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73. Uncertainty in innovation

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There will always be uncertainty at the core of innovation. By definition, innovations involve the exploration of new and often uncharted territories. This automatically implies a good measure of uncertainty. If an innovator fully understands the different kinds of uncertainties, it helps him or her to take appropriate action, whatever that it is.

Knight (1921) established the difference between risks and uncertainties. This distinction was further enhanced by Runde (1998, n. 2):

> Knight's tripartite schema should be restated as follows:
>
> 1. Classical or *a priori* probability. The ideal case in which numerical probabilities can be computed on general principles, namely where they are assigned to equally probable and mutually exclusive possible outcomes such as the six sides of a perfect die . . .
> 2. Statistical probability. Situations in which frequencies may be derived on the basis of an empirical classification of outcomes obtained in classes of more or less homogeneous trials . . .
> 3. Estimates. Situations in which it is not possible to calculate *a priori* probabilities or where there are insufficient trials 'like' enough to form a reference class of even more or less homogeneous trials on the basis of which frequencies can be determined.

NON-CHANCE-RELATED UNCERTAINTIES

All of the previously described situations contain an element of chance, and the nuances have to do with the ability to determine whether or not something is likely to happen, which is expressed by a probability. The problem with this use of the expression 'uncertainty' is that it ignores another part of its own definition. The Cambridge Dictionary defines uncertainty as 'a situation in which something is not known, or something that is not known or certain' (accessed 16 October 2020 at https://dictionary.cambridge.org/dictionary/english/uncertainty). This includes the lack of certainty associated with chance, and thus the probability, but it also refers to a lack of knowledge (something that is not known).

Knight's and Runde's approach concerns the knowledge or lack of knowledge of the statistical information required to identify the probability. However, lack of the knowledge needed in order to calculate a probability is not the only kind of lack of knowledge that generates lack of certainty. For instance, not being sure if the range of a Wi-Fi antenna will be sufficient to reach a receiver located in a garden is an uncertainty. One way to end the uncertainty is simply to test it. It has nothing to do with probabilities, only with lack of knowledge. Once the knowledge has been obtained, there is no longer any uncertainty or any lack of certainty.

To explain the nuances, particularly for innovators and decision-makers who need practical approaches, we must first distinguish between:

1. unidentifiable uncertainties (those that are discovered along the way, which nobody has thought of yet. As soon as someone thinks of them, they become part of the second category); and
2. identifiable uncertainties (those that can be listed in advance).

The first category could be split into different subcategories, but since such differentiation cannot trigger any action (as nobody knows about it), subcategories are not very relevant for innovators and decision-makers.

For the second category, Table 73.1 shows different subcategories of identifiable uncertainties. These subcategories are important, because the actions each of them can trigger differ in their nature (italic items in Table 73.1 emphasize the differences). Columns A, B and C refer to Runde's and Knight's chance-related situations, while column D refers to a simple lack of knowledge, unrelated to chance. This last subcategory corresponds to information gaps or missing information. We chose to use the shorter expression 'unknown' to indicate this missing information or lack of knowledge.

Subcategories A, B and C can be handled very effectively using risk management tools that are designed to deal with chance-related issues (whether the probability can or cannot be assessed). Since subcategory D, which has nothing to do with chance (except for the probability of obtaining the missing information that is not of the same nature as the probability of occurrence, as is the case for subcategories A, B and C), risk management tools are not suitable for dealing with unknowns. Subcategory D uncertainties (unknowns) require information-gathering tools.

An innovation project usually contains a significant number of unknowns (subcategory D uncertainties). Sometimes the missing information cannot be obtained, and people accept having to live with the remaining uncertainty.

DIFFERENT CATEGORIES OF UNKNOWNS

Unknowns ordinarily fall into seven categories, each with its own corresponding set of questions.

1. Technological Unknowns

- Will the product perform consistently, as expected?
- Can you manufacture an industrial product economically?
- Will you be able to scale up production and delivery?
- What impact will the product or its production have on the environment?
- And so on.

2. Market-Related Unknowns

- Who will benefit and who will buy?
- At what price?
- How many people would be prepared to pay an appropriate price as required by your definition of success?

