Learner's Guide for the Toolkit on New Product Development and Inventions in the Public Domain

The Toolkit on New Product Development (NPD) and Inventions in the Public Domain is a set of Excel spreadsheets and associated training materials developed to support inventors and entrepreneurs in developing new products or services. The Toolkit can be used independently or as a companion to the WIPO publication *Using Inventions in the Public Domain: A Guide for Inventors and Entrepreneurs* (2020).

What is New Product Development

New Product Development (NPD) is a formalized process for turning ideas into products and services. The ideas for new products or services, or new features for improving existing ones, come from many places. Finding and permissible use of such ideas is the focus of the WIPO publications *Identifying Inventions in the Public Domain: A Guide for Inventors and Entrepreneurs* (2020) and *Using Inventions in the Public Domain: A Guide for Inventors and Entrepreneurs* (2020). This Toolkit is a companion to those publications.

There are a variety of methods for conducting NPD. The most common are waterfall and agile methods. Waterfall methods involve a linear process where one step or set of activities must be completed before beginning the next step or stage of the process. There are usually formal reviews, called gates, between each stage. Waterfall methods are commonly seen in heavily regulated industries and where very large capital investments are required to develop products (sometimes called deep tech).

Agile methods involve a process of spiral development, where one spiral may be focused on the development of a particular product or service feature or set of features (e.g. the user interface of a cell phone), while another spiral may be focused on a different feature or set of features (i.e. Bluetooth and internet connectivity for a cell phone). Gates exist at the end of each cycle or spiral. Agile methods are commonly seen in software development. The spirals may overlap. Agile development allows a shorter time to market. It allows releasing a "minimally viable product" to test customer reactions and gain insight into what improvements are needed. The product or service should require fewer updates and improvements in each release as insights into what customers want and how well the design works are gained. By testing the market and getting feedback from customers faster and more frequently, agile development incorporates continuous quality improvement.

Regardless of which approach is being used, NPD consists of a set of stages, steps, or spirals with completion milestones and gates or reviews that help the user make "Go" or "No Go" decisions before proceeding to the next stage, step, or spiral. This kind of milestone-driven process is called a "stage-gate" approach to project management, based on the Stage-Gate®

process developed by Scott J. Edgett and Robert G. Cooper.[1] During each stage, a series of tasks are conducted. At the end of each stage, there is a two-part "gate review" to assess progress and make decisions about whether to proceed to the next stage. First, the results are reviewed to ensure the milestones have been met and the project is within its budget. Next, there is an examination as to whether the resources and capabilities exist to move on to the next stage, complete the planned work, and attain that stage's milestones. When both parts of the review confirm that the project is still feasible, a Go decision is made and the project continues through the gate to the next stage. If both parts do not confirm feasibility, then a No Go decision is made and the project does not continue onto the next stage until and unless an acceptable fix is found.

Increasingly, companies are adopting their own hybrid approach of agile methods with stage-gate processes to better fit their unique needs and garner the benefits of both. In this Toolkit, we use a simple stage-gate process approach to NPD that is presented in the WIPO publication *Using Inventions in the Public Domain: A Guide for Inventors and Entrepreneurs* (2020). The following graphic of a stage-gate process is adapted from Figure 4 of that publication.

The stages of NPD are labelled within the large grey arrow. The gates are at the ">" symbols along that arrow. The outcomes or deliverables that are expected as NPD moves through the indicated stages and gates are aligned below the stage-gate graphic. In agile development, all of these steps or stages may be conducted in each spiral and it is possible to have multiple spirals occurring simultaneously, as when a software company releases beta versions that incorporate one or more features, and then releases a second beta version with additional features.

