Toolkit
Using
Inventions
in the
Public
Domain

Tool 14

Gate Progress Review

WIPO

Tool 14/ Gate Progress Review

The document describes how to use the Gate Progress Review tool as an aid for conducting a gate review during new product development (NPD). Gate reviews are used to make Go and No Go decisions based on whether enough has been accomplished and risks have been managed well enough to continue to the next stage of NPD for a product or service.

What is the Gate Progress Review tool?

The Gate Progress Review tool uses risk analysis to examine the execution, co-innovation and adoption risks at any time during NPD. Execution risk refers to your capability and capacity to conduct NPD successfully. To the extent that it is lacking, there is execution risk. Co-innovation risk refers to the capability and capacity of your partners to do their part, so the overall project succeeds. To the extent that it is lacking, there is co-innovation risk. Adoption risk refers to the likelihood that customers and end-users will buy and deploy the product or service emerging from NPD and that you can successfully introduce it to the market. To the extent that this is not the case, there is adoption risk. The Gate Progress Review tool provides a method for systematic risk analysis conducted as part of a gate review at the end of a stage in an NPD project and before making the determination to proceed with the next stage. It quantifies, on an ordinal scale, your perception of the current level of these three risks and the risk reduction that can reasonably be expected during the next stage.

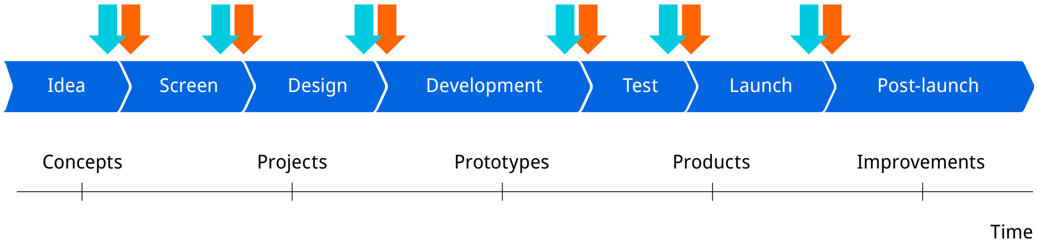
The gate progress review begins by referring back to the project charter and the action plan you generated for your NPD project. While these may get refined and made more detailed as NPD moves through the various stages, they are always the benchmarks that should be used to define whether progress is being made or not.

Progress is determined through a series of yes or no questions. Was this task accomplished: yes or no? Was it completed in time: yes or no? Was the work done within the allotted budget: yes or no? Has the project charter or action plan been refined during the stage: yes or no? Is the refinement an improvement: yes or no? Is further refinement or rewriting of the project charter or action plan needed now: yes or no?

Assessing the risks associated with making progress is a matter of probabilities, not certainties; of likelihoods rather than facts. The Gate Progress Review tool is a heuristic aid for evaluating the total execution, co-innovation and adoption risk probabilities at each gate.

Beginning with the entry into the Screen stage, this tool is used at every gate to assess risk and make a decision about whether to proceed, as indicated by the overlapping blue and orange arrows in Figure 1 below. It is particularly important for the gates between Design and Development, between Development and Test, and between Test and Launch. Significant increases in costs occur in each of these stages, which makes minimizing the risk of failure before entering them especially important.

Figure 1: **The Gate Progress Review tool can be used at every gate, as indicated by the blue and orange arrows.**



This tool supports Module III "Integrating public domain knowledge into product development" in the WIPO publication *Using Inventions in the Public Domain: A Guide for Inventors and Entrepreneurs* (2020). It is particularly helpful in the context of section 9 "Design," section 10 "Development and implementation," section 11 "Test" and section 12 "Launch."

How do you enter data in the Gate Progress Review tool?

The Gate Progress Review tool is an adaptation of the house of quality (HOQ) matrix-based tool. The traditional HOQ is a product-planning matrix that is used to examine how customer requirements relate directly to the ways a company can achieve those requirements. It is called a "house of quality" because the spreadsheet used looks like a multi-story house with an attic. In the present adaptation, the customer requirements are the tangible and augmented features that customers and end-users are seeking from the product or service under development. These are met through adherence to the design specifications associated with each.

To use the tool, you first need to enter data about customer requirements for the specific tangible and augmented features of the product or service. Next, you enter the design specifications that determine acceptable technical approaches to meeting those customer requirements. By evaluating the interactions or relationships between customer requirements and design specifications, you identify which execution risks, adoption risks and co-innovation risks exist at the gate and which ones it is critical to address in the next stage.

The Gate Progress Review workbook has two main tabs: the "Tangible features risk review" tab and the "Augmented features risk review" tab. The house is the same, but one focuses on tangible features and the other on intangible (augmented) ones. Figure 2 shows a blank spreadsheet from the "Tangible features risk review" tab of the workbook.

