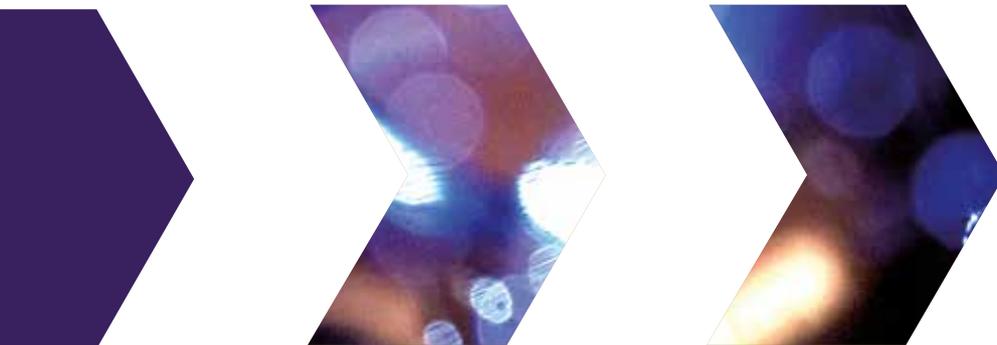


REDUCING THE RISK OF FAILURE IN NEW PRODUCT DEVELOPMENT

Getting it right at the front end of innovation

A PRACTICE GUIDE



Published by the University of Cambridge Institute for Manufacturing
17 Charles Babbage Road
Cambridge CB3 0FS
United Kingdom
www.ifm.eng.cam.ac.uk

CTM Practice Guides

CTM Practice Guides are a series of short practical guides on a range of topics aimed at technology management practitioners. These guides derive from work undertaken by the Centre for Technology Management at the IfM, including work done in collaboration with industrial practitioners involved in the Strategic Technology and Innovation Management (STIM) consortium. This consortium brings together researchers and practitioners to develop new approaches to some of the key the challenges facing manufacturing and technology-intensive companies.

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of the Institute for Manufacturing.

Title: *Reducing the risk of failure in new product development: Getting it right at the front end of innovation*

© Simon Ford, Clémence Aubert and Emmanuelle Ryckewaert,
Centre for Technology Management, Institute for Manufacturing

ISBN: 978-1-902546-32-2

First published in Great Britain in 2016

Contents

Executive summary	3
Who should read this practice guide?	3
Acknowledgements	3
Introduction	4
What do we mean by the ‘front end’ of innovation?	4
The challenges of FEI	5
Fuzziness at the front end	5
Identifying ideas and opportunities	5
Organisational challenges	6
Idea-driven and opportunity-driven innovation	7
Idea-driven FEI	7
Creativity	9
Approaches to idea generation	10
Idea management systems	11
Customer-driven innovation	13
Online communities	13
Integrating online communities into the front end of innovation	13
Opportunity-driven FEI	15
Working with customers	17
Ethnography	17
Customer toolkits and living labs	19
Design thinking	19
Improving the front end of innovation	22
Formalising the process	22
Providing resources for exploration	23
Articulating clear product strategies	23
Allocating resources to the front end	24
Defining the project and product concept	25
Supporting innovation champions	25
Creating cross-functional projects	25
Building communication	25
Conclusions	27
Reading list	28

Executive summary

When it comes to innovation there are no shortcuts. Developing and launching new products and services isn't easy and failure should be expected as part of the process – but not all failures are created equal. There are a number of types of failure – project delays, cost overruns, misalignment with company strategy are just three – that are directly attributable to the earliest stages of the innovation process.

It's these early stages of the innovation process, that occur before new product development formally begins, that we term the 'front end' of innovation (FEI). It's in this phase that ideas are generated and opportunities are recognised. The subsequent analysis, prioritisation and selection of these ideas and opportunities needs to be done in line with the organisation's innovation strategy and project portfolio.

This practice guide discusses ways in which the front end of innovation can be organised to avoid some common failures and improve the success of the innovation pipeline. It considers two main types of innovation front end: idea-driven and opportunity-driven. The former occurs when an innovative idea is generated either inside or outside the firm. Idea management systems and online communities are discussed in relation to this type of front end. Opportunity-driven front ends are initiated when new commercial opportunities are recognised. Ethnography and design thinking are two ways of identifying latent customer needs and opportunities.

Establishing the right organisational culture and effective leadership are considered vital in order to support the emergence and development of these ideas and opportunities. The guide presents some ways to create such a culture and to establish the required leadership in order to improve the front end of innovation. These include the importance of aligning innovation activities with a company's strategic aims, formalising the front end processes, allocating the required resources to early-stage projects, creating cross-functional teams and making

sure that projects and products are clearly defined as early as possible.

Who should read this practice guide?

If you're involved in the innovation process then this practice guide is for you. If you're a technology or innovation manager you will gain insights into how to organise your innovation activities more effectively. If you're a project manager then you will find some guidance on the practices you should adopt – and some of those you shouldn't. Finally, if you're a technologist then this guide will help you identify some of the problems you may encounter when working at the 'front end'.

Acknowledgements

The authors would like to thank the members of the Strategic Technology and Innovation Management (STIM) Consortium of 2013 for their financial support in enabling this research: BP, Grundfos, GSK, Lego, Mars, NetworkRail, Rexam, Syngenta, TWI, Xaar and Zeiss. Furthermore, we would like to thank all those who contributed to our research, whether by attending workshops, answering interview questions, or completing surveys. Your perspectives were an enormous help in shaping the project and this report.

Introduction

The ‘front end’ of innovation – the period when ideas are still emerging and formal product development has yet to begin – is a challenging but crucially important time. Strong leadership and a supportive organisational culture are vital in enabling the identification, analysis and selection of new ideas and opportunities. If the complex processes involved at this early stage are managed well a great deal of time and money can be saved. If they are poorly managed new product development projects are likely to fail.

What do we mean by the ‘front end’ of innovation?

Those studying the front end of innovation (FEI) have proposed a variety of definitions. These include:

- From the generation of an idea to its approval for development
- From when an opportunity is first considered until it is judged ready for development
- Where new product ideas gain their shape, justification, plans and support, leading to their approval and subsequent execution

Overall, FEI can be defined as those activities that take place before an actual, well-structured product development process, such as a New Product and Process Development (NPPD) or Stage Gate™ process, has been established. It is this definition that is used in this guide.

Failure due to problems at the ‘front end’

Innovation projects can fail for a variety of reasons.

These include:

- Cancellation of new products mid-development when they no longer align with company strategy
- Delayed introduction of new products when the product concept is constantly being revised
- Poor performance of priority projects due to key individuals being too busy to contribute effectively

These failures are all symptoms of problems with FEI where the foundations for innovation are established.

Working with a number of industrial companies the Centre for Technology Management has been exploring the processes that companies use during these early stages, in order to reveal some of the factors that contribute to success and failure.

Two drivers of innovation – ideas and opportunities

The various contexts in which organisations exist can give rise to different types of ‘front end’. In this guide a distinction has been drawn between innovation that is driven by ideas and innovation that is driven by opportunities.

While the front end of innovation can be represented linearly as in Figure 1, the new concept development model in Figure 2 helps to recognise that FEI is not a linear process and that the start point can be either idea generation or opportunity identification.

There is a close association between four stages of the concept development model: idea generation and idea selection, and opportunity identification and opportunity analysis, with both selection and analysis acting upon the diverse ideas and opportunities that

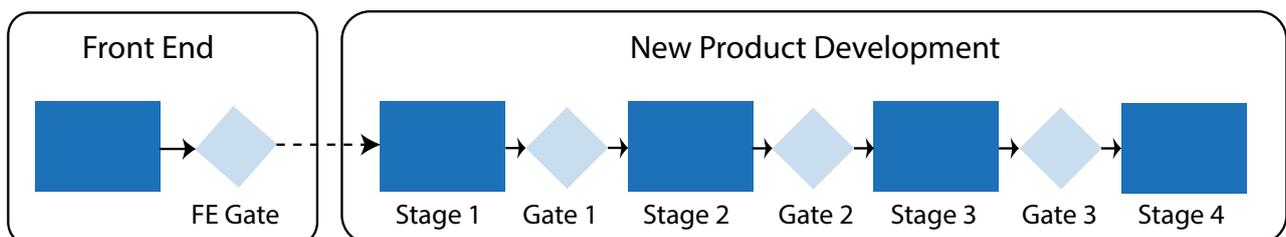


Figure 1. The front end of innovation in relation to new product development

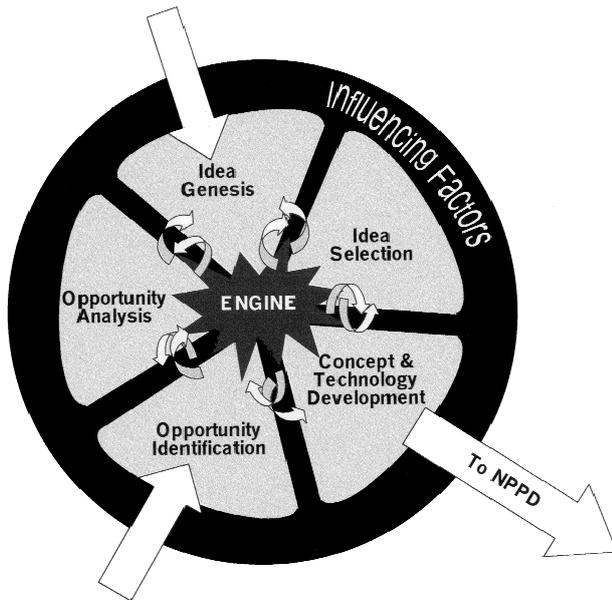


Figure 2. New concept development model (Koen et al. (2004))

enter the system. A fifth stage involves defining the basic concept. The sequence that an organisation proceeds through these five processes can be highly iterative as new variations are proposed, refined or rejected. FEI is completed when a compelling case is made for further investment and development. Such a case is usually in the form of a well-defined concept or business case. Once this case has been successfully made the concept then enters the new product development process.

The impact of leadership and culture

This model also highlights two other factors that affect the operation and effectiveness of FEI. The first of these is at the heart of the model and is termed the front end 'engine'. The engine is concerned with those internal business elements – leadership and culture – that create the environment for successful innovation. Leadership is important to ensure that innovations are aligned with the organisation's strategy. It is also important because the innovation process can sometimes take significant time, requiring senior management to continue to support projects as they go through this process.

A specific organisational culture also needs to be fostered for FEI, one that is different to the culture required for new product development. This culture must be accepting of ambiguity and failure, and should support experimentation and rapid learning.