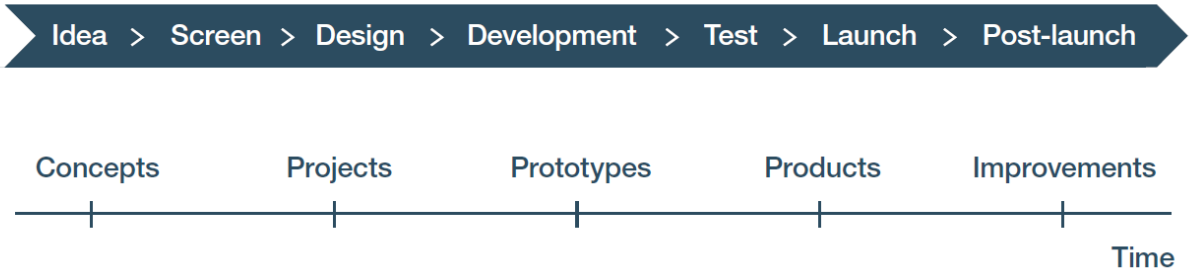

Figure 1: New Product Development Process stage-gate process

[1] Stage-Gate® is a registered trademark of Stage Gate International for business management and consulting services, educational services, technical services, computer software, and educational materials provided by the trademark owner. The term stage-gate is widely used to refer to a stepped NPD process consisting of stages or steps separated by review gates where Go/No-Go decisions are made as to proceeding.

The Toolkit was developed to enable you to use well-known tools for business management, project development design, brainstorming, evaluating risk, calculating value, etc., to evaluate an NPD project and make strategic decisions. To do this, the Toolkit provides tools (spreadsheets) for collecting and analyzing data about the project, and in some cases the spreadsheets have embedded functions that will take the data you entered and complete the analysis. The data and results in these spreadsheets will have a bearing on the Go or No Go decisions made at the various gates in this simple stage-gate type NPD process shown in Figure 1 above.

Each Go or No Go decision involves a judgement concerning value creation for the NPD initiative. This judgement has three aspects and is made using stage-specific metrics and criteria:

1) Are you on-track to develop a product or service with sufficient value for customers and end-users that they will acquire it and use it?

2) Do you have the skills, capabilities, capacities, resources, and intellectual property rights to conduct the next step successfully and within the budget and schedule?

3) If you complete NPD, will the product or service create value in the form of desired profits and/or other net benefits?

If the answer to any of these questions is *no*, NPD stops until an additional question is answered:

4) Do you modify what you are doing or abandon this NPD initiative?

The way these questions are handled is the same regardless of whether or not the idea being pursued is based on an original idea for a product or service, an in-licensed idea that was developed by a third party, or an idea based on an invention in the public domain. However, the answers to these questions may be affected by factors specific to the source of the idea. For example, the fact that you did not develop the product or service yourself may affect whether you have the skills, capabilities, capacities, resources, or intellectual property rights necessary to gain value from the product or service (question 2). If the product or service is based on an invention considered to belong to the public domain, that fact may affect what patent rights you could seek for the product or service you develop, which may in turn affect your ability to create value from it (question 3).

If a No Go decision is made because the milestones were not met or the project is over budget, there should be an assessment of whether the NPD project can be brought back on track in a timely and affordable manner. If it cannot, it should be abandoned. Similarly, if resources or capability are lacking to move forward with the work planned for the next stage, there should be an assessment as to whether the work plan needs to be changed, additional or alternative resources and capabilities should be brought to bear, or more funds should be allocated to increase the budget. Such decisions usually involve higher levels of management. If an acceptable fix is found, the No Go decision becomes a Go decision and the project can proceed.

This Toolkit helps answer these three questions and provides a framework for helping you find information you can use for developing “fixes” if needed.

Content of the Toolkit on New Product Development

The Toolkit has four primary components:

1) A set of fifteen tools (see summary table below). Each tool is an Excel spreadsheet;

2) A short video introducing each tool and explaining its importance for NPD;

3) A Tool Description explaining why and how to use each tool with instructions on how to use the tool, together with examples of how to find the data needed to complete the spreadsheet. Accompanying each Tool Description is an example of a completed Excel spreadsheet based on a Biofuels Example of developing a biofuel mini-refinery. The examples discussed in each Tool Description are drawn from using that tool in the Biofuels Example. It is important to be aware that many tools rely on re-examining data collected in other tools used in earlier stages of the stage-gate process; and

4) A set of exercises used to test the learner’s comprehension of the materials provided. These exercises may be used either in a formal online or onsite training setting or during self-study by independently completing the tasks in the exercises.