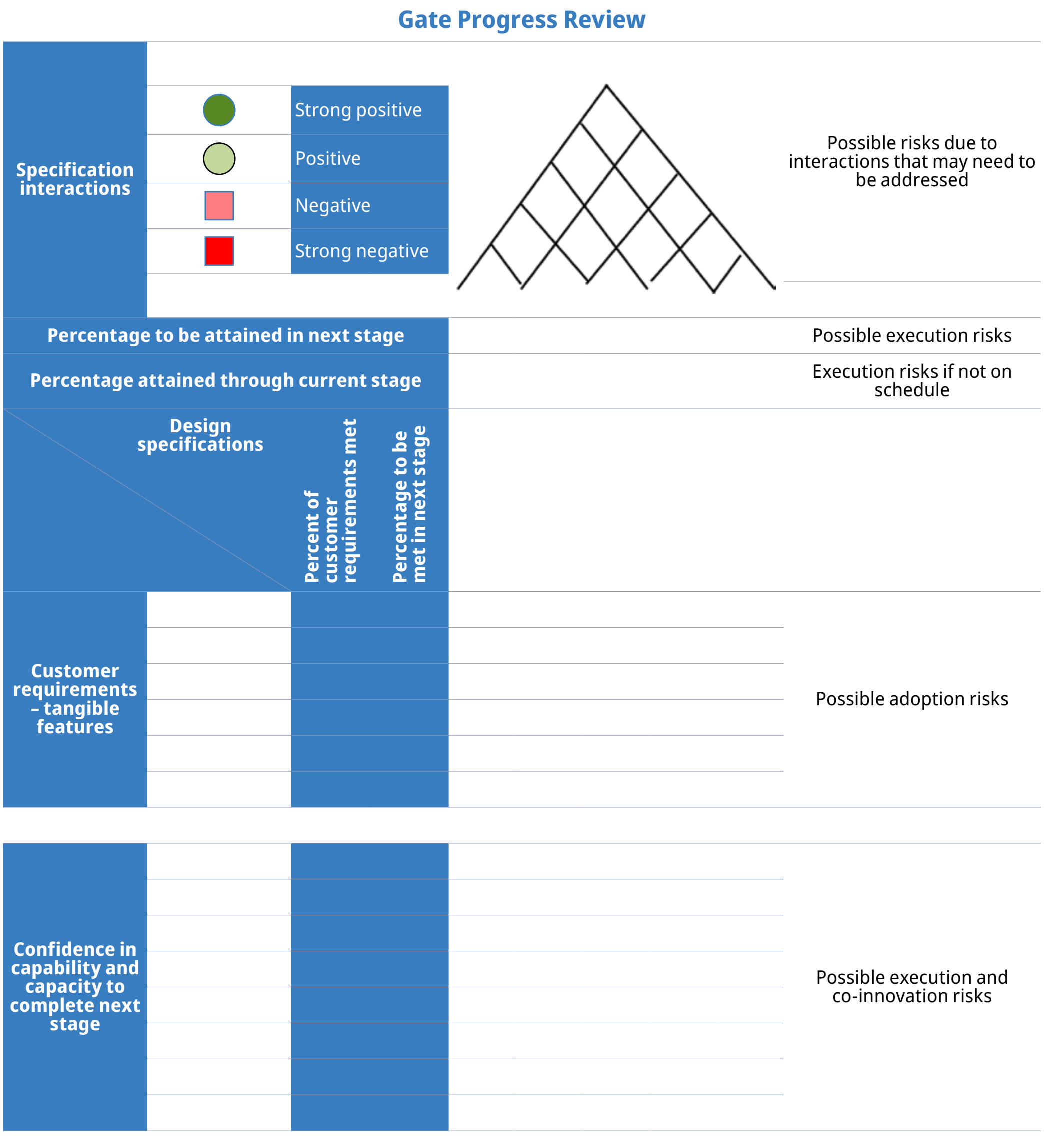


Figure 2: The "Tangible features risk review" tab of the Gate Progress Review workbook.

Relationship matrix: Customer requirements for features and design specifications to satisfy them

The "second floor" of the house in the Gate Progress Review tool, entitled "Customer requirements – tangible features" on the "Tangible features risk review" tab or "Customer requirements – augmented features" on the "Augmented features risk review" tab, is completed first. The term *requirements* refers to the quantitative or qualitative metrics which customers and end-users will use to measure satisfaction of those requirements. You will have to determine appropriate metrics that are specific to your customer segment(s) and your product or service.

On this floor, you create a relationship matrix of customer requirements for specific tangible or augmented features, and the design specifications that determine which technical approaches can be, or are being, used to meet those requirements. The specific features and requirements come from the "Design specifications" tab of the Voice of the Customer workbook and the "Inputs" tab of the Competitive Advantage workbook. These tools can be used to identify customer requirements for tangible or augmented features and provide metrics for measuring when and how these customer requirements are met.

In the biofuels example, a customer requirement for "affordability" might mean a price below a specific amount or it might mean a price below a certain percentage of annual revenue, and the appropriate metrics must be identified in order to evaluate how well the project design specifications meet the affordability requirement. Likewise, requirements for "delivery anywhere" might mean delivery anywhere in the countries in which the product will be sold, or delivery anywhere customers meeting a certain defined profile are located.

In the examples below, Figure 3 shows the "Design specifications" tab of the Voice of the Customer workbook using the biofuels example, and Figure 4 shows the "Inputs" tab of the Competitive Advantage workbook using the biofuels example.

Figure 3: **The "Design specifications" tab of the Voice of the Customer workbook using the biofuels example.**

Design specifications based on primary sources

	Customer requirements	Specifications	Importance
Performance	Wide range of waste that can be treated	Moisture content, size, relative mass	2.333333333
	Efficiency of biofuel production	Energy output/energy consumption	2.5
	Flexible production rates	Speed range in hours	1.333333333
	20 to 50 year usable life	Years	2.666666667
	Meets regulations and standards for fuels	Relevant standards, highlighting British Thermal Units (BTUs), viscosity, and emissions	3
	No adverse environmental or health impacts	Emissions, particle size, organisms must be safe	2.666666667
Ease of use	Does not require much training	Training time	2.666666667
	Ease of transport	Size of vehicle needed	1.333333333
	Little maintenance and monitoring time required	Labor time per month	2.5
	Customer support	Customer support hours and personnel	2.333333333
Price	Purchase price	Currency	2.6
	Operation costs	Cost per month	2.4
	Payback period	Years	3
Other	Better than competing technologies	Cost per liter of fuel	1.8
	Addressing skepticism of customers	Independent test laboratory results	2.6
	Energy independence	Barrels of imported oil not needed due to one unit running full-time for one year	2.4

Figure 4: **The "Inputs" tab of the Competitive Advantage workbook using the biofuels example.**

Closeness of good on a scale of 1 to 10

Desired core benefits and features (customer requirements)	Ease of use	Efficiency	Applicability	Environment-friendly	Affordability	Scalability	Delivery anywhere	Average
Our product	10	7	8	10	10	9	8	8.9
OWS	8	7	7	7	7	8	5	7.0
Anaergia, Inc.	8	8	9	6	7	6	4	6.9
Fiberight, LLC	8	8	8	7	5	7	1	6.3
Thomas Asher	6	7	7	6	8	5	3	6.0
BriJen Biotech, LLC	7	7	7	7	6	6	6	6.6
Aarhus University	7	7	5	6	7	3	7	6.0
WSU	8	7	6	6	7	8	8	7.1
U. Patras	6	6	6	6	7	9	10	7.1

Start with the "Tangible features risk review" tab. Customer requirements for tangible features are entered in the "Customer requirements – tangible features" section in the second column at rows 10 to 15. Additional rows can be added as needed, but the purpose of the tool is to focus on the most important features so there is no need to go into excessive detail. The most important features are the ones which will be used by end-users and customers to determine if this product has a competitive advantage.