Influencing factors

The second set of factors, the 'influencing factors', are both internal and external to the organisation. The internal factors comprise the resources and

capabilities possessed by the firm, including its technology base. The external factors are those political, economic, social, technological, legal and environmental (PESTLE) trends and drivers that lie outside the control of the organisation. These factors combine to define the evolving macro-environmental context that provides the basis for new opportunities.

The challenges of FEI

Fuzziness at the front end

The term 'fuzzy' is often used to describe the front end of innovation to denote the lack of clarity and objectivity found at this stage. The fuzziness can be considered as having four elements: uncertainty, ambiguity, complexity and variability.

- **Uncertainty** primarily arises when those involved lack information or knowledge about the innovation project. Uncertainty can also arise when they have such information or knowledge but are unable to process it.
- **Ambiguity** (also termed 'equivocality'), refers to the different interpretations and understanding that people have concerning the processes, activities and goals of FEI. Ambiguity exists in its most extreme state when those involved are unaware that front end processes, activities and goals exist.
- **Complexity** arises from the differences between the experience, knowledge base, values and assumptions of those involved in the project. The level of complexity is related to the project size and the number of interdependent people, functions and processes.
- **Variability** is caused by the rate and intensity of change occurring in the market. It is distinct from uncertainty in that it stems from the difference between the apparent attractiveness of a given idea or opportunity at the front end and the attractiveness of that idea or opportunity once it is actually realised.

Fuzziness can be resolved by clearly defining the project and the product concept to be investigated and developed.

Identifying ideas and opportunities

As Figure 2 highlights, ideas and opportunities are the entry point for FEI. Sources of ideas and opportunities are numerous. An organisation may look internally to its employees to propose ideas and identify potential opportunities, or it may look externally to its collaborators, suppliers, customers,

Ideas competitions

When GE ran its *Ecomagination Challenge* it was inundated with submissions. Over 70,000 people submitted 3,844 ideas between them, a number that was far in excess of what GE had anticipated and for which it hadn't budgeted.

users, competitors or other organisations with which it has no established relationship. The approach can involve proactively searching for ideas and opportunities or reacting to ideas and opportunities as they arise organically from normal business activities.

The organisation then faces the task of identifying whether any of these ideas and opportunities have value and are worth pursuing. This will involve some kind of screening process, which could be conducted by an individual or by a panel or committee.

Some organisations suffer from a dearth of ideas and opportunities; others actually have an overabundance and have to decide which to pursue. Having a great number of inputs at the front end means that significant resources will need to be invested into a screening process. This can be particularly challenging when an organisation engages with the outside world through mechanisms such as ideas competitions.

If large numbers of ideas are put forward screening becomes an unmanageable task. Organisations face

the challenge of motivating people to propose ideas and opportunities that are in areas of particular strategic interest to the organisation. They also need to continue to motivate individuals and teams that have had their proposals rejected.

Organisational challenges

There is a tension between exploration and exploitation, particularly in large established firms. The firm must continue to serve its existing markets and incrementally improve the goods and services it provides for its customers. In addition, it must look to the medium and longer term by investing resources in more exploratory activities.

While resources need to be dedicated to FEI so that ideas and opportunities can be developed and reach the point where they can be approved for development, it can be difficult to justify allocating resources when the return on investment is unclear. Allocating resources to the front end, however, can help reduce uncertainty and ambiguity, and prevent mistakes from being made later in the development process.

The front end is the period of the innovation process where there is still flexibility and the penalties of changing direction are relatively low. These factors and others distinguish FEI from new product development. A summary of the differences between FEI and NPD is provided in Table 1.

Factors	General characteristics of FEI	General characteristics of NPD
State of an idea	Probable, fuzzy, easy to change	Determined to develop, clear specific, difficult to change
Features of information for decision-making	Qualitative, informal and approximate	Quantitative, formal and precise
Outcome (/action)	A blueprint (/diminishing ambiguity to decide whether to make it happen)	A product (/making it happen)
Width and depth of focus	Broad but thin	Narrow but detailed
Ease of rejecting an idea	Easy	More difficult
Degree of formalisation	Low	High
Personnel involvement	Individual or small project team	A full development team
Budget	Small/none	Large, designated
Management methods	Unstructured, experimental, creativity needed	Structured, systematic
(Visible) damage if abandoned	Usually small	Substantial
Commitment of the CEO	None or small	Usually high

Table 1. Differences between the 'fuzzy' front end and new product development

Idea-driven and opportunity-driven innovation

Two generic types of innovation ‘front ends’ can be observed in companies: those that are driven by ideas and those that are driven by opportunities. In the following sections, we describe models for each of these, together with the specific characteristics and challenges they present.

Idea-driven FEI

The starting point for an idea-driven FEI is, as the name suggests, the generation of an idea. Among the numerous models that have been developed to describe this process, two can be seen in Figures 3 and 4.

Standard model for idea-driven FEI

The first model (Figure 3) is a standard linear depiction of the stages followed when deciding whether or not a project should go forward to new product development. It depicts a common process followed by companies to assess new ideas, but is less relevant for new technology developments.

Stage 1 Strategic guidelines: the first stage of this model highlights the importance of the organisation having a strategy for innovation. Strategic guidelines establish the innovation context and clarify the types of innovations that senior management would like to see developed.

Stage 2 Idea generation: this can be passive or proactive. If the former, ideas may emerge when individuals are doing other tasks; if the latter the ideas may be stimulated by idea generation techniques, used either by individuals or in groups. Some common idea generation techniques are described on page 10.

Stage 3 Screening: organisations do not have the resources to pursue every idea put forward so some form of screening is required. The initial idea is first assessed by an idea or innovation manager. If this is approved then the idea will be developed further for review by a cross-functional team. The team examine the technical, financial and market attractiveness of the proposal. Funding and/or resources are given to successful proposals to enter the fourth stage.

Stage 4 Preliminary projects: at this point a project team develops a full concept for the proposal. The level of detail required will depend on the organisation involved. There may be several stages of cross-functional review, with the degree of definition increasing as the idea gets closer to entering new product development. Once sufficient definition has been achieved a decision is made about whether the project should go into NPD.

Front end: Idea management/Concept-finding/Predevelopment				Decision	NPD: Project management
Strategic guidelines for innovation	Idea generation and adoption	Idea screening, execution and further conceptual development	Preliminary projects		Portfolio of innovation projects
<i>Development of innovation guidelines by top management and innovation manager</i>	<i>Strategic analysis of ideas by idea or innovation manager</i>	<i>Cross-functional teams reach decisions concerning ideas based on estimations (product, technical, financial and market attractiveness)</i>	<i>Verification of the estimations</i>	<i>Multi-project management</i> <i>Allocation of R&D budget</i>	

Figure 3. First model of idea-driven FEI

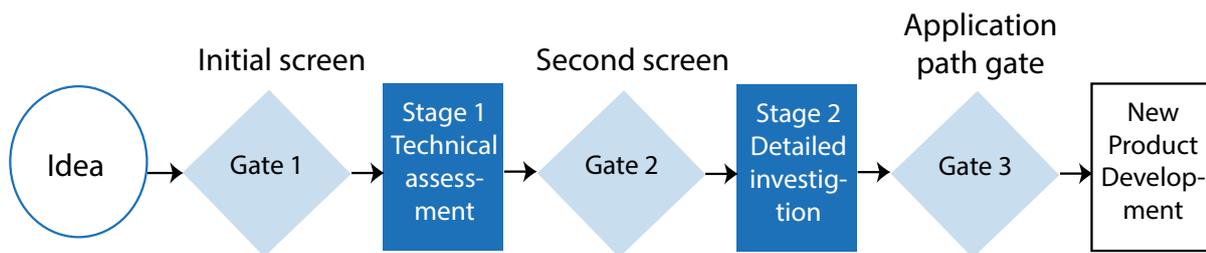


Figure 4. Second model of idea-driven FEI – appropriate for new technology developments

Model for ideas emerging from fundamental research

The second model (Figure 4) describes a process used for ideas that emerge from fundamental research, such as new technologies or scientific developments.

Stage 1 Technical assessment: the technological readiness of ideas that emerge from R&D laboratories will often be quite low and it will first be necessary to conduct feasibility studies. Stage 1 of this model therefore involves a high-level technical assessment. This includes initial conceptual and preparatory work, feasibility testing and the development of an action plan for the next stage. During the conceptual and preparatory work, the firm undertakes tasks such as a technical literature search, an intellectual property search, an assessment of competitive alternatives, and the identification of any resource gaps. During feasibility testing it also develops an outline for a prospective commercial application. The deliverables from this stage should include a reasonable demonstration of technical feasibility and documented results from the experiments, as well as an understanding of the intellectual property situation and a plan of action for the second stage.

Stage 2 Detailed investigation: the second stage sees the continuation of technical work including further experimental work, with an analysis and documentation of the results. An assessment of the competitive position of the technology is conducted alongside the development of a strategy for its protection. A number of other evaluations are undertaken, including preliminary assessments of the market, manufacturing, business and finance, together with the identification of possible commercial products. These may be new products or new processes. These activities should demonstrate the feasibility of the technology and provide some preliminary assessments of commercial applications, giving the company a better understanding of the value of the technology. A number of forward plans should also be drawn up.

The model also depicts three gates at which decisions are made about whether or not the project should be supported. The criteria used here are more strategic in nature and less financial compared to those used for new product development stage gates.

At the second and third gates, the technology will move to the next stage if the necessary deliverables are realised. If the third gate is passed then the technology will be brought into new product development. In contrast to the first model, in which approved ideas always start at the beginning of the new product development process, technology projects could proceed more swiftly and may enter new product development at any stage. The point of entry will depend on the evaluation made at the third gate.

Criteria for selecting technology projects

Toray Chemical uses the following criteria to decide which technology projects to support.

- Degree of strategic fit and strategic importance for the company
- Ability to achieve strategic leverage (e.g. platform for growth, impact on multiple business units)
- Potential for reward (value to the company, if successful)
- Likelihood of technical feasibility
- Likelihood of commercial success (e.g. competitive advantage, existence of in-house competencies)

Similar criteria were used at Philips for screening R&D projects applying to enter the technology incubator.

Creativity

Creativity is the first step towards innovation. How can the creativity of individuals and teams inside the organisation be harnessed and improved in order to support the innovation process?

Individual creativity is linked to the personal skills, temperament and motivation of the individual, together with the environment in which the individual is located. The individual is almost never a lonely thinker; he or she is influenced by the environment, which includes their team and organisation, along with the wider world. The challenge is to create a working environment in which the individual is motivated to be creative.