When using the Toolkit for the first time (whether as part of a formal training or self-study), it is recommended to start by watching the introductory video for each tool before reading the Tool Description. When reading the Tool Description, it is recommended to have the associated Biofuels Example spreadsheet open (i.e. the completed spreadsheet for the biofuel mini-refinery example) so learners can better see where the data comes from and where it is entered in the spreadsheet. Finally, it is recommended to do the exercises to test whether the learning objectives have been achieved.

As learners begin to review and enter data into the spreadsheets while reading the training materials or as part of an exercise, they should take note of the consistent color scheme used in the spreadsheets across all tools, which indicate the following:

- Dark blue: These are cells that provide category labels or row/column headers to identify the type of information in the row or column. These cells can be edited to better fit the learners’ product or service.

- White: White cells mean input is expected. These cells require alphanumeric user input such as a numerical value or labeling of rows and columns.

- Light blue: These cells are data processers and should not be edited as they draw their data from other cells within and/or outside of the tab. The light blue cells could contain specific requirements or information carried over from a previous sheet, or values calculated from previous values entered into input cells (white cells), or a calculated

average value that will be carried over to another tab to be plotted in a graph within the tool.

The following table presents the fifteen tools that have been developed, how they are used to address value creation and help answer the three questions mentioned above, and at which gates in the stage-gate process they are commonly used.

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
1. Project Charter: Defines why you are doing this NPD initiative and the value to be created	• Identifies the customers, what the product or service is, and why it should have value for the customers • Initial estimate of market size and profit margin target (hurdle rate for net present value) • Estimates the timing and overall cost and why it should have value for the developer	• Before beginning NPD • At each gate to determine if on track • Revised before entering the Design stage • Revised before entering the Development stage	Understand what you must do and commit to complete NPD.
2. Action Plan: Establishes the tasks and milestones to be accomplished in each stage.	• Defines who will do what • Identifies core tasks and milestones • Specifies resources to be used and when money will be spent (timing of cost) • Specifies who is responsible for what • Enables initial estimate of potential technical risk and firm-specific risk	• Before beginning NPD • At each gate to determine if on track • Reviewed before entering the Design stage, before entering the Development stage, before the Launch stage, and revised whenever appropriate	Understand the critical path and resources and capabilities required to attain the milestones on time and within budget.

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
3. Voice of the Customer: Establishes what it will take to get customers to buy the product or service and end-users to deploy it	• Specifies the core benefits and the tangible and augmented features needed to provide them • Suggests if the benefits are sufficient to drive buying • Identifies beta testers, confirming there is potential value for the customer • Provides initial estimate of revenues and length of time for product life cycle • Enables initial estimate of market risk	• Before entering the Screen stage • Reviewed at each gate to ensure it remains valid • Revised whenever customer needs, desires, and requirements may have changed	Understand the core benefits and the tangible and augmented features from the customers' point of view.
4. Competitive Advantage: Establishes if your product or service idea will be preferred by customers and end-users over other available alternatives	• Identifies current and potential substitutes and competitiveness vis-à-vis them • Enables refining estimate of market risk	• Before entering the Design stage • Before entering the Development stage • Revised whenever a new substitute is discovered	Understand what the minimal performance, ease of use, and cost parameters will allow you to develop a product or service that can be successfully introduced to a competitive market