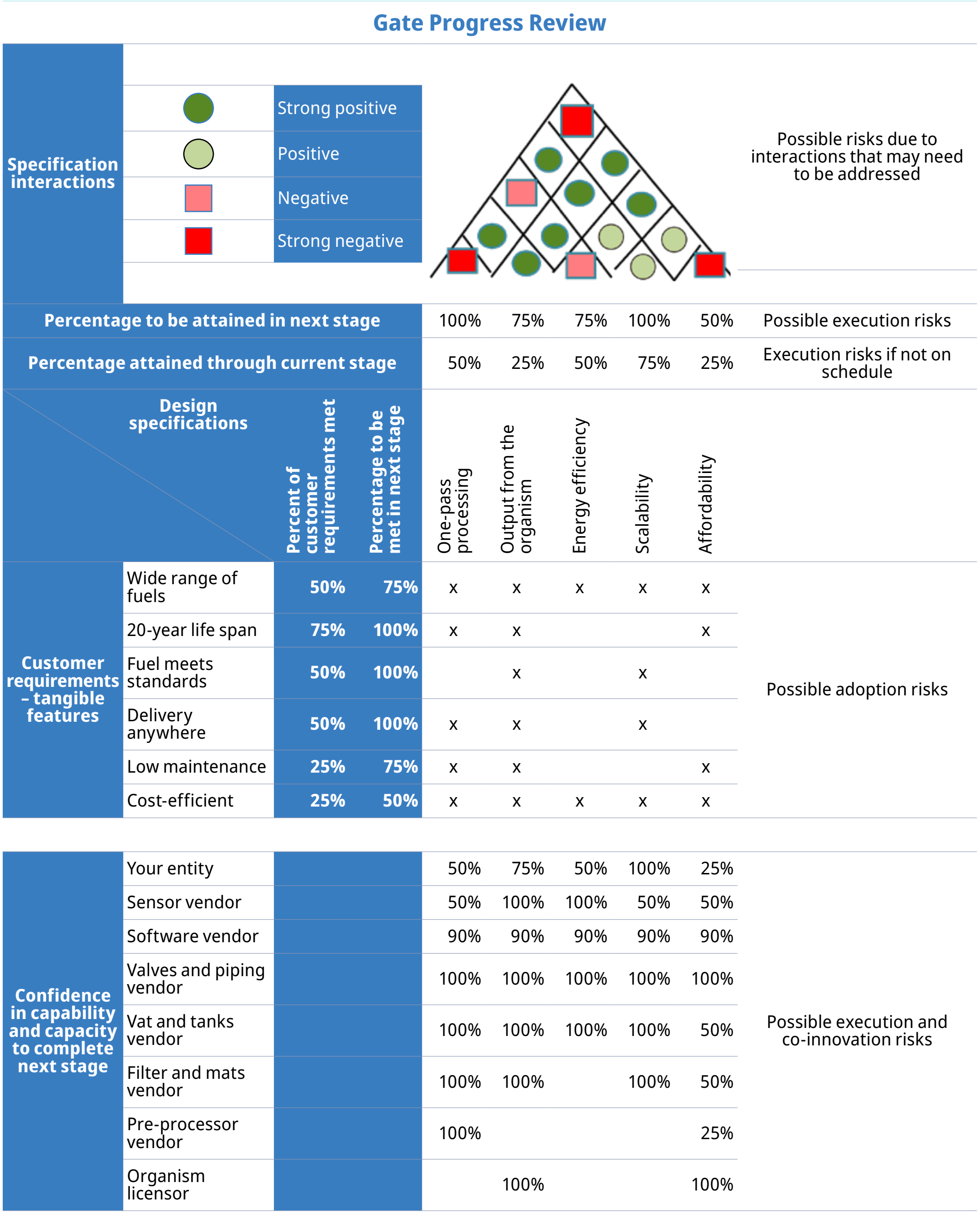
Design specifications for these tangible features are then entered in columns E to I of the spreadsheet. Again, focus on entering the most important design specifications, which are the ones critical for providing the listed features and meeting customer requirements. As noted, depending on the stage, the source for these varies. The design specifications come from either the voice of the customer or the analysis of competitive advantage at the end of the Screen stage gate. At the end of the Design stage gate, they are found in the final product or service design (i.e., the specification sheet). As discussed in connection with the Technology Forecasting tool, the Toolkit does not provide a tool for developing a design specification document because these can vary widely depending on what product or service is being developed.

The names for design specifications/features can be reworded so long as you capture what matters to buyers and end-users, and what is listed on your design specification document. The name of each specific design specification is entered, but *not* the specific engineering parameters for that specification. There may be several of those, and to keep the spreadsheet manageable, they are recorded on the “Notes and references” tab. Of course, more columns can be added if necessary, but be aware that adding columns will require redrawing the “attic” of the HOQ matrix in its current format. The functions of the attic are discussed later in this document.

The focus of this tool is to determine whether the design specification overall is on schedule to be attained, and whether acceptable progress will continue in the next stage. To analyze that, for each intersection cell of a customer requirement listed in the second column with each of the design specifications listed in row 9, enter an X if the design specification addresses that customer requirement. Some design specifications can address multiple customer requirements. Multiple design specifications can address a single customer requirement. Likewise, some customer requirements require the contribution of multiple design specifications, while other requirements can be met with a single specification. For example, the requirement for cost efficiency for the multi-step process involved in a biorefinery is addressed through multiple design specifications. In contrast, a requirement for a safety shut-off valve on an outlet pipe can probably be met by a single design specification for that valve.