Creating the right atmosphere within the team is key to achieving this. The individual must feel they can rely on their team's trust, confidence, insight, commitment and complementary skills. The organisational climate, culture and structure also influence individual creativity. The individual must also feel that any resources required (e.g. tools, systems, finance) will be made available, and that they have the freedom and autonomy to be creative, to

*"The vital essence of innovation is creativity."
Chris Harris (Building Innovative teams)*

take some risks, and even to fail.

Team creativity is affected by the team's diversity, the quality of communication and the tools and systems put in place by the organisation. Greater diversity between team members usually improves creativity. However, extreme diversity can sometimes lead to conflicts and have a negative impact on team creativity. Teams, like individuals, need support from the organisation and its management. A leadership style that promotes passion and optimism, encouraging the team to feel it has the management's support to take the initiative and run risks, provides a good creative environment.

Organisational creativity is affected by the organisation's climate, culture, structure, leadership style and resources. It is also a function of team creativity and individual creativity, and of the global environment and global creativity. Figure 5 summarises the relationships between organisational creativity, team creativity and individual creativity.

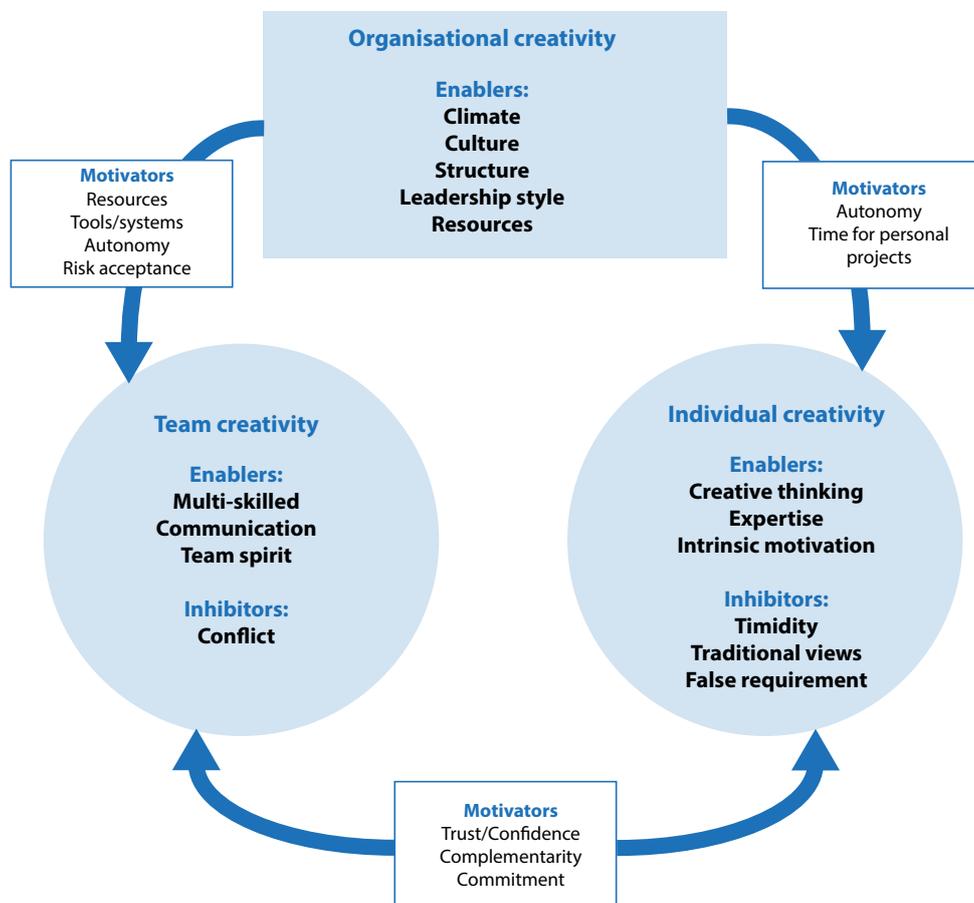


Figure 5. The relationships between organisational creativity, team creativity and individual creativity

Factors	General characteristics of FEI
Mind-mapping	A mind map is a diagram that outlines information visually. It is often created around a single word or text, placed in the centre, to which associated ideas, words and concepts are added.
Brainstorming	A group technique in which participants attempt to find solutions to a specific problem by spontaneously proposing ideas.
Convergent thinking	Convergent thinking is designed to achieve the single, best (or correct) answer to a clearly defined question.
Divergent thinking	Divergent thinking involves producing multiple or alternative answers from available information.
Scenario development	Scenarios are developed that represent descriptions of a variety of hypothetical futures, reflecting different perspectives on past, present and future developments.

Table 2. Common idea generation techniques

When to use brainwriting	When to use brainstorming
<ul style="list-style-type: none"> • For very large groups • When little time is available • When status differences need to be equalised • When there is need for anonymity • When there is no need for verbal interaction 	<ul style="list-style-type: none"> • For small groups of individuals • When time is plentiful • When status differences between group members is minimal • When there is need to verbally discuss ideas with others

Table 3. Deciding when to use brainwriting and brainstorming

Approaches to idea generation

Ideation is the creative process of generating, developing and communicating new ideas. There are a huge number of idea generation techniques. Table 2 summarises five of the most common.

Four elements underlie the design of these techniques:

- Is the technique designed for an individual or a group? While all techniques for individuals can be used by groups, only some group techniques can be used by individuals.
- Does the technique use free association or forced relationships to help ideation? Free association relies on the past experience of the person generating the ideas or their immediate environment to act as a stimulus, while forced relationships use specific stimuli to force together ideas and concepts in order to see what is produced. Picture cards showing visual metaphors or symbolic representations are examples of such stimuli.
- Are the stimuli related or unrelated to each other? Related stimuli are likely to lead to ideas with greater practicality; unrelated stimuli may create more radical concepts.
- Is ideation conducted silently or vocally? Brainwriting involves the silent generation of ideas, while brainstorming is a process for generating ideas vocally. Table 3 summarises the most appropriate situations for using brainwriting and brainstorming.

Brainstorming

There are three well-known problems with brainstorming:

- **Evaluation apprehension** when participants fear being judged for their contribution
- **Free riding** when participants do not contribute in a group setting
- **Production blocking** when a participant misses an opportunity to contribute because the conversation moves on to other issues

Furthermore, while brainstorming is a commonly used tool it is open to significant abuse. Originally designed to be a quite structured approach, the technique is now often run in an unstructured way, with poorly framed problems, no independent facilitation and with no pre-agreed procedures. As a result, such sessions can favour the more talkative or senior members of the group over those who are more introverted or junior, and can lead to individual agendas being pushed through.

Getting the best ideas

The classic principles of ideation suggest that participants should do the following:

- **Defer judgement.** It is very easy to analyse ideas too early. Doing so can slow down the generation of ideas and inhibit those participants whose ideas are criticised.
- **Aim for quantity.** Generating a larger number of ideas can improve the probability that some will be worth pursuing in greater depth. More ideas also provide more stimuli for other participants in the group.
- **Be radical.** Wilder ideas are often necessary to generate breakthrough innovations. Such ideas may not be immediately realisable but with some modification they could become so.
- **Combine ideas.** Generated ideas can inspire more to be put forward so use any clashes between different ideas to stimulate further suggestions and variants.
- **Take breaks.** Working intensely on idea generation can be mentally demanding; time limits should be set and breaks scheduled to allow minds to recharge.

Idea management systems

Idea management systems can be used to review, store and retrieve proposed ideas at the front end of innovation. A systematic approach to gathering and channelling ideas can help:

- Utilise the diversity and collective creativity of all employees
- Ensure that the right ideas are selected to meet your innovation needs
- Measure and drive front end innovation activities
- Provide participants with feedback and recognition

- Integrate idea management with other practices and tools

The first idea management systems took the form of suggestion schemes in which employees could post their ideas on pieces of paper in suggestion boxes. These however did not prove that successful as it was difficult to sustain employee engagement. Later, during the lean movement, a second generation of suggestion schemes was launched by Japanese companies. Termed 'Kaizen Teian', these promoted employees' involvement, holding managers accountable for participation rates and rewarding all ideas submitted. This process, helped by a supportive Japanese culture, saw Japanese workers become global leaders in the submission of ideas. They submitted an average of 61.6 suggestions per year, more than two orders of magnitude greater than the 0.4 suggestions per year submitted by European workers.

One reason for the success or failure of an idea management system is the effect it has on employee motivation. Intrinsic motivations are more important in this regard than extrinsic motivations, such as monetary rewards. Evidence suggests that employees will be more eager to submit ideas if the following is true:

- The idea submitted has an impact on their job
- Some of their ideas are rejected so that the system appears challenging
- The monetary rewards are kept low
- Campaigns are themed to address specific issues
- Ideas are submitted in groups

A typical idea management system

A typical system for managing ideas sourced from within the organisation is depicted in Figure 6. In such a system, ideas are first submitted by

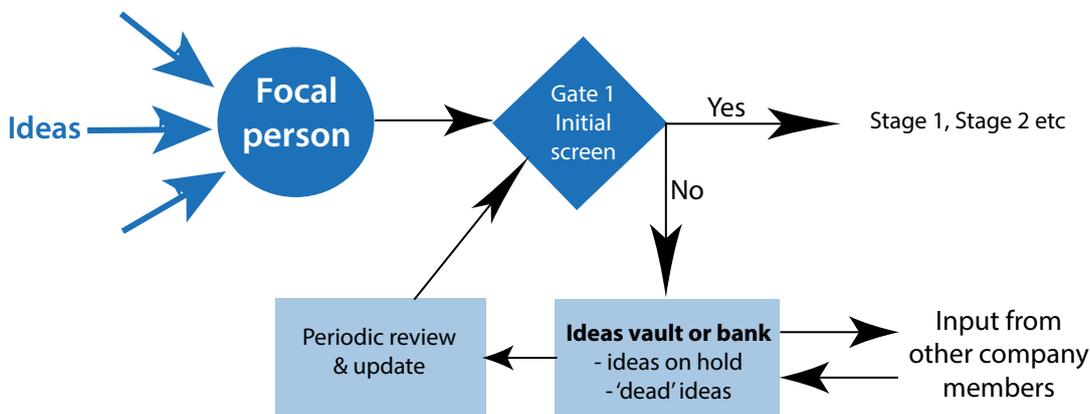


Figure 6. An idea management system

The first requirement of an idea management system is to have well-defined objectives.

employees to a focal person. This is now usually done electronically. In larger organisations this focal person may have a dedicated responsibility to maintain the idea management system, while in smaller organisation it may just be one of many responsibilities.