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
5. Freedom to Operate: Establishes knowledge of IP rights that may be relevant to the product or service, and evaluates the probability that you will not be blocked from successful market entry by IP owned by others	• Determines if the product can legally be made, used, sold, and transported to the customer • Determines if there is potential for IP based monopoly in specific markets • Enables initial estimate of IP risk	• Before entering the Design stage • Revised whenever new IP is published by a patent-granting agency or developed in-house	Understand how your product or service fits within the patent landscape affecting markets of interest; can sometimes provide information on other IP rights in markets of interest
6. Value Chain: Establishes if you have the resources and capabilities to successfully conduct NPD, production, market entry and support the viability of the product or service over time	• Determines if NPD is likely to be completed within time and budget • Determines if the capabilities and capacities exist to make the product and market, sell, and support it effectively and cost-efficiently • Enables refining estimate of firm specific risk	• Before entering the Design stage • Revised whenever the product or service changes or the value chain changes	Understand the core capabilities, capacities, and resources needed to conduct and extract value from your NPD

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
7. SWOT (Strengths, Weaknesses, Opportunities, Threats) Analysis: Identifies the critical factors relating to project planning and execution, and facilitates developing strategies and tactics for success	• Helps identify strategies and tactics for development and manufacturing • Helps identify strategies and tactics for launch and market expansion • Enables refining estimates of all risks	• Before entering the Design stage • Before entering the Launch stage • Revised whenever a modification of the product or service concept is needed, or the value chain changes	Understand the strengths, weaknesses, opportunities and threats facing your NPD initiative and how to leverage strengths and opportunities to overcome weaknesses and threats
8. Business Model Canvas: Defines the viable value-creating business opportunity that is the framework and benchmark for the remainder of your NPD process	• Confirms there is a viable business opportunity for the product or service being considered or developed • Focuses on what is necessary to create value for the customer segment and the entity conducting NPD • Acts as a business plan framework or a “path marker” for NPD • Facilitates finding gaps or weaknesses in the NPD initiative which create risks	• Can be used at any gate but is particularly helpful before entering the Design stage or early during that stage. • Reviewed before entering the Development stage. • Summarizes findings from prior stages and gate reviews when used before the Design stage	Understand your product or service, its market opportunity, and the critical resources, capabilities, and capacities required for success. Ensure NPD is still aligned with the framework and vision in the Project Charter

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
9. Intellectual Property Audit: Determines what intellectual assets and intellectual property (IP) your entity owns or controls, which can be applied to this NPD initiative, and how best to protect them	• Catalogs the intellectual assets of the company or organization • Determines which ones should be protected and how best to protect them • Indicates intellectual assets and IP that can be used to restrict competition and create a competitive advantage in the marketplace • Indicates intellectual assets and IP that can be used to open up new revenue streams (e.g. through licensing)	• Before entering the Design stage • Updated whenever a new intellectual asset is created • Reviewed before the Launch stage to ensure nothing which may restrict competition or have marketing value has been missed and determine which IP, if any, could be licensed without harming the competitive advantage of this or subsequent products and services	Understand what an intellectual asset is, and which assets can be protected by IP rights through patents or utility models, industrial designs, trade secrets, trademarks, geographical indications, and copyright
10. Technology Forecasting: Determines the present and future options for parts, components, subsystems, and systems for the product or service	• Examines the technology available today and in a relevant timeframe going forward that can be used in NPD • Considers technology relevant for the current product or service, for future improvements to this product or service, and for other goods in relevant product lines or families • Used to update the Competitive Advantage analysis for this product	• Before entering the Design stage • Before the Development stage • During the Post-launch stage for purposes of product or service improvements or development of a superior substitute	Understand how to conduct a functional decomposition and use it to determine the options for implementing the design

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
	or service; can be used concurrently with the Competitive Advantage Tool • Facilitates eliminating risks associated with suboptimal selection of technology to implement the design, production, marketing and sales, and support of the product or service		
11. Life Cycle Risk Reduction: Looks forward over the entire product or service life cycle in order to identify any potential risks that can be avoided, eliminated or mitigated during design and ways of doing that	• Examines the risks that occur during a product's or service's life cycle from the initial idea conception into sales and use, and until its final disposal • Considers execution, co-innovation, and adoption risks • Used to identify risks that can be mitigated or avoided through the product or service design and subsequent stages of NPD	• Early in the Design stage • Revised thereafter whenever there is a change in internal operations, the external environment, customer and end-user requirements, or the materials, components, subsystems, and systems purchased to make the product or service	Understand how to identify future risks and how to mitigate them through better design