Figure 5 shows an example of a completed “Tangible features risk review” tab for the gate between the Design stage and the Development stage using the biofuels example. The completed “Customer requirements – tangible features” section shows the relationship matrix. The customer requirements for the tangible features are: wide range of fuels (cell B10), 20-year life span (cell B11), fuel meets standards (cell B12), delivery anywhere (cell B13); low maintenance (cell B14) and cost efficient (cell B15). The design specifications for meeting some or all of these requirements are: one-pass processing (cell E9), organism output (cell F9), energy efficiency (cell G9), scalability (cell H9) and affordability (cell I9). An example of the relationship(s) between a requirement and the listed design specifications is the requirement for a wide range of fuels (cell B10), which is addressed by all of the listed design specifications. For comparison, the requirement that the fuel meets standards (cell B12) is addressed by only two of the design specifications: organism output (cell F12) and scalability (cell H12).

Figure 5: The "Tangible features risk review" tab of the Gate Progress Review workbook using the biofuels example, completed for the gate between Design and Development.



Gate Progress Review

Specification interactions

●	Strong positive
○	Positive
▨	Negative
🟥	Strong negative

Possible risks due to interactions that may need to be addressed

Design specifications		Percent of customer requirements met	Percentage to be met in next stage	One-pass processing	Output from the organism	Energy efficiency	Scalability	Affordability	
Percentage to be attained in next stage				100%	75%	75%	100%	50%	Possible execution risks
Percentage attained through current stage				50%	25%	50%	75%	25%	Execution risks if not on schedule
Customer requirements – tangible features	Wide range of fuels	50%	75%	x	x	x	x	x	Possible adoption risks
	20-year life span	75%	100%	x	x			x	
	Fuel meets standards	50%	100%		x		x		
	Delivery anywhere	50%	100%	x	x		x		
	Low maintenance	25%	75%	x	x			x	
	Cost-efficient	25%	50%	x	x	x	x	x	

Confidence in capability and capacity to complete next stage	Your entity		50%	75%	50%	100%	25%	Possible execution and co-innovation risks
	Sensor vendor		50%	100%	100%	50%	50%	
	Software vendor		90%	90%	90%	90%	90%	
	Valves and piping vendor		100%	100%	100%	100%	100%	
	Vat and tanks vendor		100%	100%	100%	100%	50%	
	Filter and mats vendor		100%	100%		100%	50%	
	Pre-processor vendor		100%				25%	
	Organism licensor			100%			100%	

Assessing risks associated with meeting customer requirements using design specifications – adoption and execution risks

Completing the relationship matrix allows you to begin assessing the current level of adoption and execution risks by examining progress to date compared with the planned progress according to your action plan. The column to the right of the HOQ matrix entitled "Possible risks due to interactions that may need to be addressed" shows which type of risk is associated with which information in the HOQ matrix. In this step, you consider risks and progress in meeting customer requirements in view of the design specifications that address each requirement. You also consider your confidence that your company or organization and your partners/vendors can perform as required for NPD to succeed.

Overall adoption risk associated with meeting customer requirements. Begin by evaluating how well each customer requirement has been met in the stage that is ending, and how well you expect the customer requirements will be met in the next stage. You will estimate the percentage to which each listed customer requirement has been completed by the combination of listed design specifications that address that requirement and enter this value in column C in the row corresponding to the customer requirements (column entitled "Percent of customer requirements met"). You will then predict the expected percentage completion of each customer requirement by the end of the next stage and enter that value in column D (column entitled "Percentage to be met in next stage") in the row corresponding to the customer requirements.

The values you enter in columns C and D provide benchmarks for assessing how close you are to having met a customer requirement listed in the matrix, given the design specifications listed in the matrix. If the value in column C indicates that not much progress has been made toward meeting a customer requirement by the end of this current stage, then there still may be significant risk associated with meeting that requirement. This lack of progress may or may not be an issue, depending on your action plan.

For most of these requirements, you would expect progress toward meeting the requirement for that feature by the end of the next stage, which would be indicated by a higher percentage in column D. This higher completion percentage indicates you are confident that you can continue to reduce adoption risk by the end of the next stage (unless it is a requirement that cannot be addressed at the next stage but rather is addressed in later stages of NPD).

The example in Figure 5 shows the progress made toward meeting the listed customer requirements for tangible features by the end of the Design stage (column C), and the expectations for further progress by the end of the Development stage (column D) for the biofuels example. The requirement for a "wide range of fuels" (row 10) is considered to be only 50 percent met by the end of the Design stage (cell C10) and is expected to be 75 percent met by the end of the Development stage (cell D10). The requirement that the "fuel meets standards" (row 12) is considered only 50 percent met by the end of the Design stage (cell C12) and is expected to be 100 percent met by the end of the Development stage (cell D12).

Execution risk associated with design specifications. You will now focus on risks and potential problems associated with meeting the design specifications listed in the matrix. Design specifications are technical approaches to meeting customer requirements, and these technical approaches must be complete and work reliably.

Look at rows 7 and 8 above the design specifications. First, review your action plan to estimate how much progress will be made toward meeting (completing) each design specification at the end of the next stage, and enter this as a percentage in the row entitled "Percentage to be attained in next stage," in the column corresponding to each design specification. This value indicates whether activities in the next stage are expected to reduce execution risk for that design specification. Next, check if that is realistic given where you are at the end of the stage you are in.