Table 73.1 Identifiable uncertainties

Subcategory	A	B	C	D
Nature / Characteristics	Factor *with* history that cannot be influenced	Factor *without* history that cannot be influenced	Factor that *can be influenced*	Missing knowledge or information, or 'unknown'
Possibility of influencing the occurrence	*Not possible*	*Not possible*	*Possible*	*No occurrence* (only lack of information)
Probability of it happening	*Predictable* because of existing reliable historical data (*certainty about the probability*)	*Not predictable* because of the lack of history (*uncertainty about the probability*)	*Not predictable*	*No probability*
Example	Raw material price fluctuation	Fire that destroys supplier facilities	New regulatory requirement	How many ISO standards have already been published?
Chance component	*Yes*	*Yes*	Sometimes	*None* (except perhaps the possibility of finding the missing information)
Nature	Risk (or opportunity)	Risk (or opportunity)	Risk (or opportunity)	*Missing information*
What kind of action can be taken by the project team	*Mitigation* = protection of the impact of occurrence (i.e. hedging to secure future price)	*Mitigation* = protection of the impact of occurrence (i.e. finding an alternative supplier)	*Mitigation* = influencing decision-makers (i.e. lobbying)	*No mitigation, but only an attempt to obtain the missing information* (i.e. review and count ISO list of publications)
Impact of the action	*Reducing the negative consequences* of the factor (or exploiting it if it is a positive factor)	*Reducing the negative consequences* of the factor (or exploiting it if it is a positive factor)	*Preventing the occurrence*	*Reducing the lack of knowledge*
Benefit of gathering information	Calculating the probability and/or assessing the impact of the occurrence	Assessing the impact of the occurrence	Finding ways to influence decision-makers	Obtaining the missing information (= reducing the lack of knowledge ➔ transforming an unknown into a known)

Note: ISO = International Organization for Standardization.

- How will the customers choose between the different offerings (the customer decision criteria)?
- How can you reach customers?
- And so on.

3. Stakeholders Unknowns

- Do you know all of your stakeholders' aspirations?
- Have you identified all of your stakeholders' resistances?
- Have you cataloged each and every one of the constraints that are imposed by your stakeholders?

- Are you sure of the decision-makers' criteria for selecting a project?
- And so on.

4. Organizational Unknowns

These particularly affect intrapreneurs.

- What kind of organization is required in order to exploit this opportunity?
- Will you be able to build your 'dream team'?
- And so on.

5. Resource Unknowns

- What resources do you need to reduce all the critical unknowns?
- What resources do you need to deliver the definition of success?
- Does the organization have the internal capabilities that your project needs?
- When will these skills be available?
- Can you obtain the necessary resources, and will they be available when you need them?
- And so on.

6. Regulatory Unknowns

- Do you need a license to do what you intend to do?
- What are the conditions for obtaining such a license?
- In terms of intellectual property, do you have the freedom to operate?
- What are the regulatory constraints?
- And so on.

7. Network Unknowns

- Do you have access to the network of experts that you need?
- Do you have access to influential government officials?
- Do you have a good enough rapport with the key players in the distribution sector?
- And so on.

Since there are so many types of unknowns, an individual will rarely have all the skills required to reduce the lack of knowledge for all of them. This is a field in which multi-disciplinary teams tend to be more effective, and it is critical to put together a team that combines the relevant skills for reducing unknowns in the most cost-effective manner.

REDUCING UNKNOWNS

The types of action needed to obtain the information for subcategory D uncertainties include:

- prototyping (including fast prototyping);
- design thinking;
- market research;
- testing;
- literature research;
- intellectual property search;
- database search; and
- discussion with experts.

These actions cannot always provide all the missing information (that is, eliminate all the unknowns), but they can usually reduce the unknowns to some degree.

As decision-makers and investors do not all have the same level of tolerance to uncertainty, they should decide which unknowns they want to see reduced, and to what extent. This decision will have a very significant impact on the cost and duration the project.

THE PROCESS FOR MINIMIZING THE WASTE OF RESOURCES

Some unknowns could possibly serve as go/no-go criteria. If you want to open a new restaurant, you must find a suitable building in the right neighborhood. The availability and cost of such a place would be typical unknowns. A no-go criterion might be a higher rent than you can afford or the lack of a suitable location. To reduce your level of ignorance, you would check the market conditions and the availability of an appropriate premises. These terminator criteria are the equivalent of a customized phase-gate or stage-gate[1] process.

