Beyond Business Models : Why Innovation Needs an Impact Model

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Résumé :

Nous soutenons que les business models, en tant que composante du design d'une innovation, ne constituent pas un moyen d'évaluation de leurs effets. Nous soutenons également que, d'un point de vue logique, toute approche de création d'innovations s'appuyant sur une phase divergente de génération d'idées ne peut pas garantir la meilleure idée possible, pour des contextes, objectifs et contraintes donnés. Nous proposons un "Modèle d'Impact" permettant de projeter les impacts d'une innovation par rapport aux alternatives; et une approche de "Design by Impact" utilisant ce modèle pour créer des innovations de façon analytique, déductive et convergente, en allant de leurs fonctions idéales à leur forme. Cette approche réduirait la dépendance à la créativité dans le processus de conception, permettrait de générer la meilleure idée possible et améliorerait l'efficacité globale du processus d'innovation.

Mots-clés : innovation, innovation front-end, business model, création de valeur

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INTRODUCTION

Numerous studies have shown that more than a significant lever of competitive advantage (Pil and Cohen, 2006), innovation goes so far as influencing the very survival of firms (Baregheh et al., 2009; Morris, 2013; Zizlavsky, 2013). However, despite (or because of) its relevance, the term "innovation" suffers from a large number and diversity of definitions (Rogers, 1998; Keupp et al., 2012; Zizavsky, 2013). The Oslo Manual (2005) defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." While this definition is widely used by scholars and practitioners, it considers the innovation at the implementation stage. Yet, there are many challenges that arise at the conception stage of the innovation, which is often referred to as the "invention stage". For practical purposes, as our work of business design takes place at the very beginning of the innovation process, we use the same term, "innovation", to designate the concept in creation, for all its different future phases of evolution, from the idea stage to the effective availability. We define "innovation" as "the availability of a new possible choice of solution for users to accomplish something", that is, a very functional perspective, covering any type of innovation.

As a consulting firm, we have been accompanying diverse organizations in their innovation projects for many years. From startups to international groups, but also non-profit organizations, we have managed hundreds of projects from their early stage on, observed and

collected the actions and decisions, taken or not taken to bring the innovative ideas to reality. This data collection constitutes a significant amount of empirical data, including many cases where the innovation did *not* turn into a sustainable business, despite significant potential at the original *invention* stage. Ideas of applications or pain points were not lacking, but the ability to determine the application/solution with the highest success potential, and then to optimize the business design (that is, what the solution allows, how it gains more users, and its business model) for this specific solution was.

For example, we worked with an international electronics leader on finding mass market applications for NFC tags. They had been working for more than 20 years on the subject, had numerous deployed applications in the B2B market, but, despite their best effort, almost no application took advantage of the nearly 3 billions NFC readers in the smartphones, despite myriads of B2C application ideas. They had excellent technological and executive capacities, but no tool nor method that would allow them to determine the applications with the highest potentials to make a difference for the users, and then to optimize the business design for the application. The firm had spent a considerable amount of time and resources on applications with suboptimal potential, and the wrong business designs. As a result, resources were being wasted and many users' lives were not being improved. How did it happen ?

Currently, at the conception stage, innovation plans and designs very often constitute suboptimal choices of applications, value propositions or customers. In Innovation, most plans fail when confronted with reality; but reality is not to blame, the plans are. The process of analysis and design that led from the idea to the designed innovation is often not sufficient to optimize the success of the innovation. This leads, as we just saw with the previous case, to the waste of a good idea and the resources that were spent in development. We therefore think we need methods to devise better business designs and plans.

The question that emerged was therefore : How can we optimize the conception of innovations so as to systematically maximize their success potential from the conception stage on?

The innovation is made available through a business model, which is the "design or architecture of the value creation, delivery, and capture mechanisms" (Teece, 2010, p.172). This business model is what allows the innovator (in our context, generally a firm) to create and capture value from the innovation. Business models are highly important to the success of an innovation, since they build the activities and resources necessary to exploit it in a profitable way (Chesbrough and Rosenbloom, 2002). They largely influence the success of an innovation, in such a way that the same innovation with two different business models can take a radically different path (Chesbrough, 2010; Brea-Solis et al., 2015). Therefore, it has been an important focus of innovators and has gained significant traction in the academic community as well (Foss and Saebi, 2017, 2018). The discussions surrounding business models and innovation have thus been largely focused on how to optimize the implementation and value extraction from an innovation to maximize the revenue generation for the innovator (Amit and Zott, 2001; Keupp et al., 2012; Snihur et al., 2021).