The proposal is then screened. This may be conducted by the focal person or by a committee. If the latter, the process may include a pre-screen by the focal person.

If the result of the screening is positive, the proposal is resourced and taken to the next stage of development. This can involve the creation of a small, cross-functional team to begin to scope and develop the idea.

If the screening results in the rejection of the proposal then the idea is archived within an ideas database, vault or bank, and feedback is provided to the submitter of the idea.

The purpose of the ideas database is to retain those ideas which are considered to have merit but which either do not currently align with the organisational strategy, are not realisable at that time due to the maturity of necessary technologies, or for which no clear market opportunity is yet apparent. Open access to the database, or to elements of it, then allows other employees to propose suggestions on how the idea could be improved. A periodic review of ideas held in the ideas database can also be conducted to identify if any of the conditions of rejection have changed. Ideas that are retrieved can then be input anywhere into the innovation process.

Idea management systems can also be used to review and store ideas from sources other than company employees. Ideas and opportunities from outside the organisation (e.g. customers, users, suppliers, collaborators, competitors) can be brought to the focal person by an employee and be taken through the same review process.

Computer-based idea management systems

The emergence of the internet, company intranets and social networking platforms makes it feasible to use computer-based idea management systems for contributors who are geographically dispersed.

Such systems follow the same basic approach depicted in Figure 6. The online aspect of the system allows for some variation in the flow of ideas. For example,

it is possible for peer review and feedback to be incorporated into the process. In such cases, other employees may be able to provide feedback with the aim of improving the quality of the idea proposed, or they may be part of a voting process that aids selection decisions.

Although the design of a computer-based idea management system must be user friendly, the processes involved are much more important as far as its adoption by employees is concerned. This requires a number of process elements to be clearly defined at the launch of the system.

Well defined objectives: The first requirement is to have well-defined objectives for the system, both for the organisation and its employees. Generating and submitting ideas are usually additional tasks for employees that go beyond their usual routines. To help build these tasks into their day-to-day lives it can be helpful to set guidance targets for the expected number of ideas that each employee should submit. This will help to establish common expectations about how much time and effort employees should put into using the system. This also applies to any peer review process that employees are expected to contribute to.

“When peer review is done on a voluntary basis then it requires a certain level of energy to engage. It relies on people seeing it, being prepared to take a little bit of time out of their day to think about it, and then reply to it.” Global Technology Manager

It is also important to define the types of ideas to input into the system. Organisations that do not do this may find it a challenge to categorise and analyse the ideas submitted. These systems are generally more effective when some boundaries are placed around the types of ideas being sought. Some organisations use time-based challenges around certain topics to spur employees into action.

Managing the system: The second element that needs to be defined is who is responsible for managing the system. This is particularly important if a single person is to be responsible for its operation. That person needs to have sufficient resources to enable them to dedicate enough time to the task. If multiple individuals are responsible for managing ideas as they pass through the system then it is important that each has specific responsibilities for contributing to the process. Two features, feedback and recognition, are particularly significant in relation to employee

Feedback and recognition are particularly important in helping to motivate employees to contribute ideas.

motivation. Employees care about the ideas they propose, not only about how they are judged but also about how they are applied if successful. Employees need to be provided with feedback in a timely fashion, whether their idea is successful or not. This is even more important if the idea is rejected as it will affect the employee's motivation to submit ideas in the future.

Employees also care about recognition and receiving recognition can be a powerful motivator. This need not be a significant monetary reward but could take the form of recognition ceremonies, stories about the idea on the company's intranet, in its newsletters or on blogs. All are ways to acknowledge the fact that the employee has contributed something beneficial to the company. The challenge here can be that innovation is usually a team effort and singling out individuals for praise can disappoint others whose efforts were not also recognised.

Promoting the system: In addition to establishing sound processes to run the ideas management system, it is also very important to promote it widely so that employees know about it and understand its goals, as well as their own role within it and how to use the tool. Employees' first contact with the system should be a positive one. The system's management team needs to be very active in promoting it, particularly in those companies with multiple business units or divisions that are geographically dispersed. Presentations by the team can help when it is first launched with regular updates once it is up and running.

A final consideration for those launching or operating a computer-based idea management system is that, in the majority of cases, employees will first share their ideas with colleagues before submitting them to the ideas system. Using a friendly or knowledgeable colleague as a sounding board is an established practice that people are used to doing. After sharing the idea in this way the employee may decide that it isn't worth pursuing and so will not submit it to the system. When first introduced, computer-based idea management systems should therefore be seen as just one of a number of mechanisms for identifying ideas, rather than a single, unifying approach. If successfully promoted and operated, the adoption of the system will increase and it will become part of established practice. However, even in such situations not all ideas generated by employees will flow through the system.

Customer-driven innovation

In some cases innovation is driven by customers, with customers and users becoming the principal source of ideas, designs and prototypes. Customers may be motivated to innovate through curiosity, by a passion for the technology, or by the need to solve a particular problem.

In such cases very little collaboration takes place between the customer and the organisation, until the innovations are incorporated into the organisation's innovation pipeline. With this type of innovation, the organisation's role shifts from that of principal innovator to coordinator of innovation activities. This approach allows inputs from customers into the innovation process at specific points in time. Active engagement is required, with the organisation needing to be part of customer communities, inviting customers to reveal and share their innovations through competitions and award schemes. Some companies believe that without these types of interactions with customers there is a real risk of losing customers and their innovations to competitors.

Online communities

Online communities (also described as virtual communities) can be a rich source of innovation. The internet has made innovation much more community-oriented, and much cheaper and faster as a consequence. Consumers rarely innovate in isolation; instead they do so with like-minded people. Members within online communities share enthusiasm for an issue or an activity; as a result, these members exchange information, knowledge and opportunities, in order to transform innovative ideas into new products.

The online community enables ongoing dialogue between members, as well as learning to be generated via feedback. A customer introducing a new innovation will be continuously challenged by other community members. The innovator must rethink their ideas based on the suggestions made, and be able to overcome any problems.

Integrating online communities into the front end of innovation

Two organisational conditions stand out as necessary in order to integrate interactive online communities into the company's front end of innovation:

- A high level of involvement by the organisation
- A well-established back-end system for successful online platforms

Online communities and LEGO

LEGO uses online communities to feed ideas from customers into the innovation process. Its 'Out to In' digital platform allows community members to post new product ideas in an array of predefined categories and subcategories (education, sustainability, movies) that are not directly related to existing LEGO products.

"If a customer working in sustainability has a new biodegradable LEGO brick idea, he or she will be able communicate that to us. Customers can link things together; things that we thought had nothing in common. In this case: LEGO and biodegradable technologies," explained an Open Innovation Manager.

Another platform, LEGO Cuusoo ('Make a LEGO Wish' in Japanese), provides a dedicated avenue for the online community to post pictures, drawings, designs and self-created LEGO concepts.

Customers are provided with Digital Designer, a free online 3D tool, to generate the new product designs, enabling them to provide explicit information about designs and desired products. "At one point, all of the posted designs were about time machines; we just knew that we had to build one!" a LEGO Concept Manager said. By working in this way,

customers are stepping out of the traditional role of passive consumers and becoming co-creators of new products. While only a small proportion of community members will generate new designs, other members are able to vote for the models they believe should be created. Models that receive 10,000 votes from the LEGO community are reviewed by the LEGO Group for potential commercialisation. LEGO Mindcraft was one product that went through this proposal-and-vote process. The Concept Manager explained: "It was hugely popular, the 10,000 votes were raised in two days. The previous products took more than a year." Following its launch, the number of LEGO Mindcraft products shipped outstripped any other LEGO product.

Involving community members in the selection process helps reduce risk. The number of votes and the rate with which they are made allows LEGO to estimate the commercial attractiveness of the design and potential market size. Reaching 10,000 votes means that the design will be evaluated by LEGO, but it does not guarantee that LEGO will make it. Features may be modified and the business case for the design has to be considered. Customer-designers can provide inspiration, but are not a substitute for professional designers.

Interacting with the community

Online community members frequently ask for help and raise questions which a company needs to process quickly. They also expect direct feedback on their inputs and for the company to show interest in their product ideas.

These relationships require careful management. At LEGO the responsibility for liaising between the company and the community is usually held by a community manager or developer. An Open Innovation Manager explained: "We have the responsibility to deliver answers to the community members, to keep them updated, and to give them feedbacks. It is very critical to communicate to the community members why a decision went that way."

Dealing with the ideas that come in

Involving customers and harnessing their competencies involves much more than simply

establishing an online dialogue. For LEGO and other users of online communities, it is critical to implement back-end systems that connect the users to the business, so that each idea and suggestion from customers is directed to the right person in the company. LEGO offers a relatively straightforward approach for this: "If someone has a new digital game idea, they would go into the 'new product' tab, then the 'digital game' tab, and then they would add some tags into the webpage," explained a Concept Manager. "So using the set categories, sub-categories and tags we are able to put that idea into a bucket. And internally we have owners of the buckets, so every idea has somebody on the other side of LEGO who can evaluate it."

It's important to get these connections right. Those customers involving themselves in online communities are not interested in just buying a product. For them the product becomes an artefact around which

Online communities can provide ideas, but these may be of low quality. Adopting guidelines and boundaries can help overcome the issue of too many low quality or irrelevant ideas.

they interact with other customers. What is more important to them is to shape and to take part in new experiences with other likeminded customers. Being part of these development communities helps establish brand loyalty and fosters on-going relations.

Managing online communities

Online communities represent rich sources of inputs from customers. However, managing these communities bring significant challenges. These challenges include the low quality of online content, managing community expectations, the management of intellectual property and industrial espionage.

Setting guidelines for ideas

Very few online community members are experts, and fewer still have the knowledge and know-how to develop a product. Adopting guidelines and boundaries can help overcome the issue of too many low quality or irrelevant ideas. A LEGO Open Innovation Manager explained: “If you give them a blank sheet of paper and you say ‘Give us your best idea’ they might have a bad idea. But if that same person participated in a challenge about creating the next jeep for LEGO and the jeep has to include this many parts, then all of a sudden the same user will send much better ideas.”