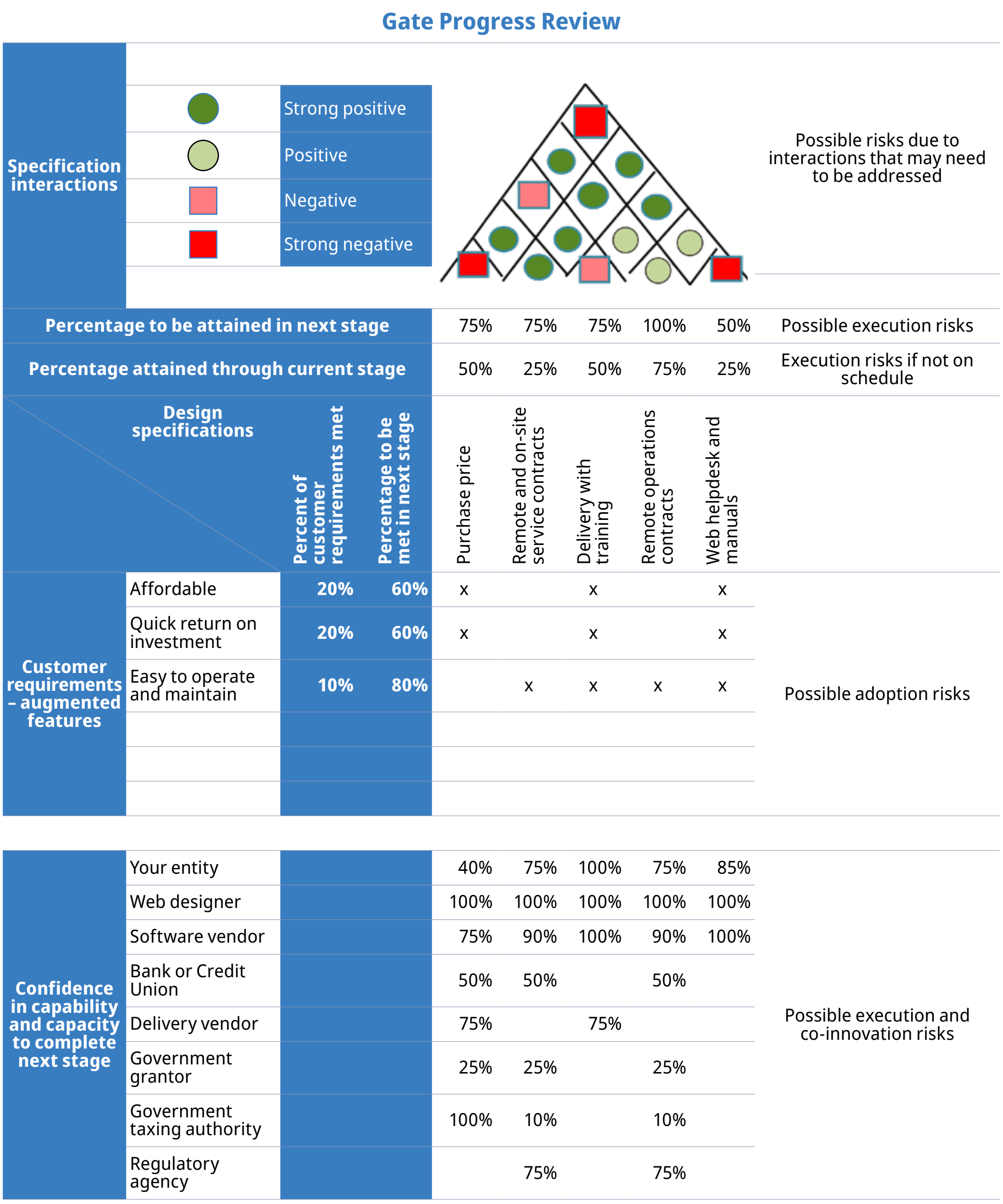
Consider how much progress has been made toward attaining the desired design specification at the end of the current stage. Enter this as a percentage in the row entitled "Percentage attained through current stage," in the column corresponding to each design specification. This value can indicate if execution risks exist because NPD is not on schedule to attain the design specification. Where it is behind, the question becomes whether you think you can make it up in the next stage given the goal there, or whether you need to hold off going through the gate and continue this stage until it is met. It also is possible that the gap is so large you need to consider terminating NPD.

A prediction of less than 100 percent completion by the end of the next stage is not necessarily a problem if the work is going according to the action plan. If not, that suggests a need for modifying the plan to allow more time and budget for the activity, adopting a new technical approach, making a change in the parts, revising the design specification as it was unrealistic, etc. The reason for pointing this out is to highlight that this is a heuristic tool for focusing your risk analysis. It requires you to ponder what has happened in your NPD process for your product or service, and what you anticipate will happen in the future. It also forces you to think about whether you should continue or abandon the project.

The example in Figure 5 shows the progress associated with each design specification at the end of the Design stage and expected progress by the end of the Development stage. The "one-pass processing" specification (column E) is considered 50 percent complete by the end of the Design stage (current stage) and is expected to be 100 percent complete by the end of the Development stage (next stage). In contrast, slow progress (25 percent) toward the design specification of “affordability” (column I) has been made by the end of the current Design stage, and the expectation of 50 percent completion by the end of the next stage (Development stage) can indicate problems with this specification. The specifications for “organism output” (column F) and “energy efficiency” (column G) are likewise not expected to be complete at the end of the Development stage.

On the next tab, entitled “Augmented features risk review,” the relationship matrix and benchmarking for risk assessment is completed in the same way as the “Tangible features risk review” tab (see Figure 6 from the biofuels example workbook).

Figure 6: **The “Augmented features risk review” tab of the Gate Progress Review workbook using the biofuels example.**



Gate Progress Review

Specification interactions	
●	Strong positive
○	Positive
□	Negative
■	Strong negative

Possible risks due to interactions that may need to be addressed

	Design specifications	Percent of customer requirements met	Percentage to be met in next stage	Purchase price	Remote and on-site service contracts	Delivery with training	Remote operations contracts	Web helpdesk and manuals	
Percentage to be attained in next stage				75%	75%	75%	100%	50%	Possible execution risks
Percentage attained through current stage				50%	25%	50%	75%	25%	Execution risks if not on schedule
Customer requirements – augmented features	Affordable	**20%**	**60%**	x		x		x	Possible adoption risks
	Quick return on investment	**20%**	**60%**	x		x		x	
	Easy to operate and maintain	**10%**	**80%**		x	x	x	x	
Confidence in capability and capacity to complete next stage	Your entity			40%	75%	100%	75%	85%	Possible execution and co-innovation risks
	Web designer			100%	100%	100%	100%	100%	
	Software vendor			75%	90%	100%	90%	100%	
	Bank or Credit Union			50%	50%		50%		
	Delivery vendor			75%		75%			
	Government grantor			25%	25%		25%		
	Government taxing authority			100%	10%		10%		
	Regulatory agency				75%		75%		