However, its business model is not enough to guarantee the success of an innovation. The value extracted by the firm is dependent on the adoption of the innovation. This adoption, in turn, depends notably on the perceived value of the innovation in the eye of the user (Sanchez-Fernandez and Iniesta-Bonillo, 2007), but also on the diffusion of the innovation (Rogers, 1998).

The business model is one of the components of the design of the solution, not the evaluation function of its resulting success. To optimize the success of innovations from the conception stage on, we need to see beyond their business model, and build a new perspective.

As Khurana and Rosenthal (1998) point out, the front end of the innovation process, during which the ideas are generated, selected and developed, is considered as the weak link in the global innovation process. Out of 3000 ideas generated, only one goes on to become a success (Stevens and Burley, 1997). Most of the time, ideas are generated in a divergent manner (through brainstorming), without any rigorous way of generating "good" ideas, "good" meaning "that bring the desired success", which generally implies financial benefits. The innovator then faces two problems. Firstly, the innovator has no way of knowing that among all the ideas generated lies the "best possible" idea, which would need exhaustivity of ideas generated. Secondly, having no rigorous and objective way of knowing what a "good" idea is, the innovator could very well reject an idea which would, in fact, be the most successful concept (Burkus, 2013).

Therefore, the ideal front end should allow the innovator to generate "the best idea", in an efficient way. That is this ideal front-end and the requirement needed to make it possible that we will develop in this paper. To this end, we hypothesize that a different approach is needed in the analysis and design process. This approach would seek to model and maximize the impact potential of the innovation, that is, the difference it makes to the life of those who use it, and only then, determine the design choices that will concretise this potential (among others, in monetary value).

We call the modeling tool we use for this step the Impact Model, which allows the modelization of the difference made by the innovation for all users, compared to the other available ways to achieve the same goal. This approach would be non-divergent in nature, and focused on what the innovation allows, rather than what it is. We think that by designing innovations in a way that maximizes the potential for impact, an innovator can maximize the potential for value creation for its entire ecosystem, and thus the potential value they can extract from it with a suited business model.

Our research aims to open a conversation about the way we build the business design of solutions based on innovations, and give practitioners the guidance in innovation conception that has been lacking until now (Keupp et al., 2012). We hope to spark a new perspective on designing more initially successful innovations not through empiricism and experience, but through analytical maximization and valorization of the difference they make in people's lives. We believe the Impact Model allows the innovator to identify how to make the most difference possible and build a business model that exploits it in order to generate maximum revenues.

In a context where the handling of environmental and social issues by firms is increasingly valued by customers, where technologies like AI drastically change the way activities are performed, where global events affect whole industries (notably their supply chains), innovation is more essential than ever. Those innovations that allow firms to tackle these issues should be given all the chances they deserve, and firms should have tools at their disposal that allow them to adapt without fear of uncertainty. The Impact Model aims at reducing this uncertainty, so that firms can allocate resources to the projects that make a real difference in the world.

This article is organized as follows. In the first section, we analyze what the ideal innovation front-end would be. The second section introduces the Impact Model and the design method

that uses it called "design by Impact", which we believe makes this ideal front end possible. The third section describes how we typically use the Impact Model for the conception of innovations.

1. THE IDEAL INNOVATION FRONT-END

Functionally, an Innovation Front-End (IFE) receives a context, objectives, and optionally constraints to be respected, and uses resources to return ideas. In turn, those ideas are transformed into new projects, and eventually into new solutions effectively available for users.

1.1. THOUGHT EXPERIMENT

1.1.1. Initial hypothesis

Hypothesis: Let's consider an Ideal Innovation Front-end (IIFE) that would return the best possible idea for any given initial context, success criteria and constraints.

We'll define the terms used in the hypothesis as follows:

- The "Initial context" is defined as the reference considered when questioning the IIFE, the world without the idea yet to be identified. It includes anything and everything existing, and as such, cannot be expressed or described in its entirety.
- The "success criteria" is defined as the scale of measurement, in nature and quantity, to use for the evaluation of the effects that would result from the ideas.
- The "constraints" is defined as anything that has to be respected regarding the *means* required to obtain the desired resulting effects.
- The "best idea" is defined as the change proposed to the context of reference that will have the most favorable resulting differential effects considering the submitted success criteria, for means respecting the submitted constraints.

As a result, we would have the process presented in Table 1 below:

Table 1: The Ideal Innovation Frond-End

	Question	Answer
Subject	Context, as the reference without the idea to be determined	Proposed new idea in the context
Effects	Expected results, to be measured through success criteria	Projected results of the proposed change
Means	Constraints on the means to achieve the expected results	Projected means required to achieve the projected results

Those definitions allow the questioner of the IIFE (who gives the initial context, the success criteria and constraints and expects an idea from the IIFE) to ask for the best possible idea in any context, considering any measurement of success, and respecting any constraints, in accordance with the initial hypothesis.