Without these boundaries, community managers take the risk of receiving an overabundance of low-quality ideas that are difficult to manage and organise. The enthusiasm of community members towards the brand and/or the product can lead them to think that they have better plans, ideas and designs than the professionals working within the organisation. Community members can get upset when they feel that their opinions have not been listened to. For example, LEGO might make a decision based on

the company’s business perspective, which could go against a member’s view, said an Open Innovation Manager. “Many users think that ‘There is a place to have my say’; that means that there is somebody on the other side who is going to do what I am saying.” LEGO tries to be very clear upfront with its community members about what they should expect from participating in the community. This includes explaining to members that professional designers also get their ideas and proposals rejected, and that rejection is part of the innovation process.

IP issues

Intellectual property issues can arise when members propose ideas that are the same or similar to ideas that a company is already working on, but which it has yet to launch. In such cases members may claim that the firm stole their intellectual property. To address this potential problem, LEGO provides community members with signed agreements before any types of engagement or interaction start, which clearly explain ownership policies. In addition, LEGO employees are required to date new designs and ideas that arise internally to prove their origins and to avoid accusations of theft by customers.

A final challenge is the threat of competitors gaining access to valuable information. This was considered to be a significant risk for organisations operating online communities. An Innovation Programme Manager commented: “We don’t know who the person is behind all of those comments; it could be one of our competitors, jotting down all of the ideas.” As a result, companies need to be very careful about what information they share with the community.

Opportunity-driven FEI

The second generic type of ‘front end’, is driven not by an idea but by an opportunity. It begins when a potential new opening for the company is identified which then gives rise to ideas and possible ways to take advantage of the opportunity. Two different models are presented to illustrate the stages of this type of FEI.

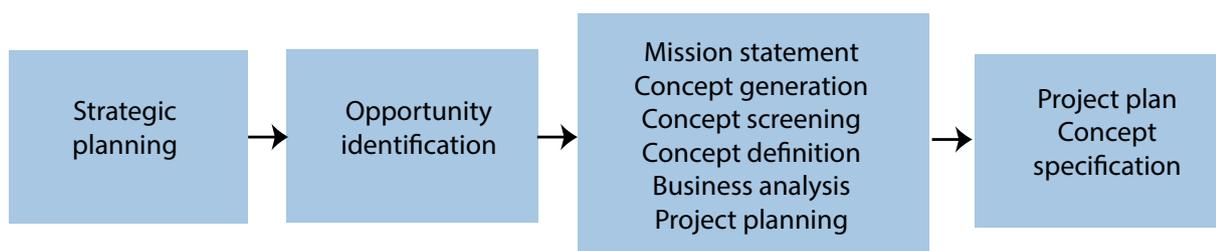


Figure 7. Opportunity-driven front end of innovation

Basic model for opportunity-driven FEI

A simple model of an opportunity-driven front end is shown in Figure 7.

Stage 1: Strategic planning As with the first, idea-driven front end (see Figure 3), a strategic element is the first step of the process: in this case strategic planning. This may be high-level strategic planning or it may be more specifically focussed on innovation strategy. As before, this planning stage sets the context for what follows, directing resources towards those domains that are of strategic or commercial interest to the company.

Stage 2: Opportunity identification In the next stage the objective is to identify opportunities. This may be a passive activity in which opportunities are identified as people go about their regular work, or it may be a proactive activity in which people are actively engaged in searching for new opportunities, either as part of their main job function or during a group exercise organised to identify opportunities.

Stage 3: Concept development Having recognised these opportunities it is up to those involved in the project to seek and develop a possible commercial solution for this opportunity. This usually begins with the creation of a mission statement that defines the scope of the project. The next steps involve generating and screening solution concepts. This may involve using some of the ideation techniques previously described to define the concept more closely. Alongside this concept development the team will also investigate the attractiveness of the opportunity

in terms of estimated market size, rate of growth and intensity of competition. They will also begin to develop a project plan.

Stage 4: Project plan and specification The outputs of these activities are a project-specific document: a project plan, and a product-specific document: a concept specification. The project plan details what is to be done, who will be involved and what the process will be to realise this. The concept specification provides a clear definition of some of the product's significant functions and features.

A second model for opportunity-driven FEI

Another model for opportunity-driven front end can be seen in Figure 8.

Strategic and organisational issues: The basic front end elements of this model are the same. However, this model includes a number of 'foundation elements' that are important to the success of the front end. These include linking in product and portfolio strategy, as these drive the innovation process and help to define which opportunities should be pursued. The capabilities, competences, structure and culture of the organisation are also considered as these will help define which opportunities are feasible for the organisation to pursue.

Opportunity recognition: The strategic and organisational considerations are taken into account during Pre-phase Zero when companies first recognise an opportunity and then conduct preliminary market and technology analyses to assess whether the opportunity is worth exploring.

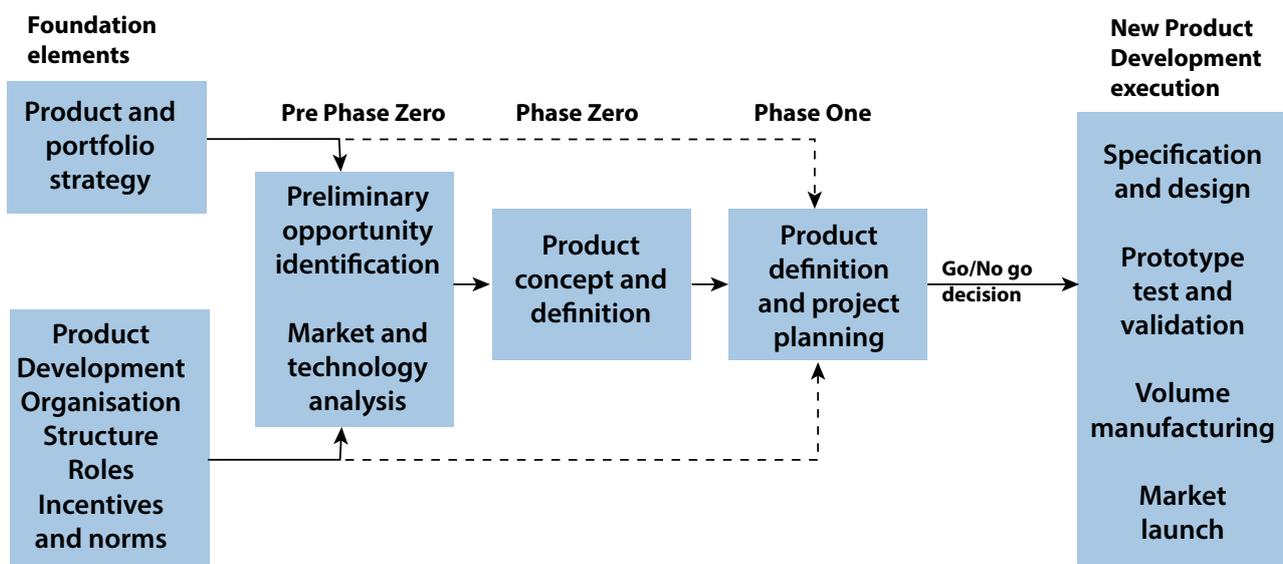


Figure 8. Opportunity-driven front end of innovation

Concept development: If it is, then a small project team is brought together during Phase Zero to develop a product concept and define the product's specification.

Product definition: This product definition is further developed during Phase One alongside technology and business feasibility.

Finally a decision is made as to whether a project should continue into new product development.

Many of the approaches and techniques used with idea-driven FEI can also be used with opportunity-driven innovation. It is primarily the starting point that differs.

Just as there are a variety of ways that ideas can be generated, so too are there many ways for opportunities to be identified. Working with customers and users can be one of the most effective.

Working with customers

Traditional product development is often an unstructured ping-pong match between the firm and a customer. The match begins when the firm develops a prototype based on poor information provided by the customer. The customer then tries the product, identifies many flaws, and submits corrections. This cycle is repeated until a reasonable solution has been developed. The process is often costly and time-consuming.

This highlights the importance of gaining market information early in the innovation process, in a more structured manner, in order to acquire all of the critical information needed at each stage of a successful innovation process.

Existing customers

There is evidence to suggest that a focus on serving existing customers can be bad for a firm. It can lead to the development of similar products, R&D myopia, and a reduction in the organisation's innovative capabilities. Serving these customers can act as a barrier to the development of radically new products. However, engaging with users can lead to pioneering innovations, as has been observed in a wide variety of industries, including semiconductors and electronic process equipment, chemicals, scientific instrumentation, medical devices and sports equipment. In such cases, customer-generated products have often been developed ahead of industry trends and have been the first to be adopted by other users. They have the added benefit of being developed in a more cost-efficient fashion than the organisation's own innovations.

Working with customers and users is challenging. Listening to existing customers can hinder the firm because these customers are bounded by their own experiences and are often unable to imagine improvements to, or alternative applications for, a product. On the other hand, customers are aware of what they want and will innovate in an attempt to solve their needs. The problem then is that they are often ignored or their ideas are not integrated effectively into the organisation's innovation process. This presents the twin challenges of how to draw out latent needs from customers, and how to engage with those customers who have ideas for improvements.

Customer research

Customer research methods such as focus groups, interviews, brainstorming and surveys have been used by organisations to inform R&D for some time. Traditionally these approaches do not involve the active participation of customers in the innovation process, instead they are used to collect data on customers' preferences which are then fed into the new product design process.

While these methods are relatively fast and easy to conduct, they do not tend to result in innovative ideas. Questions focus on identifying the required solution rather than the desired outcome. A Global R&D Collaborations Portfolio Manager commented: "Sometimes people don't come to you with a problem, they come with what they perceive to be their preferred solution."

Steve Jobs recognised another issue when talking to customers in this way and is on record as saying: "You can't just ask customers what they want and then try to give that to them. By the time you get it built, they'll want something new."

Rather than asking customers to identify solutions to their problems, focus should be on identifying what customers would like a new product to do for them. Or as Jobs said: "You've got to start with the customer experience and work back toward the technology – not the other way around." This is challenging because the customer's knowledge of what they want is tacit. Accessing this tacit knowledge demands close interaction.

Customer-centred innovation

This can be achieved through customer-centred innovation, where the innovation is done in partnership with customers, so that company and customer innovate together in a collaborative fashion. While data on customer preferences may be used, the emphasis is on the development of divergent concepts and solutions by customers in a known or controlled

How Mars tries to understand a customer's shopping experience

Mars conducts what it terms 'safaris' to help develop new shopping experiences for customers. These involve going shopping with the customer and exploring the supermarket environment.

The researcher asks questions about how the customer shops. Do they fill a big trolley once a week for the entire family? Or do they have a supermarket nearby where they go after work, without really having a shopping list – just looking around and remembering a few things they want?