The effort/resources required to reduce the critical unknowns represent the price you pay for peace of mind. If you want to be on the safe side, you should allocate the necessary resources, in order to reduce those unknowns before committing to the definitive launch of the project. If you prefer not to spend those resources, you have to choose between giving up the opportunity or trusting your intuition and letting fate decide.

Skimping on the resources needed to reduce the number of critical unknowns increases the likelihood that your project will fail. The choice is a balancing act between allocating resources and remaining ignorant in the knowledge that accepting the ignorance may reduce the chances of success.

Cataloguing this early-stage inventory of unknowns will allow you to create a customized plan for reducing these critical unknowns in the most cost-effective sequence. To properly assess the effort, money, skills and other resources required for a project, innovators should try to identify as many identifiable unknowns (subcategory D uncertainties) as possible as soon as possible.

As shown in Figure 73.1, the most reasonable process, between the burgeoning of the idea and the green light, follows these steps.

1. Opportunity analysis (Cohen, 2016, n. 3) which should enable you to identify:
   (a) the critical unknowns, those that are go/no-go criteria;
   (b) the tactical moves or actions that can be taken to reduce the critical unknowns and the necessary resources needed in order to do so; and
   (c) additional tactical moves for implementation.

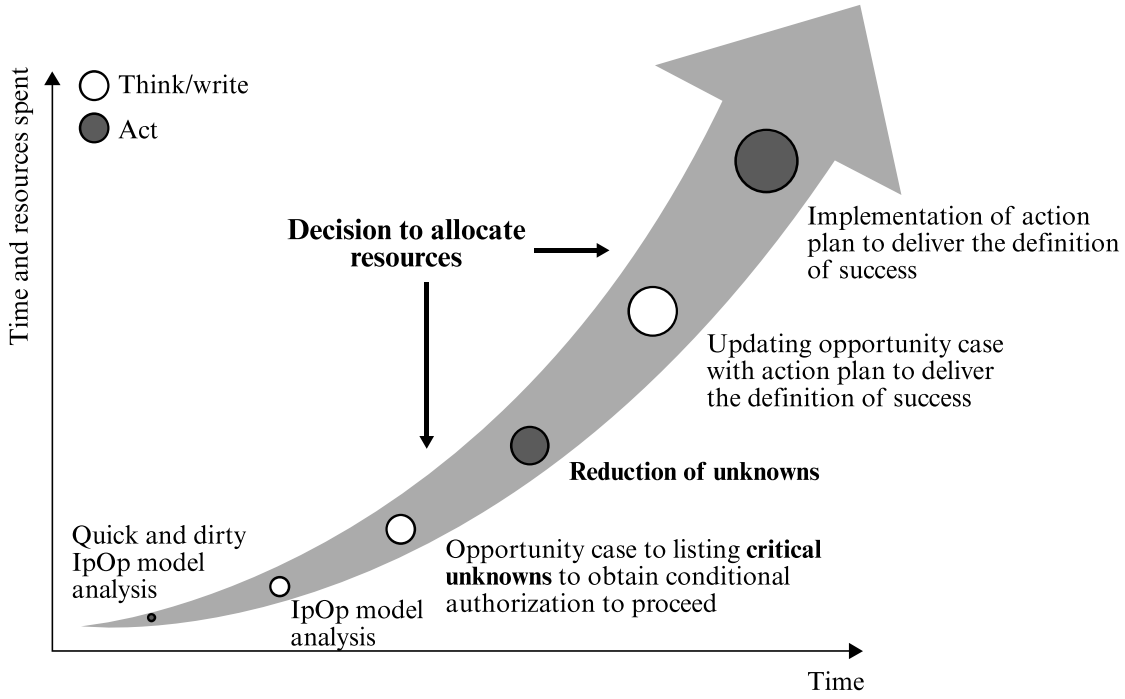

Figure 73.1 Process from idea to launch

2. Drafting and presenting an opportunity case with three objectives:
   (a) to demonstrate the merits of the opportunity (why it should be seized);
   (b) to obtain what you want and/or need to deliver the outcome/definition of success (investment, authorizations, and so on), provided that you can reduce the critical unknowns that bother the decision-makers; and
   (c) to obtain the corresponding resources for reducing these critical unknowns. You should include a specific plan of action for the reduction of unknowns in your opportunity case.