1.1.2. Analysis of a possible internal approach for an IIFE

Any approach that would consist in generating ideas before evaluating them would require infinite resources to guarantee the best possible idea. Indeed, even supposing a perfect evaluation method (which is clearly not the case today, as evidenced by the literature), the system could only guarantee recognition of the best idea among the considered ideas. To guarantee the best possible idea, the idea generation phase would require exhaustivity of ideas generation, before idea evaluation and selection, which would require infinite resources. Therefore, from a purely logical standpoint, no approach including a divergent phase for idea generation can become an ideal Innovation Front-End.

Any approach that would respect the initial hypothesis would therefore need to have a convergent process for ideas generation. One such approach could be:

- to start by identifying the best possible effects according to the provided success criteria,

- to analyze what functions would be required to obtain them (a function being composed of a set of inputs, a set of outputs, a relationship between the two, and certain conditions),
- To then identify solutions that could accomplish these functions in the respect of the provided constraints.
- And then, to create a whole from the individual solutions

This approach would guarantee that any solution identified through it would automatically have the best possible effects, and therefore, by our definition, would be the best possible solution.

This approach is commonly used for the design of technical solutions, under the name of "Functional analysis or functional design", but is usually limited to physical or mechanical subjects. For example, engineers derive the best suited form and material composition of a part from the load and constraint it has to be able to withstand. Functional analysis works for "technical" subjects because the coherence of the known scientific framework of units and laws makes it possible to derive a form of solution from the functional objectives and constraints. We propose to create a model that would allow the same approach to be used for business design.

We propose to apply this approach, that we call "Design by Impact", to create a model that would meet the requirements of an ideal Innovation Front-End as determined previously.

1.2. STEP 1: DETERMINING THE BEST POSSIBLE EFFECTS

In this particular case, we only have one user: the questioner of the IIFE. All other actors are users of the idea provided by the IIFE. The context is non-specific and the constraints are non-existent. Therefore, the best possible effects are given in the hypothesis: systematically

providing the questioner with the best possible idea for an innovation, in a given context, success measurement and constraint.

1.3. STEP 2: FUNCTIONAL REQUIREMENTS ANALYSIS

1.3.1. Requirements deriving from the need for universal modelization

All notions (context, idea, constraints, objectives) used in the hypothesis must be able to cover any potential subject with a potential ability for infinite precision, but infinite precision cannot be a requirement on the inputs.

Functional requirement: The system must be based on an information structure that allows representation of anything with infinite precision, but doesn't require infinite information.

1.3.2. Requirements deriving from the notion of "effects"

By hypothesis, the IIFE returns a new idea, destined to become a choice effectively available to users, through implementation by a project. The idea and its implementation require means and have effects.

The effects of something new, something that didn't exist before can be defined as anything that wouldn't have occurred if the new thing didn't exist. But, unless you consider that the world would have ceased to exist if the idea hadn't emerged, the effects are not absolute, but relative. So to evaluate the effect of the new idea, we have to consider the differences of effects its existence implies.

Functional requirement: The system would need the notion of "Impacts", defined as the differences of effects resulting from the appearance of an idea, compared to an alternative, including differences in inputs (the means) as well as in outputs (the results), and through time.

1.3.3. Requirements deriving from the differential notion of "most favourable"

The usage of the expression "Most favorable" implies judgment and comparison ability, in the sense of being able to determine if an impact is a good thing or not. Any relative change in ability resulting from a change of solution by a user can only be judged regarding the goal of the user, and in a context. For example, considering the goal of a user of maintaining a good thermal comfort, in a cold place (context), the isolation abilities of a jumper would be a better option than a t-shirt, but that would not be true in a hot place. This is required for all innovations of the type "What change in a given context would have the most favorable impacts?", often called "Market pull"

Functional requirement: The system would need the ability to evaluate the impact of a solution, in terms of effectiveness, compared to an alternative solution, for a specific goal provided by a user, in a context. The impacts must include differences in inputs (the means) as well as in outputs (the results).

But, sometimes innovations come from an existing technical solution searching for use cases, users, goals and context, which would be what the IIFE would be required to find. This type of approach, "What would this given new ability most favorably impact?", is often called "Techno Push". In terms of requirements, this implies that the impact of a novelty can be evaluated without a specified goal, user or context, but as a transformative function of the solution, defined by its ability to provide specific outputs from specific inputs in a context parametrically defined. In this case, the solution can be judged through its efficiency at providing its outputs, relative to the use of its inputs.