It is not enough though to simply observe customers' behaviours. It is necessary to get to understand the reasons for their behaviour:

Why do they walk up and down the aisle?
Why do they park their trolley at the end?
Why did they choose this product? Why is it easier to carry?

environment, with customers then able to react to these proposed designs and solutions. Approaches for conducting customer-centred innovation include ethnography, customer toolkits and living labs.

Ethnography

Ethnography involves researchers observing customers as they go about their everyday lives, often over days or weeks, in order to understand customers' dreams, histories, hopes, memories and experiences. Through this insights can be gained into the values and needs of these customers.

For some companies, observing customers in their own environment is their primary method of learning about the customers' latent and unformulated needs. Mars terms their 'expeditions' to observe customers in their natural habitats as 'safaris'. As a method it involves innovators immersing themselves in their customers' daily lives, with 'need seekers' attempting to identify new insights and assess opportunity potentials through close contact with customers. Ethnographic approaches involve the collection of tacit knowledge: feelings, values, and perceptions. These need to be observed and identified and are best done within the user's normal environment.

Planning an ethnographic study

When planning an ethnographic study there are a number of questions the investigators need to answer:

- Who will you observe?
- How will they be observed?
- When will they be observed?
- Where will they be observed?
- How many people will you observe?
- How long will the study take?

Having planned the study and identified the participants, questions that the investigator seeks to answer while observing the participants could include:

- Why is the person using this product or service?
- What is the job to be done?
- What are their expectations?
- Are they using the product or service as designed, or in an unexpected way?
- How does the person appear to feel about the product or service?
- Do cultural needs, barriers or misunderstandings affect the use of the product or service?

Challenges

A major challenge of using ethnographic approaches is the difficulty of interpreting customers' behaviours, responses and emotions. This requires specific skills. Those conducting the study need to have the observational and interpretation skills to understand the customer's behaviour and to be able to identify the underlying reasons for it.

Another challenge is transferring what has been learned to the management team. One way to tackle this is by having designers go out into the field with the researcher, so they can help transfer learning back to the organisation. Another way is to use audio and video recordings, so that these can be used to share moments where insights were garnered. The challenge of using such devices is their potential intrusiveness. Video cameras could alter customers' behaviours, and so bring into question the validity of the data. "It takes a while before customers can ignore the camera.

Getting expert help

IDEO, a design company uses teams of social anthropologists and designers for ethnographic studies. Social anthropologists have the skills to interpret behaviour, while the designers help to transfer insights back to the organisation.

We are wasting time, valuable information, and customers' behaviours might be distorted as a result," commented one Innovation Programme Manager.

Any existing assumptions held by the organisation, or by those in the field, must be overcome in ethnographic research as otherwise customers' behaviours may be misinterpreted. The reasons for these assumptions can be due to culture, race, age, gender and much more. As the Innovation Programme Manager pointed out: "We are talking about Generation X, Generation Y and baby boomers, and their attitudes may be very different to those of the person conducting the research. It is critical to understand the differences, and never to make assumptions."

It is necessary to try to avoid embellishment, interpretation and judgement when conducting ethnographic studies. Furthermore, investigators should have humility and remain curious. Humility in terms of recognising that they do not understand the values and desired outcomes from the customer's perspective, and curiosity in terms of continuously striving to learn more about the customer's changing needs.

Customer toolkits and living labs

Along with ethnographic approaches, customer toolkits and living labs can be used to keep the customer at the centre of the innovation process.

Customer toolkits

Customer toolkits enable product-oriented firms to build their understanding of customer needs by equipping customers with an appropriate toolkit. There can be real advantages to such an approach as toolkits are often very specific to a firm's production system, setting boundaries within which customers have the autonomy to innovate and develop products. In addition, transferring responsibility for gathering information about customer needs to customers, makes it easier to access tacit knowledge, the type that is very difficult to acquire and transfer.

A downside to this approach is that toolkits do not always lead to efficient idea creation. Instead of remaining a representative user, the customer becomes a developer, responsible for designing products that will be profitable for the company, and begins to put the interests of the company ahead of their own. One customer said: "Although it was a superb design for me as a user, I could not imagine how your company would be able to capitalise on it, so I dropped it."

Living labs

Living labs are infrastructures within companies and research firms which attempt to reproduce a real-life environment in a controlled context. This enables the company to collaborate with customers on developing, designing, defining and validating new products. Customers' participation can take the form of dialogue cafés, story-telling and focus groups.

Living labs are very complex initiatives that are more than physical facilities, requiring specific skills and competences to manage customers' involvement, including choosing appropriate users and analysing the data gathered. While the living lab approach has proved to be a very practical technique for new product development, allowing customers to test prototypes for further development, the artificial setting may not accurately reflect the customer's natural environment.

Design thinking

The IDEO approach

Customer experience is at the heart of design thinking. The most famous exponent of design thinking is the design consultancy IDEO, which uses a five step process (Figure 9) to satisfy its client's briefs. Within this process ethnographic techniques play a significant part.

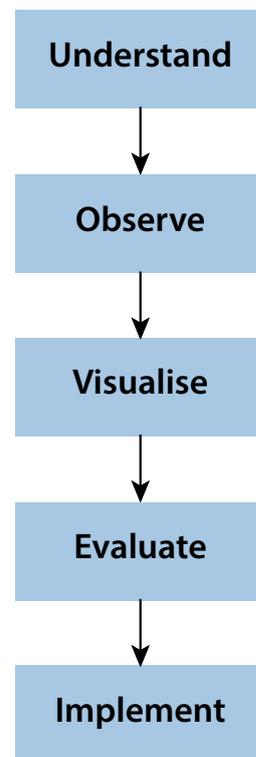


Figure 9. The IDEO approach

An underlying philosophy of the IDEO approach is known as FLOSS:

Failure: don't be afraid to take risks

Left-handed: not all users are like you

Out there: don't just sit at your desk

Sloppy: prototypes don't need to be perfect

Stupid: don't try to be too clever or presume you know it all.

Stage 1: Understand The project team meets to get a handle on the problem and get inside the minds of potential users. This includes considering business, marketing and technical issues such as identifying who the competitors and customers are, what technologies can be utilised and which users should be involved during the observation phase. This stage also includes generating some initial product ideas and insights.

Stage 2: Observe This involves conducting ethnographic studies of existing and potential users of the product or service to provide insights into what customers do and don't want. The ethnographic studies involve teams comprising human scientists

“Traditional market research asks people questions about what they do and the design is based on what they say. But there is a difference between what they say they do, and what they really do. IDEO observational research deals with what people are really doing and feeling.” Tom Kelley, IDEO

and designers. Using the information gathered, the team is able to generate user profiles and usability requirements, along with defining functional specifications.

Stage 3: Visualise This involves the development of detailed scenarios that demonstrate how customers might use a product or service. These scenarios can take the form of storyboards, videos or physical prototypes.

The studies enable designers “to build empathy with users on site and start thinking creatively about how they can improve things”. David Kelley, IDEO

Stage 4: Evaluate The team reviews the options that emerged from Stage 3, and refines the working design. During these two stages the idea is to develop concepts and options and expose these to customers in order to refine the working designs, a process that David Kelley of IDEO describes as “faking the future”.

“We build lots and lots of imperfect prototypes, not because we've got the right answer, but to get responses from buyers and users. Then we can respond to their comments and fix their complaints,” explained a Head of Development. “Our design process is like a spiral. We're into multiple realisations of what the future can be.”

Another manager commented: “Essentially what we are doing is we are prototyping until we believe we've met the needs of the consumer. At that point we freeze the design.”

Tools	Description
Visualisation	Using imagery to envision possibilities and bring them to life
Journey mapping	Assessing the existing experience through the customer's eyes
Value chain analysis	Assessing the current value chain that supports the customer's journey
Mind mapping	Generating insights from exploration activities and using these to create design criteria
Brainstorming	Generating new possibilities and new alternative business models
Concept development	Assembling innovative elements into a coherent alternative solution that can be explored and evaluated
Assumption testing	Isolating and testing the key assumptions that will drive the success or failure of a concept
Rapid prototyping	Expressing a new concept in a tangible form for exploration, testing and refinement
Customer co-creation	Enrolling customers to participate in creating the solution that best meets their needs
Learning launch	Creating an affordable experiment that lets customers experience the new solution over an extended period of time, to test key assumptions with market data

Table 4. Ten tools for use in design thinking (From ‘Designing for growth: A design thinking tool kit for managers’ by Liedtka and Ogilvie.)

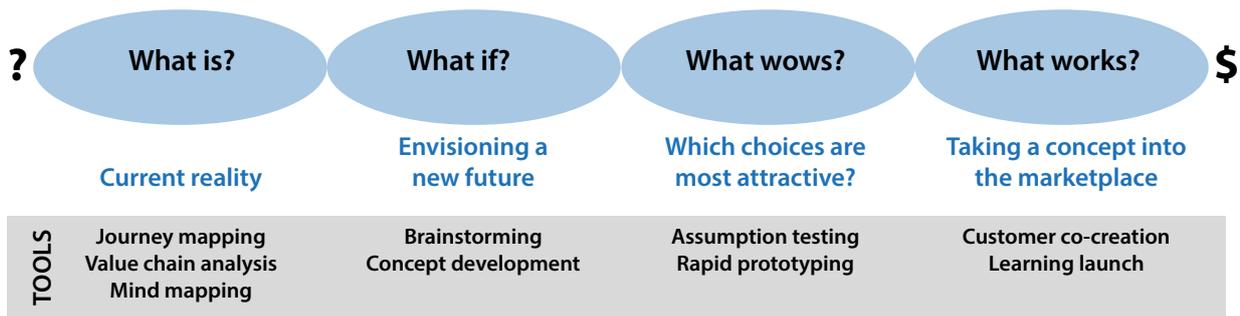


Figure 10. A four-stage, design thinking approach using ten tools. ‘Visualisation’ is not shown as it is a tool common to all four stages.

Stage 5: Implement The first four stages of the process are highly user-centred. At the fifth stage the emphasis shifts towards the client and the focus is on engineering design and manufacturing considerations. The decisions made will depend on the resources and capabilities of the client.

These four project management aids can be used in an integrated fashion to help structure the process, with the project team choosing the tools it needs to progress the project from inception to final concept definition.

Tools to support design thinking

Another approach to design thinking is depicted in Figure 10, a four-stage process in which ten tools can be used in sequence (Table 4). Each stage involves divergence to explore possibilities, followed by convergence around selected options, with a high-level trend of convergence towards a consensus.