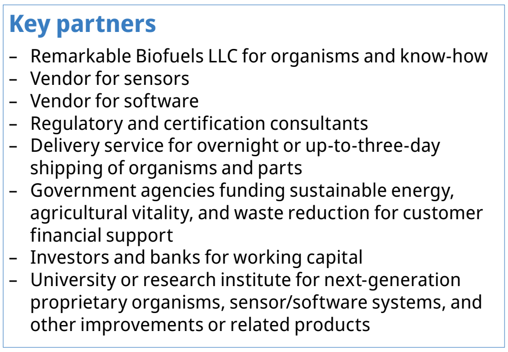
In the tab shown in Figure 6, design specifications for “purchase price,” “delivery with training” and “web helpdesk and manuals” all contribute to meeting customer requirements to be “affordable” (row 10) and provide a “quick return on investment” (row 11). These specifications can increase the cost-efficiency for the buyer and end-user. By themselves, however, they are not enough to meet these requirements, indicated by the expectation of below 100 percent satisfaction of these requirements being met at the end of the next stage (see cells E7, G7 and I7 in Figure 6, where the likelihood of requirements being met in the next stage is 75 percent for the design specifications “purchase price” and “delivery with training” and 50 percent for “web helpdesk and manuals”). This suggests one or more additional risk reduction means are needed. An example of such means might be low-interest financing. A column could be added to this table to address financing, or financing might be substituted for a less critical specification that is currently listed. Once again, the use of this tool requires you to ponder what has happened in your NPD process to date and what you anticipate will happen in the future.

Assessing risks related to capabilities and capacities – co-innovation and execution risks

The next step for using the Gate Progress Review tool is to move to the “ground floor” of the HOQ matrix, to the section entitled “Confidence in capability and capacity to complete next stage.” This floor focuses on the confidence you have that your company or organization has the capability and capacity to complete the next stage. It also focuses on whether your partners have the capability and capacity required to complete their role in the next stage. This is a forward-looking analysis that addresses both execution and co-innovation risks.

The questions you consider for this section of the HOQ matrix will highlight additional sources of execution and co-innovation risks. A lack of capacity or capability may be the source of an inability to completely meet the parameters or metrics of a design specification. This part of the spreadsheet looks at who is doing the work. The first row of the “ground floor,” row 17 in the blank worksheet, is for entering information about your company or organization (your entity), which is conducting the NPD project. The remaining rows below are for your partners (including vendors) for this NPD project. Key partners have been identified in the box with that name in the Business Model Canvas tool (see Figure 7, from the Business Model Canvas workbook using the biofuels example). Be aware that all important partners for co-innovation may not have been previously identified as a “Key partner” in the business model canvas, and some of these partners who were not previously identified may be crucial for the design specifications you are evaluating here. This highlights the importance of reviewing and modifying prior tools as necessary at subsequent gates.

Figure 7: **Key partners identified in the Business Model Canvas workbook using the biofuels example.**

