five primary stages: “idea generation, preliminary investigation, business case development, development and testing phase, and launch phase”. Each stage focuses on projects more narrowly while elaborating on the details of the project (Eljayar & Busch, 2021).
- The decision gates serve as checkpoints where management checks on progress, resource allocation, and whether the project aligns with overarching organizational strategies. This model, therefore, emphasizes structure over creativity in evaluating and developing ideas for innovative activities.

The stage-gate process provides a way to classify issues and manage innovation in a systematic way by turning innovation into a four-stage process with gates. Each stage develops and projects more completely, while each gate keeps them mindful of what it takes to meaningfully state integration resources. Doing this instills discipline, aligns integration and innovation activities with enterprise strategy, and manages risk. Using a stage-gate process for IoT-related partnerships and projects limits developing ideas that won't work and minimizes the organizational costs of engagement while developing innovative ideas and focus. Managers can also monitor and develop a sense of where each integration or innovation effort between multiple teams is proceeding. Overall, this is a reasonable approach to enable efficient exploration and an opportunity for expanding innovation with a consensus of using sustainable and efficient options to improve these structures.

Major elements of the stage-gate process

- Stage 1 is about idea generation and scoping. This may involve brainstorming together with initial research and identifying opportunities (Santiago, 2023). Decision criteria include whether or not the idea/system fits into strategic objectives.
- Stage 2 is about building a business case, market research to understand the depth and breadth of need, technical factors, and cost analysis (Cooper, 2022). Gate criteria consider margins for profitability, whether the solution is feasible, and the approximation of value to customers.
- Stage 3 is about development, prototyping, and technical development through testing. Stage 4 is about market testing or a pilot launch. Stage 5 is about commercialization and introducing products worldwide (Cooper, 2022).

In the second batch of stages, ideas will move from scoping at level 1 toward usable outputs. Building a business case prepares projects to assess whether a project is suitable or usable to provide value for customers, to warrant or justify the work done. Stage 3 is about development, and with prototyping, turning concepts into physical products. Stage 4 is about launching a pilot, which enables mechanisms for real-world feedback to develop the end product. At stage 5, we will focus on commercialization, to move accepted products to market to sell to customers around the world. At each of the stage gates, management teams will consider results, business case financials, levels of risk, and what product(s) and solutions have shown promise. For the IoT, this ensures that only valid solutions that meet customer expectations, the technical requirement, and a threshold amount of value to provide profit consideration will move through the process toward a broader implementation to obtain a more sustainable business model.

Stage-Gate Flowchart

- The flowchart illustrates a process composed of five stages: idea generation, scoping, business case, development and testing, and launch. In each instance, a management decision, denoted as a gate, allows or disallows continuation to the next stage.
- Each stage includes example activities such as brainstorming for creative IoT features, feasibility research to determine if connectivity is possible, development of prototypes, customer testing, and readiness activities to make the final product commercially available in the selected markets.
- Examples of decision criteria include filtering ideas for alignment, providing approval for viable business opportunities, determining whether a project is feasible for development, validating success through pilot testing, and finalizing approval for worldwide commercialization of the product.

The flowchart visually shows the five-stage process, including the gates that progressively filter ideas. For each stage, the activities should ensure more detail as it progresses, and the gate decisions affirm that it is ready to continue. For example, the brainstorming stage may have identified some possible safety features as part of the IoT initiative. Once that is confirmed, feasibility studies will determine if the features could potentially be incorporated into the device. Then the prototypes will be developed, and then test them with customers, and based on those results, certain pilot tests or market studies will also be conducted. Management will monitor to ensure alignment with the strategy, develop value to customers through the IoT, and maintain technical success before granting final approval for commercialization in select countries around the world. This procedure substantially decreases jeopardies and ensures discipline while facilitating incremental IoT.

Implications of using the stage-gate process

- The stage-gate process is most impactful in complex, high capital investment industries like automobiles because a structured and organized process ensures that resources are utilized on appropriate and strategic initiatives (Shinde et al., 2025).
- The process encourages collaboration across functions by requiring marketing, engineering, and financial perspectives at each gate, ensuring IoT innovation decisions are made with technical, market, and profit considerations (Alešnik, Vrečko & Palčič, 2025).
- By funnelling projects systematically, the process mitigates waste of resources, lessens redundancy, and raises the likelihood of a successful IoT product development process and eventual commercialization (Magnacca & Giannetti, 2024).

The stage-gate process provides significant value in industries where new products necessitate high capital. For example, in automobile manufacturing, the stage-gate process ensures that innovation processes are organized as strategies. In IoT innovation, the stage-gate process gathers engineering, marketing, and financial insights into the decision-making process. The structured framework of the stage-gate process ensures risks are considered, projects remain aligned, and capital is employed, but perhaps most importantly, it establishes a mutual understanding among departments, creating ownership, fostering collaboration, and mitigating uncertainty in product development outcomes.

Implications of using the stage-gate process

- Even if the stage-gate process can be beneficial, it might slow down the innovation process due to several factors: long review periods, too many approvals, and an overly

rigid process structure that reduces flexibility, especially in industries that are quickly changing due to technology (Trott et al., 2022).

- The stage-gate process works better with incremental innovation since the structure and evaluation processes support an evolving and deliberate buildup, while disruptive or breakthrough innovation typically requires much more flexibility, rapid cycles of experimentation, and sustained toleration of increased levels of uncertainty (Tavares-Quinhoes & Velez-Lapão, 2023).
- For Internet of Things (IoT) integration, the stage-gate process allows for incremental integration of manageable projects, such as getting connected safety systems, while keeping in mind strategic fit, financial discipline, and, cross-functionally, quality assurance.

While the stage-gate process provides structure and discipline, it can unintentionally slow innovation by creating delays due to inflexible approvals at the gates. In industries undergoing rapid change that depend on technology, excess structure might reduce the potential for a fast response. Regardless, the stage-gate process aligns with the desired form of innovation. Incremental innovation benefits from the structure and potential for step-wise progress while also controlling risk. The structure is what disturbs a manufacturer in a discontinuous situation, as it typically requires more flexibility and faster experimentation. In the case of developing IoT, the stage-gate process is the best suited due to allowing for incremental integration of controlled and potentially innovative technologies from the company's perspective while strategically aligning with technical considerations and customer needs.

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