Specific milestones, or gates, occur during this process before each new stage, supported by four project management aids:

- **Design brief:** clarifies the intent of the project at the start of the process. It defines the goals, resources and timeframe and acts as a navigational aid to prevent the project team from deviating too far.
- **Design criteria:** establishes the criteria by which different design concepts will be judged. It can be incorporated into the design brief.
- **Napkin pitch:** used to compare a small number of design concepts.
- **Learning guide:** helps to define what resources should be invested in the highest-ranked design concepts.

Improving the front end of innovation

This practice guide has described two distinct approaches to the front end of innovation: idea-driven and opportunity-driven. Although these two types are different, they also share a number of common features and benefit from similar tactics to overcome some of the challenges involved.

Tactics to improve the front end of innovation

- Formalising the process
- Providing resources for exploration
- Articulating clear product strategies
- Allocating resources to the front end
- Defining the project and product concept
- Supporting innovation champions
- Creating cross-functional projects
- Building communication

These approaches are discussed in more detail below.

Formalising the process

The resources, capabilities, size, location and markets of each firm vary considerably, with the result that FEI is different for each company. At one end of the spectrum, particularly in smaller organisations, the front end process, activities and roles will be very loosely defined. At the other end, organisations will have a well-documented process with clear entry points for new ideas and opportunities, and individuals responsible for different aspects of the process.

Some of the costs of a poorly functioning FEI were outlined at the beginning of this guide. While using a formalised process is not a guarantee that mistakes will be avoided, defining it more clearly can help remove ambiguity, both for those responsible for managing the early stages of innovation, and for those who provide the inputs and carry out the activities.

A more informal process could make it difficult for good ideas and opportunities to gain support. In such cases it can require considerable energy to find resource holders and persuade them to support the project. “The process is often about trying to go around the organisation and excite someone to give

How structure can improve decision making

An idea was brought to an operations director at a plant in South America. Recognising its merits, he decided to bypass the stage gate process normally used by the company for new process development and go straight to commercialisation. Although the idea proved to be highly successful in the business unit involved, problems emerged when trying to coordinate with other business units and transfer the learning to them.

It was recognised that global rather than regional leadership would have helped improve coordination, and that a global commercialisation strategy would have enabled each business unit to benefit from the innovation. If the idea had been fed into a structured front end process then it would have become more visible to the global business. The management team at the front end would then have been able to decide whether it was best to follow the normal process or to fast-track this particular technology.

you some money to carry out the next step,” explained a Global R&D Collaborations Portfolio Manager. “It can be quite a lengthy process to find someone who is commercially interested in that particular technology, unless you are in an area where the company already has some funding for that type of work.” This often leads to nothing happening as people ultimately lose the will to take it forward.

While it can be very easy to get excited about new possibilities at the front end, it’s also important to be able to turn down opportunities that aren’t very attractive, or don’t fit with the company’s objectives,

When a less formal process is required

One company uses a stage-gate type process at the front end, albeit one that has very flexible gates. The firm wants to be aware of new concepts that are developing in the early stages and how they might progress on to product development and form new lines of business. At the same time, it wants to avoid overburdening those working at the front end with bureaucracy.

An Operations Manager commented: “A lot of these creatives don’t want to write a business case for every piece of work they do.” In this part of the organisation there are no timesheets and employees are afforded quite a bit of freedom in terms of how they undertake their research.

before they start to consume resources. Once projects are underway it can be difficult to stop them, particularly if they are a pet project of a senior manager. As one Innovation Programme Manager admitted: “We’re not very good at stopping things.” The cost of cancellation at the front end is very low and is an option that needs to be exercised judiciously.

Having formal processes in place can help improve the overall effectiveness of the front end. However, there may also be special cases when an alternative process is required. For example, a concept that is identified as particularly promising at one of the selection stages may need to diverge from the standard process and be fast-tracked.

Providing resources for exploration

It is important to have time, freedom and resources to experiment and explore new ideas if innovations are to emerge and develop successfully. Companies approach these very early stages of innovation in different ways – some more formally than others. 3M and Google have at times allowed their employees to spend 15% and 20% of their time respectively on such exploratory endeavours. These firms are extreme outliers, however. Another company interviewed allows its employees to spend up to 4% of their time exploring new ideas that have emerged during their work. However, commercial pressures mean that this actually acts as a target rather than a limit. In fact few employees manage to dedicate even 4% of their time to work that is not directly linked to their current projects.

Supporting exploratory work

One company initially uses an informal process for such exploratory work. Employees can book two to three hours each week for these activities. What they do with that time is at their discretion. One IP Manager commented: “I was quite worried when we first put it in place that we were going to have it all spent in the first month and no one would remember what they did. But actually I would say we’ve underspent it, or only just spent it, every year.” Although the scheme is well known around the company and there are people advocating its use, employees often do not get round to using it, thinking perhaps that they will save the time up for when they really need it. The reporting required for this informal mechanism is very lightweight, with the need for only a very short email message from the individual describing the results of their experiments. These short reports are sent to the front end manager, then collated and used as inputs to a more formal process.

The company’s more formal process allows individuals to access funds of between £5,000 and £120,000. The process begins with the submission of a short proposal. A one page template is used, providing a structure to help the applicants think about their resource requirements and anticipated outcomes and benefits, and to aid those reviewing the proposal. A cross-functional group meets every six to eight weeks to review the proposals, providing recommendations to the research director. The group might simply recommend whether or not to fund a project, or it might suggest dividing the project into a number of phases, or to assign a specific mentor to provide support.

Another company asks employees to write down five lines describing their project when emailing a proposal to the technology director. The director will then provide a few resources and allow some time to be committed to the proposal’s development, while also overseeing the project. Applicants can use up to 20% of their time on such projects. No end time is set. An Industry Sector Manager commented: “If you don’t know how much time or money you will use, you just type in the maximum.”

Articulating clear product strategies

Companies need clear strategies to guide their decision-making when selecting which ideas and opportunities to pursue. If such product strategies are not in place, or if the strategy is not linked clearly to activities at the front end, then problems can arise.

To support effective go/no-go decision-making an effective product strategy needs to formulate and communicate:

- A clear strategic vision
- A product-platform strategy
- A product-line strategy

Having such strategies in place, and linking them to the front end, makes it simpler to assess the value of an idea or opportunity for the organisation.

One company has a team of directors who are responsible for steering the direction of innovations from an early stage. They look ahead to the next five, ten and twenty years and try to ensure that new concepts stay close to the strategic aims of the company. Emerging concepts receive continued support provided they match these strategic aims, offer a sufficiently compelling customer proposition and are expected to have a large enough market. Otherwise support is withdrawn.

Allocating resources to the front end

Time pressures can make it difficult to operate an idea management system effectively. One manager admitted that they didn't have sufficient time to manage their computer-based system. Due to other work commitments it can be several weeks before submissions are reviewed.

"We could potentially be missing out on huge opportunities because, firstly, I'm not looking at the ideas often enough, and secondly, people I do send the ideas to don't give me any feedback." Global Technology Manager

Further problems can then arise once the review process is initiated. Reviews are conducted on a distributed basis with multiple individuals providing feedback. However, reviewers also find it difficult to fit this activity into their work schedule. In some instances, even after prompting, no feedback had been received and the proposal was placed in the idea repository without having been reviewed. As a global technology manager commented: "We could potentially be missing out on huge opportunities because, firstly, I'm not looking at the ideas often enough, and secondly, people I do send the ideas to don't give me any feedback." This problem results from inadequate resources being allocated to the front end process and the job not being a sufficiently large part of anyone's remit.

Allocating resources to the front end is also necessary to ensure that funding continues to be invested

in exploratory activities. "If it's not the core day business, when resources or money become short it is always the first thing that gets cut," said a Global R&D Collaborations Portfolio Manager. Such a situation is far from uncommon. When an organisation's financial position becomes more

Senior management 'scouts'

Senior management can be involved in proposing new projects. A senior engineer at one company frequently comes across new pieces of research, ideas and opportunities and is therefore able to perform a scouting function. When he sees something that he thinks needs to be pursued he puts together an opportunity description and feeds that description into the review process.

At another company, the Head of R&D may identify an interesting area for investigation. He then tells someone to "go away and come back with a concept". That person assembles a team to study the area. This often leads to a 'white paper' providing the organisation with more information about this particular subject.

Pet projects

Senior figures, who are aware of company strategy and have the ability to allocate resources, can steer new ideas they come across into the front end process. However, they may also circumvent the formal process. In this case, 'pet projects' can result which continue to receive funding even when feasibility studies have failed or it has been shown to have no business case.

A Head of Technology commented: "Sometimes these pet projects turn out to be good ones. But sometimes they fail and they just disappear off the radar and nobody has any idea about how much resource they've consumed."

While there is a danger these pet projects can become a drain on resources, attempts can be made to prevent investments being misplaced by having independent parties involved in the review process.

precarious, funding for exploratory activities is often removed, despite the recognition that the outputs of such activities could prove beneficial in the medium and longer term. The adoption of a more formalised front end can help ensure that funding remains allocated for early-stage projects. Furthermore, it should mean that once funds have been allocated to specific projects, these projects are only terminated if their feasibility is low or an opportunity is unattractive – rather than as a result of short-term business pressures.

Defining the project and product concept

The benefits of having well-defined project and product concepts are numerous. Amongst other things, they provide a better understanding of the necessary development time and costs, the technical expertise and project personnel required, and the organisational fit. Altogether, having a well-defined product concept helps avoid those project decisions that could have painful consequences for the organisation later on. It also helps to identify showstoppers – the critical problems that mean the project should be cancelled. If these are not identified during the product definition stage, they will surface later on, during the development phase, with far greater consequences for resource allocation and the product portfolio.

A project charter is one means of establishing a clear project concept. It can be used at the beginning of a project to define the project scope and then referred to later on to steer the project in a consistent direction. The content of the project charter should be similar to the previously described design brief. This could be anything from a single page document to something that is several pages long. For projects originating in R&D, such a charter might set out the technology to be used, how and where it might be used, the alignment of the project to the business, and the project sponsor. As the project progresses, this charter may be expanded to include additional information that has been generated, so that it continues to help define and realise the project's objectives.

Supporting innovation champions

Building support for an innovation can be a highly demanding experience; setbacks, organisational resistance, and frustration are all normal parts of the process. Enthusiasm, energy and persistence are required in order to drive innovation at the front

end. Individuals who possess these qualities are very important. A number of general characteristics of such 'innovation champions' have been identified:

- Recognising the potential of a new technology or market opportunity
- Adopting the project as his or her own
- Committing personally to the project
- Generating support from other people in the organisation
- Advocating the project vigorously

Product champions are particularly important for more radical forms of innovation, where there is significant technical novelty. Without their support, these more radical projects are likely to disappear.