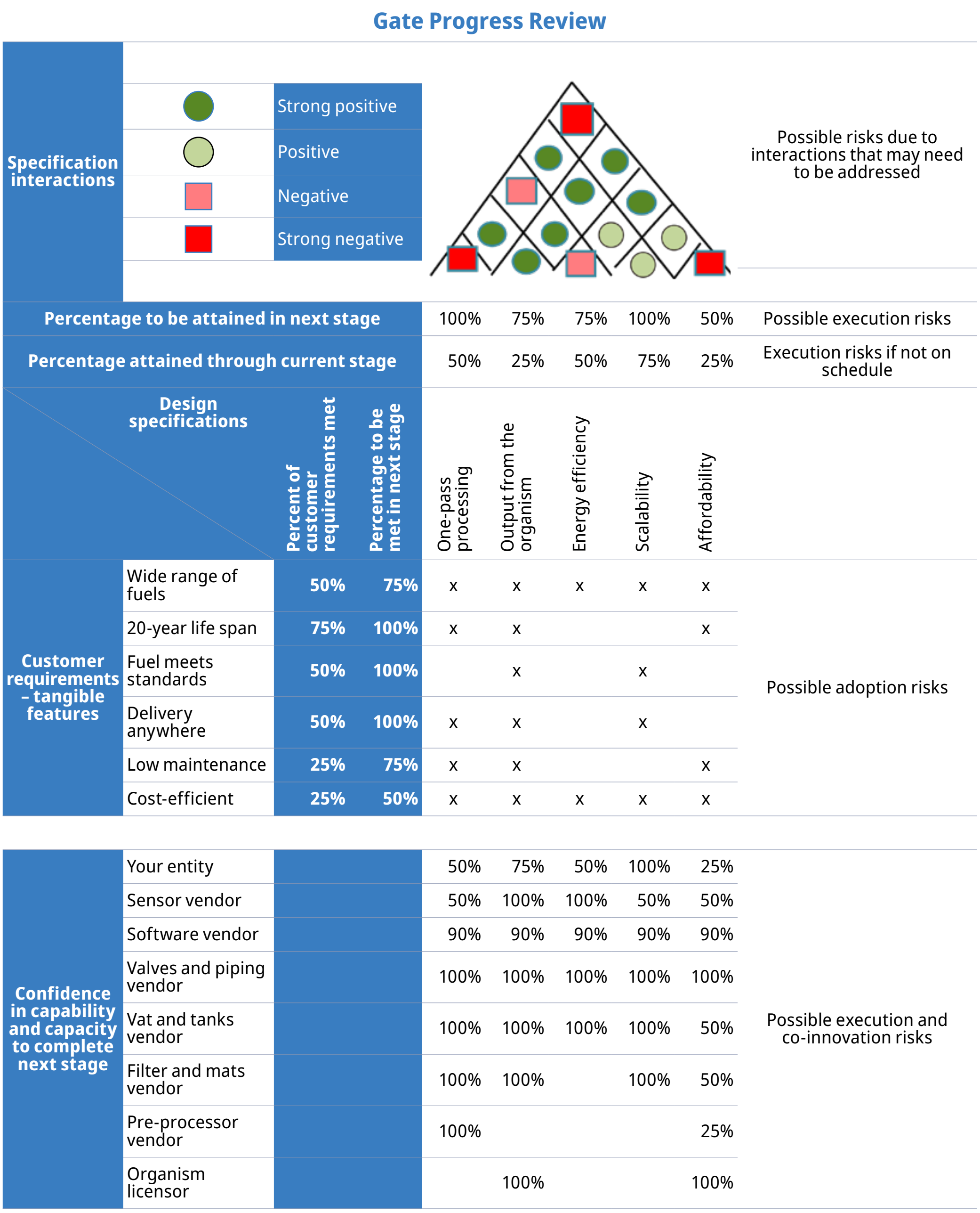


Key partners

- Remarkable Biofuels LLC for organisms and know-how
- Vendor for sensors
- Vendor for software
- Regulatory and certification consultants
- Delivery service for overnight or up-to-three-day shipping of organisms and parts
- Government agencies funding sustainable energy, agricultural vitality, and waste reduction for customer financial support
- Investors and banks for working capital
- University or research institute for next-generation proprietary organisms, sensor/software systems, and other improvements or related products

Figure 8 shows the “Tangible features risk review” tab of the workbook using the biofuels example in the Gate Progress Review tool. Note that “Your entity” in row 17 has a very low confidence level (25 percent) where the design specification “affordability” is concerned (cell I17). This example is constructed with the assumption that this rating reflects numerous factors, but you have determined that the most important one is the uncertainty associated with the ability of the “pre-processor vendor” (row 23) to deliver the unit required at the price allotted when designing the product. You are 100 percent sure this vendor can satisfy the specification for “one-pass processing” by delivering the required unit (cell E23) but you are uncertain whether this vendor can meet the requirement for affordability (25 percent confidence, cell I23). If you cannot get the pre-processor you need at a low enough cost, then your ability to make your mini-refinery affordable for your buyers is jeopardized, as indicated by the low confidence level in cell I17. The entity conducting NPD is always affected by the co-innovation risk of its partners.

Figure 8: The "Tangible features risk review" tab of the Gate Progress Review workbook using the biofuels example.



Gate Progress Review

Specification interactions	●	Strong positive							Possible risks due to interactions that may need to be addressed
	○	Positive							
	▨	Negative							
	🟥	Strong negative							
Percentage to be attained in next stage				100%	75%	75%	100%	50%	Possible execution risks
Percentage attained through current stage				50%	25%	50%	75%	25%	Execution risks if not on schedule
Design specifications		**Percent of customer requirements met**	**Percentage to be met in next stage**	One-pass processing	Output from the organism	Energy efficiency	Scalability	Affordability	
Customer requirements – tangible features	Wide range of fuels	**50%**	**75%**	x	x	x	x	x	Possible adoption risks
	20-year life span	**75%**	**100%**	x	x			x	
	Fuel meets standards	**50%**	**100%**		x		x		
	Delivery anywhere	**50%**	**100%**	x	x		x		
	Low maintenance	**25%**	**75%**	x	x			x	
	Cost-efficient	**25%**	**50%**	x	x	x	x	x	
Confidence in capability and capacity to complete next stage	Your entity			50%	75%	50%	100%	25%	Possible execution and co-innovation risks
	Sensor vendor			50%	100%	100%	50%	50%	
	Software vendor			90%	90%	90%	90%	90%	
	Valves and piping vendor			100%	100%	100%	100%	100%	
	Vat and tanks vendor			100%	100%	100%	100%	50%	
	Filter and mats vendor			100%	100%		100%	50%	
	Pre-processor vendor			100%				25%	
	Organism licensor				100%			100%	

Identifying risks not planned for in advance is the first step toward deciding whether to terminate the project (a No Go decision at the gate) or address them (a condition for the Go decision).

Here is an example of how to use the information on the risk review tabs based on the information in Figure 8. If the pre-processor co-innovation affordability risk discussed above is not avoided or mitigated and the level of risk remains high, that source of risk might indicate the need to stop and the NPD project might be canceled. Therefore, it is important to examine a source of risk and ask two questions: what is the effect if the risk is not reduced; and what can your entity do to mitigate or reduce (or in some cases, avoid) the risk? If a risk cannot be reduced to an acceptable level, you probably need to explore significant changes in your NPD project design. If you decide there are options for reducing the risk, explore those options. For example, one option would be to seek other vendors who might charge less for the equivalent part. Another option would be to explore whether building an affordable pre-processor internally is feasible. If either of those paths ended up being successful, the risk would come down and the project could continue into the Development stage. Another option would be to redesign the pre-processor. Yet another option would be to redesign the entire mini-refinery. Options may have trade-offs: if you chose a redesign where the pre-processor could only use crop waste, this would allow you to avoid the risk associated with trying to provide a pre-processor for a wider spectrum of inputs to use as feed (such as brush), but you would also have to choose to not meet the highest level of customer expectations for biomass flexibility. If none of those options are feasible and the cost of the unit is still too high, then it becomes necessary to explore whether offsetting cost savings could be found with other parts of the mini-refinery.

On the other hand, Figure 8 shows that confidence in the current “vat and tanks vendor” on “affordability” is 50 percent (cell I21), while confidence in this vendor’s capability to support all of the other design specifications is high (cells E21, F21, G21, H21). Price is probably a key factor for the low confidence level for affordability, based on current knowledge and initial market research. One option for addressing this risk is to do more market research into the likelihood of finding a vendor willing to meet your price target. If further research indicates that vats and tanks are commodities and a vendor willing to meet the price target is likely to be found, it is safe to assume that affordability of the vat and tanks vendor is not a serious risk. This information could be used to revise the ground floor of the HOQ matrix to show that this co-innovation risk will be small or perhaps could be avoided by locking in an acceptable price.