   The purpose of presenting an opportunity case that includes a list of critical unknowns, is to obtain a conditional buy-in from investors or decision-makers, whereby the understanding is to go ahead once the critical unknowns have been reduced in a satisfactory manner (see steps 4 to 6 below). A further condition might be to also present a convincing implementation plan (step 5 below).
3. Drafting and presenting the main implementation or action plan, which describes how the opportunity will eventually be implemented. This is basically the 'to do' list, which includes the tactical moves for implementation (identified in step 1(c), but also taking into account the feedback from decision-makers after step 2).
4. Spending the resources (step 2(c)) in order to move into the action phase and making whatever tactical moves are necessary to reduce the critical unknowns. Collection of information should be a managed process, with real gates (go/no-go moments) in order to stop the project if necessary. These gates should be customized for each project, rather than being a one-size-fits-all model that is often the case with a standardized phase- or stage-gate approach.
5. Revisit the opportunity (step 1) with the information obtained in step 4, in order to update:

   (a) the opportunity case (step 2); and
   (b) the main action plan (step 3), that may also include tactical moves, in order to reduce any remaining unknowns that are not critical.
6. Final green light to launch the project, assuming that the critical unknowns have been sufficiently reduced, so that the decision-makers and investors are at ease, and are prepared to allocate the necessary resources and authorizations for you to proceed. The conditional buy-in obtained in step 2 above can now become the green light to implement your plan of action.

The biggest advantage of this process is that resources only start to be spent (step 4) after the key success factors have been identified (steps 1 to 3). This might counter the trend of lean innovation or early-stage rapid prototyping, which encourage entrepreneurs to move into action as quickly as possible. There are many advantages to jumping into action at an early stage, but the biggest drawback is that each action consumes resources (your time is also a resource). The second issue with early action is the opportunity cost: building a prototype or other early-stage tactical moves may prevent you from seizing better opportunities in future.

For instance, why bother building a prototype if you find out later that market penetration is going to be too difficult, that the price is too high or that your project will antagonize influential people in your organization? It would be much wiser to first map all the parameters that can possibly be identified at the pre-project stage (that is, acceptability of the pricing level, access to distribution channels or resistance from internal stakeholders) and make a holistic judgment before jumping into costly action. This holistic assessment of the unknowns (step 2) could, for instance, demonstrate that before building an expensive prototype (which aims at reducing only one unknown), there are other unknowns that should be reduced or addressed.

It is thus useless to start spending resources, only to find out at a later stage (or gate), that there are one or more parameters that could kill the opportunity. In many cases, those opportunity killers could have been identified much earlier.

WHAT IS THE DIFFERENCE WITH THE STAGE-GATE APPROACH

As the underlying logic of the stage-gate approach is to manage the allocation of resources in a parsimonious manner, an upstream IpOp analysis makes it possible to optimize the stage gate, by customizing the sequence of reducing the unknowns. Stage-gate committees regularly stop projects at a later stage-gate phase because it becomes evident that they do not meet the expectations of that late stage. This means that the resources consumed during the previous stage-gate(s) were mostly wasted. The IpOp analysis thus allows you to start a customized stage gate, which has its own sequence, only when you have an overview of all the critical information gaps, and before you start spending the resources.

When the critical unknowns have been reduced without any killer issues popping up, the project can be launched. Since the critical unknowns have been reduced through a well-controlled approach, the launch can be implemented on a solid foundation. With a process like this, that calibrates projects at a very early stage, the chances of overrunning

your budget and time are also minimized. This implies that, by considerably improving the statistics mentioned by the Standish Group (30 percent of all projects are stopped before completion and only 12 percent are delivered on time and on budget) (The Standish Group, 1995), the amount of resources wasted is much lower.

In conclusion, innovators and decision-makers who want to avoid the huge wastage of resources as a result of insufficient early-stage analysis of all their projects, should identify unknowns as early as possible. If necessary, they can use the IpOp model (Cohen, 2016) to help them draw up an inventory of these unknowns and dispense with projects that are unlikely to succeed at a very early stage. This improved governance leads to a better allocation of research and development resources and/or those dedicated to innovation.

NOTE

1. Phase-gate is the generic expression for what many people know as stage-gate®, which is a registered trademark.

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