Furthermore, a highly significant characteristic of product champions is their responsiveness to high-level strategy. If the organisation's vision and strategy is clearly communicated then product champions are more likely to funnel their energies into identifying appropriate ideas and opportunities and developing product concepts that can fulfil this vision.

Creating cross-functional projects

Cross-functionality has long been recognised as an important requirement in new product development. It has an even greater importance at the front end. Involving different functional groups early in the process can help to define product requirements.

While cross-functional working can often be a process of accommodation and compromise, such an approach can help identify showstoppers before major decisions and investments have been made. One company described how their front end teams are designed to be multi-skilled, ensuring a project is looked at from different perspectives. In addition, other people with specific skills can be brought into the team from elsewhere in the company if necessary. Teams are co-located so that barriers to communication between team members are reduced.

Advantages of ensuring cross-functionality in the front end include:

- Facilitating mutual understanding, communication and good relationships
- Enhancing the transfer of ideas and technology between functional groups
- Minimising resistance
- Reducing ambiguity by establishing an early understanding of other functions' capabilities and limitations

A lesson from Lotus

The development of the Lotus Elise illustrates the type of problems that can arise when cross-functionality is not built into the process early on. At the beginning of the project the team discussed how drivers and passengers would get in and out of the vehicle. After considering a variety of possibilities, including a gullwing design, the team decided that the vehicle would be doorless. However, midway through product development the team heard from a vehicle legislation engineer that there were regulations governing 'step-in' vehicles. The engineer had not been involved at the product definition stage of the vehicle.

To satisfy the regulations and retain a doorless design the team would either need to incorporate running boards to assist entry into the vehicle, or lower the height of the entry point by 30mm. As the project manager, commented: "It's going to mean quite a major carve up to the whole concept of the car". The styling division were opposed to both of these options and the team reluctantly decided to change the product concept and give the vehicle doors, a significant decision late in the project that cost Lotus nearly half a million pounds.

This example also shows the importance of establishing the product definition early on, to avoid making significant changes with each new piece of engineering or legal information.

idea stimulation and opportunity identification. One company runs lunchtime sessions every two months when – in exchange for lunch – participants can hear about recent exploratory projects. These sessions describe why the project was set up, what has taken place, what the outputs were and what is being done with these outputs. Presentations are also recorded and made available on the company intranet for those unable to attend. The purpose of the lunchtime sessions is not just to communicate success stories. As one IP Manager explained: "We pick both successful and unsuccessful projects, because it's important that people see that there isn't always a successful outcome – and that that's okay because we are a research organisation."

These kinds of messages concerning the acceptability of experimental failures are important; employees need to feel that they have the ability to try things without the fear of punishment or ridicule.

The second purpose of the lunchtime sessions is to encourage the development of social networks across the different parts of the business. Research groups in particular can become quite insular and scientists and engineers from within these groups need to be brought into contact with those in other groups and functions. Some of the lunchtime sessions at this particular company involved interactive discussion, with different departments considering a particular challenge or technology from a variety of perspectives and seeing what they could learn from each other. While participation is entirely voluntary, the sessions have the additional benefit of allowing individuals to count the time invested as part of their continuing professional development record.

Overall, activities like the lunchtime sessions motivate people to meet and get to know each other better, and to improve the visibility of their respective fields of expertise and research interests.

Building communication

Communication is important as it can help improve the visibility of front end activities and provide clear guidelines for employees to follow. In addition to formalising the process, internal marketing needs to be conducted so that people are both aware of the process and know how they can engage with it. The use of newsletters, both printed and electronic, company intranets, blogs, wikis and notice boards are common approaches used by companies to help with internal communication.

Face-to-face communication remains one of the most powerful mechanisms for knowledge transfer,

Conclusions

This guide has described two types of front end: idea-driven and opportunity-driven. It should be clear from the models presented that both ideas and opportunities need to be identified if preliminary feasibility studies are to proceed. Such studies should occur as part of a formal, front end process that provides the funding and resources needed for exploratory activities, and which is in line with the organisation's strategic vision.

Establishing a culture of innovation

Innovation cannot come about without the energy and actions of individuals. Communicating the organisation's strategy to them is important so that they know where to focus their efforts. Potential innovators need to be given information about how to provide inputs to the front end and how to get resources to develop their proposals.

Feedback needs to be given to innovators and the organisation as a whole about front end activities, including both successes and failures, to allow everyone to learn from these experiences.

Embedding these types of practices helps to establish an innovation culture within the organisation.

Getting it right at the front end

While an innovation culture can be thought of as applying to the whole organisation, the characteristics of the front end are different to those of new product development.

Getting the culture right at the front end is very important for the rest of the innovation process. Some of the factors that contribute towards a culture of innovation, and which organisations need to think about, include having compelling challenges that allow people to become committed emotionally to projects; an environment that supports risk-taking and acceptance of failure; trust and openness so that people can speak their minds and offer differing opinions; and sufficient time for people to think ideas through before having to act.

Committing sufficient time and resource to these early stages will deliver significant savings in the long run, improving the effectiveness of the innovation process and avoiding unnecessary project failures.

Reading list

Amabile, T.M. (1997) *Motivating creativity in organisations: on doing what you love and loving what you do*. California Management Review, 40(1): 39-58.

Antorini, Y. M., Muñoz, A.M. and Askildsen, R. (2012) *Collaborating with customer communities: Lessons from the LEGO group*. Sloan Management Review, 53(3): 73-79.

Boeddrich, H.J. (2004) *Ideas in the Workplace: A New Approach Towards Organizing the Fuzzy Front End of the Innovation Process, Creativity and Innovation Management*, 13(4): 274-285.

Cooper, R.G., Edgett, S.J. and Kleinschmidt, E.J. (2002) *Optimizing the stage-gate process: What best-practice companies do*. Research-Technology Management, 5(1): 21-27.

DeSouza, K.C., Awazu, Y., Jha, S., Dombrowski, C., Papagari, S., Baloh, P. and Kim, J.Y. (2008) *Customer-driven innovation*. Research-Technology Management, 51(3): 35-44.

Eisenberg, I. (2011) *Lead user research for breakthrough innovation*. Research-Technology Management, 54(1): 50-58.

Guzmán, J.G., Fernández del Carpio, A., Colomo-Palacios, R. and Velasco de Diego, M. (2013) *Living labs for user-driven innovation*. Research-Technology Management, 56(3): 29-39.

Khurana, A. and Rosenthal, S.R. (1997) *Integrating the fuzzy front end of new product development*. MIT Sloan Management Review, 38(2): 103-120.

Kim, J. and Wilemon, D. (2002) *Conceptualizing, assessing, and managing front-end fuzziness in innovation/NPD projects*. R&D Management, 32(4): 269-279.

Koen, P.A., Ajamian, G.M., Boyce, S., Clamen, A., Fisher, E., Foutoulakis, S., Johnson, A., Puri, P. and Seibert, R. (2001) *Fuzzy Front End: Effective methods, tools, and techniques*. In Belliveau, P., Griffin, A. and Somermeyer, S. (Eds) *The PDMA Toolbook for New Product Development*, pp. 5-35, New York, NY: Wiley.

Liedtka, J. and Ogilvie, T. (2011) *Designing for growth: A design thinking tool kit for managers*. New York: Columbia University Press

Myerson, J. (2001) *IDEO: Masters of innovation*. London: Laurence King.

von Hippel, E.A., Ogawa, S. and de Jong, J.P.J. (2011) *The age of the consumer-innovator* MIT Sloan Management Review, 53(1): 27-35.

About the authors

Dr Simon Ford is a Senior Research Associate at the Centre for Technology Management at the Institute for Manufacturing, University of Cambridge and a Visiting Associate Professor at the Hong Kong Polytechnic University. His research primarily revolves around the organisation of innovation in established firms, industrial emergence and evolution, and the development of serious games. He is a co-author of two other practitioner guides: *Organising for breakthrough innovation: Rejuvenating the established firm* and *Technology acquisitions: a guided approach to technology acquisition and protection decisions*.

Clémence Aubert is a Department Manager at DECATHLON in Paris where she is responsible for developing and implementing the commercial strategy for her team. She previously studied at the Institute for Manufacturing, completing her dissertation on *Removing the fuzziness of the fuzzy front end of new product development through customer involvement*.

Emmanuelle Ryckewaert is a Supply Chain Project Manager at Guerbet in Paris. Her work involves the optimisation of planning processes, and establishing and monitoring performance indicators. She previously studied at the Institute for Manufacturing, completing her dissertation on *Supporting innovation through computer-based idea management systems*.

INSTITUTE FOR MANUFACTURING (IfM)

The IfM is part of the University of Cambridge. It brings together expertise in management, technology and policy to address the full spectrum of issues which can help industry and governments create sustainable economic growth.

MANAGEMENT: covers a wide range of topics including the development of sustainable industrial practice, capturing value from innovation, optimising global operations networks and moving from product to service-based models. The IfM is an international centre of excellence for roadmapping, a powerful technique for aligning technology and business strategies.

TECHNOLOGY: inkjet and laser-based manufacturing process technologies, carbon nanomaterials, advanced information systems and automated identification technologies, all with a wide range of industrial applications.

POLICY: programmes, processes and practices for translating publicly-funded R&D (in particular science and engineering research) into new technologies, industries and economic wealth.

In each of these areas of expertise, the IfM carries out:

RESEARCH: bringing together specialists in management, technology and policy to provide a unique perspective on the challenges facing manufacturers of all sizes, from start-ups to multinationals.

EDUCATION: giving the next generation of manufacturing leaders a thorough grounding in management and manufacturing technology, based on real industrial experience.

PRACTICE: applying IfM research to help organisations achieve their strategic goals. Findings from these projects directly inform future research.

CENTRE FOR TECHNOLOGY MANAGEMENT (CTM)

CTM engages in research, teaching and practical application of new ideas based on an integrated understanding of science, engineering and business management. By working with organisations at all stages of technological development, CTM aims to provide comprehensive support from early stage exploration, through multi-business unit technology strategy to end-of-life issues.

**Institute for Manufacturing,
17 Charles Babbage Road,
Cambridge CB3 0FS
United Kingdom
T: +44 (0)1223 766141
E: ifm-enquiries@eng.cam.ac.uk
W: www.ifm.eng.cam.ac.uk**