Lack of confidence can reflect other factors. Suppose that in the biofuels example, the “software vendor” has made software for other industrial equipment but never for a refinery. In that case, there is a reasonably high level of confidence (90 percent) that the vendor can provide what is needed, but 100 percent confidence is not possible until the vendor’s software has been received and tested. This level of risk will probably not halt NPD, as it can be addressed at the appropriate stage by testing the software, so long as time is built into the action plan to enable changes if the initial software delivery does not meet the design specifications.

Assessing risks and identifying problems based on interactions between design specifications

Finally, turn to the “attic” of the HOQ matrix, where you will look at how the design specifications interact. As you can see in the HOQ attic in Figure 9, from the workbook using the biofuels example, this analysis produces a visual result that helps you see specific problems that may arise from the way(s) these design specifications interact with each other. The interactions between specifications can increase or reduce execution risk, depending on whether the specifications can be met and whether meeting one specification impacts another specification.

First, consider the interaction between each *pair* of design specifications, to determine if there are any interactions that are strongly positive (possibly synergistic), positive, negative or strongly negative. Positive means improvement on one specification improves the other specification. Negative means improvement on one worsens the other. In some cases, there is no interaction between two specifications. Select the appropriate symbol that represents the interaction between each pair of specifications, and then cut and paste the symbol in the interaction cell for these two specifications. If there is no interaction between specifications, leave the interaction cell blank.

Next, evaluate execution risk for each *individual* specification (row 6) by identifying the worst rating assigned to any of the interactions for that specification, and placing the symbol for that rating in the execution risk triangle for that specification in row 6. This symbol highlights the worst possible interaction risk for a design specification and triggers consideration of whether risk avoidance or mitigation for the specification should be explored.

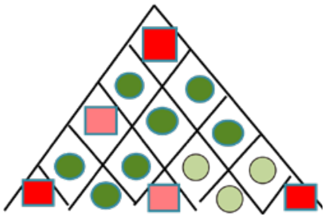
Note that in Figure 9 using the biofuels example, the interaction between the “one-pass processing” and “affordability” is a strong negative interaction, as shown by the red square pasted in the interaction cell for these two specifications (see the red square all the way at the top of the attic which represents the interaction between these two design specifications). The reason for this strong negative interaction may be because the one-pass pre-processor system, as currently designed, is expensive. This result reinforces the high level of execution and co-innovation risk associated with the pre-processor due to the current pre-processor design and the vendor selected to produce it. By providing a visualization of additional sources and levels of risk that arise from interactions between design specifications at the end of a stage, the HOQ attic gives you information you can use to make strategic decisions for the NPD project.

Figure 9: The interactions between design specifications as assessed in the attic of the "Tangible features risk review" tab of the Gate Progress Review workbook using the biofuels example.

Gate Progress Review

Specification interactions

●	Strong positive
○	Positive
□	Negative
■	Strong negative



Possible risks due to interactions that may need to be addressed

Percentage to be attained in next stage				100%	75%	75%	100%	50%	Possible execution risks
Percentage attained through current stage				50%	25%	50%	75%	25%	Execution risks if not on schedule
	Design specifications	**Percent of customer requirements met**	**Percentage to be met in next stage**	One-pass processing	Output from the organism	Energy efficiency	Scalability	Affordability	
Customer requirements – tangible features	Wide range of fuels	**50%**	**75%**	x	x	x	x	x	Possible adoption risks
	20-year life span	**75%**	**100%**	x	x			x	
	Fuel meets standards	**50%**	**100%**		x		x		
	Delivery anywhere	**50%**	**100%**	x	x		x		
	Low maintenance	**25%**	**75%**	x	x			x	
	Cost-efficient	**25%**	**50%**	x	x	x	x	x	

Confidence in capability and capacity to complete next stage	Your entity		50%	75%	50%	100%	25%	Possible execution and co-innovation risks
	Sensor vendor		50%	100%	100%	50%	50%	
	Software vendor		90%	90%	90%	90%	90%	
	Valves and piping vendor		100%	100%	100%	100%	100%	
	Vat and tanks vendor		100%	100%	100%	100%	50%	
	Filter and mats vendor		100%	100%		100%	50%	
	Pre-processor vendor		100%				25%	
	Organism licensor			100%			100%	

How do you interpret the data in the Gate Progress Review tool and use it in your NPD process?

The purpose of the Gate Progress Review tool is to help identify and highlight risks. First, this tool helps you organize information in a way that helps you identify specific problem areas at a specific gate in an NPD project. Second, the tool prompts you to evaluate the current and future risk level for each of these sources of risk based on information you currently have. Third, the tool provides a way to move beyond single-factor risk analysis and look at risks that arise from the multiple types of interactions between multiple aspects of the NPD process. After you have used this tool at the gate, you will have a pictorial framework for assessing the riskiness of continuing your NPD project beyond that stage. When the level of risk is deemed unacceptable, it must be addressed prior to moving through the gate and into the next stage.

The key to using the tool is to always remember you are estimating percentages based on how well milestones are met, whether you are on schedule and if you are within budget. These estimates rely on the assumption that the customer and end-user benefits, tangible features and intangible (augmented) features being sought have not changed.

First, look at the percentages you entered and see if they are where you expected them to be at the end of this stage in your NPD project. If they are, and the budget and timing are acceptable, a Go decision seems feasible and the project should proceed to the next stage of NPD. If not, a No Go decision must be considered – as well as what, if anything, should be done to enable the project to proceed to the next stage.

In assessing how to fix problems, look at the percentages for each design specification, for your entity and for your partners, and analyze who might be responsible for the problem and who has the best chance of fixing it. Then try to determine what the specific problem is and how to address it. If the problem can be fixed using an acceptable amount of effort and resources, then you have the option to do so and then repeat the gate review. If it is difficult to fix, then you should seriously consider whether it makes more sense to rethink your basic assumptions and either redesign or cancel your NPD project.

Finally, look at where you hope to be by the end of the next stage. Do you have the competence, capabilities and resources to get there? If not, you may decide to make a No Go decision to halt the project and not proceed through the gate until you figure out how, and whether, to fix the problem(s) you identified using the Gate Progress Review tool.

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