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
12. Portfolio Construction: Examines how this product or service fits within the overall NPD strategy and plans of the developing entity	• Determines how the product or service currently being developed fits within the larger NPD portfolio of the entity developing it and the entity's overall business and NPD strategies • Informs the design of the product or service to leverage any relevant economies of scale and scope or network economies, thereby reducing expenses associated with the product/service or the sales price • Used to ensure NPD is an ongoing activity and not a single shot, thereby contributing to the long-term vitality of the entity	• In larger or multi-product companies, during the Screen stage • Early in the Design stage for an independent NPD initiative or in a single product start-up, but can be conducted earlier if relevant	Understand how to conceptualize new product or service ideas which leverage the current NPD initiative
13. TRIZ: Determine if there is a conflict between your design specifications and resolve those conflicts in a way that maximizes the value for customers and end-users	• Brainstorming technique for resolving conflicts during design based on specifications which improve performance on one parameter but make it worse on another parameter or specification • Useful for examining if there are ways to improve the design even when a conflict does not exist between the parameters or specifications, such as finding ways to reduce the cost of the product or service	• During the Design stage • Before entering the Development stage	Understand how to systematically identify conflicts between specifications, and brainstorm solutions using the patent and technical literature as an aid in that process

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
	• Facilitates thinking "outside the box" when the team or person doing design is stumped • Used to avoid or mitigate execution and adoption risks that might otherwise be unavoidable		
14. Gate Progress Review: Ensure risks are being addressed during NPD and that the initiative is on track towards meeting its objectives for both customers/end-users and for the entity conducting NPD	• Examines execution, co-innovation, and adoption risks associated with the tangible and augmented features of the product or service being developed • Examines how successfully risks have been reduced during the stage just completed and forecasts risks going forward, with an emphasis on the next stage • Used to ensure the NPD initiative is on track with respect to the core benefits and services desired by customers and end-users, along with the tangible and augmented features they prefer and/or which are being used to provide those core benefits and services – thereby directing attention on the need to reduce specific risks	• Critically important for the gate between the Design and the Development stages due to the rapid rise of expenses that begins there • Useful for any gate review	Understand how to identify and assess execution, co-innovation, and execution risks and to develop ways to avoid, eliminate, or mitigate them

Tool	Value contribution: how it affects the net present value of the product or service being developed	Use at stage/gate	Learning objective
15. Net Present Value: Determine if the product or service being developed is likely to meet its financial objectives	• Estimates the net present value (NPV), total gross profit, and internal rate of return for the product or service being developed • Allows for developing different scenarios such as most likely, best possible, and worst possible NPVs • Useful when developing financial projections for management and investors • Useful when deciding whether to terminate continued sales of a product or service or when to phase out a current generation and go to a next generation of it • Important adjunct for the Portfolio Construction tool as it provides a means for comparing the financial impact of the products and services in the NPD portfolio	• Useful for any gate review • Critically important for the gate between the Design and Development stages due to the rapid rise of expenses that begins there	Understand how to calculate net present value, including discount rate, revenue streams, and expenses

Using the Toolkit in connection with a training and doing the exercises

The Toolkit has been designed to be suitable for use in a formal training setting as well as for self-study.

In order to use the Toolkit in connection with a training, regardless if the training is done online or in person, learners will need internet access. All learners should be on a common video-conferencing platform. A social media platform supporting group discussions is also helpful so that groups or teams formed for various exercises can do the homework together and discuss the exercises.

Learners may wonder why video conferencing and social media platforms are part of an in-person training. The reason is the use of video conferencing and social media platforms is becoming ubiquitous in NPD as well as other business activities. During the pandemic, online learning and work collaboration became the normal way of conducting activities and have remained a part of everyday work and learning. Increasingly, in-person meetings are being replaced with hybrid meetings with some people onsite and others logging in remotely to participate online. Use of these internet tools has opened up new opportunities for teaching.

The Toolkit exercises involve doing activities using the spreadsheets developed for the Biofuels Example. For most exercises, learners will act in one of four roles. If doing the exercises as part of self-study, learners are encouraged to try to act in each of these four roles. The roles are: Team Leader, Technical Expert, Marketing and Business Development Expert, and Logistics and Finance Expert.

The **Team Leader** is the person responsible for managing the NPD team, ensuring the NPD initiative stays on track, leading the gate reviews, ensuring that all necessary documentation is completed, and obtaining all necessary authorizations and approvals from higher management. Team Leaders use the Project Charter and Action Plan as the benchmarks for this as well as the Business Model Canvas. In the exercises, the Team Leaders are also the IP experts on the team as IP is critical to understand and consider for successful NPD. In the real world, they also should be competent in project management and ideally have some experience working on similar projects. The IP experts are usually an in-house lawyer or patent agent or outside counsel.

The **Technical Expert** is responsible for ensuring that the technology deployed and the technical approach are realistic, efficient, and effective. In the real world, they should have an appropriate level of experience so they understand the nuts and bolts of what it takes to develop and make the product or service being developed. Depending on what that product or service is, this may require an advanced scientific or engineering degree. Usually, where an advanced degree is required, there is also a hands-on person (a technician or mechanic) on the team as a second Technical Expert. Whichever type of technical expert they are, they should have experience working in the relevant field. Depending on the complexity of the product or service being developed and how it is produced, there may be several technical experts.

The **Marketing and Business Development Expert** is responsible for ensuring the Voice of the Customer is honored and considered throughout the NPD process, and for trying to ensure the product or service will succeed in the market. As part of that role, they conduct market research and arrange for outside alpha and beta testers. The main tools they use as their benchmarks are the Voice of the Customer, Competitive Advantage, and Business Model Canvas tools. In the real world, they should have experience marketing and selling into the targeted customer segments and a sound understanding of, and capability in using, market research techniques.

The **Logistics and Finance Expert** is responsible for making sure there is access to the materials and supplies, labor, finance, and other resources necessary for conducting the NPD initiative and successfully launching the product or service into the market. Other resources include qualified vendors and partners. Their benchmarks are the NPD initiative's budget and the analysis of the value chain. In the real world, depending on the size and complexity of the NPD initiative, this role is divided up into several ones, including Supply Chain Management, Financial Management, Scheduling, Inventory Management, and Administrator. These people may only be involved in the team on a part-time basis as needed.

In a real-life NPD team, there may even be more roles involved. For example, teams almost always have one or more product or service designers. Just who should be on a team depends on the nature of the project. Teams are also balanced in terms of personalities, such as project leader, entrepreneur, creative product developer, sponsor, information handler, and facilitator/environment creator.

If learners can do the exercises for the first tool comfortably, they can proceed to the next tool. If not, they are encouraged to review the materials for that tool again before proceeding to further tools. In a formal training setting, the instructor/training facilitator would be available to answer questions. In the case of self-study, the WIPO TISC team can be contacted for support at tisc@wipo.int and will try to identify and liaise with relevant experts that can help answer the questions raised.

Once learners are comfortable with the materials, they are encouraged to use the tools (blank spreadsheets) and use them for their own product or service development initiatives.

Note: If the spreadsheets are being used for a real-life NPD initiative and are being shared with other stakeholders, it would be useful to protect the data using features built into Excel before sharing the spreadsheet with others. Useful features include the sheet protection and cell lock options built into Excel, as these features allow the spreadsheet owner/author to password-protect specific parts of the spreadsheet.