Functional requirement: The system would need the ability to evaluate the impact of a solution compared to another solution, an alternative, in terms of efficiency for producing a considered output (the results), expressed as a function of what is used to obtain it.

1.3.4. Requirements deriving from the notion of "projected results"

The IIFE being used at the very beginning of the innovation process, any result it brings can only be based on projections of potential. But, constraints on the means as well as evaluation of success on the impact depend on the considered time, and the form of the solution evolves through time from the idea stage to the project stage, to the effectively available solution stage.

Functional requirement: The system must be able to project and convey both the required means and the resulting impacts in time.

1.3.5. Requirements deriving from the notion of "form" and "function"

By hypothesis on its function, the IIFE must be able to return an idea to the questioner with enough precision for it to be implementable, which implies information on the form this idea would take. But, at the same time, to meet the criteria of the global approach presented, the system must be able to project the impacts of a solution based solely on a functional view, before finding a form able to produce this function. And because the initial context can be an alternative, the system must be able to derive function from form, so as to allow comparison on impact between two solutions.

Functional requirements:

- *The system must be able to manipulate concepts as functions.*
- *The system must be able to derive the form from the function.*

- *The system must be able to derive function from form*
- *The system must be able to transmit an implementable form for the solution*

1.3.6. Requirements deriving from the human context

Business design is a human activity, to design new solutions for human adoption. As such, any IIFE will need to take human perception into account, while still taking into account the reality of things.

Moreover, there is only one reality, but there are as many perceptions of reality as there are consciousnesses considering it. As a result, projection of impacts in reality requires only one representation, but projection of perception of impact requires the ability, and the obligation, to take into account as many points of view as there are conscious perceptions.

Functional requirements:

- *The system must have the ability to describe reality.*
- *The system must have the ability to describe human perception of reality,*
- *The system must be able to model human evaluation, projection and decision*
- *The system must have the ability to take into account all conscious perceptions of reality.*

1.3.7. Requirements deriving from the analysis/synthesis approach

Functional design and analysis are by essence recursive. The analysis of a function at level n gives a number of input parameters, and each of those parameters can be, in turn, functionally analyzed at level n-1 into sub parameters, and so on. Using this approach, any complex system, such as for example a revolutionary reusable rocket, can be decomposed into bolts, nuts and

other basic functional elements, with a greatly reduced complexity. The same reasoning is true for functional synthesis, this time with increasing complexity.

Functional requirements:

- *The system must have the ability to functionally decompose complexity into lesser level functions, to infinity.*
- *The system must have the ability to functionally synthesize complexity into higher level functions, to infinity.*

1.4. SUMMARY OF THE REQUIREMENTS

The functional analysis has given us the following requirements for an ideal front-end innovation:

- Infinite variety and precision: The system must be based on an information structure that allows representation of anything with infinite precision, but doesn't require infinite information.
- Impacts as effectiveness: The system needs the ability to evaluate the impact of a solution, in terms of effectiveness, compared to an alternative solution, for a specific goal provided by a user, in a context. The impacts must include differences in inputs (the means) as well as in outputs (the results).
- Impacts as efficiency: The system would need the ability to evaluate the impact of a solution compared to another solution, an alternative, in terms of efficiency for producing a considered output (the results), expressed as a function of what is used to obtain it..
- Projection: The system must be able to project and convey both the required means and the resulting impacts in time.

- Functional representation:
    - The system must be able to manipulate concepts as functions.
    - The system must be able to derive form from function.
    - The system must be able to derive function from form.
    - The system must be able to transmit an implementable form for the solution
- Duality human perception/reality:
    - The system must have the ability to describe reality.
    - The system must have the ability to describe human perception of reality,
    - The system must be able to model human evaluation, projection and decision
    - The system must have the ability to take into account all conscious perceptions of reality.
- Functional analysis: The system must have the ability to functionally decompose complexity into lesser level functions, to infinity.
- Functional synthesis: The system must have the ability to functionally synthesize complexity into higher level functions, to infinity.

We have laid out the requirements of an ideal innovation front-end. We present in the next section the main principles of the Impact Model, which allows the "design by impact" approach.

2. THE IMPACT MODEL: MAIN PRINCIPLES

2.1. REPRESENTATION OF INFORMATION

Several solutions exist to satisfy the possibility for infinite variety and precision. The numbering system allows representation of any number from zero to infinity, with infinite precision, but is limited to the expression of quantities. Object oriented programming models concepts in objects, associated with properties (form) and methods (functions). This allows representation

of anything, be it material or conceptual, with complete liberty. It also allows the expression of the function of the thing independently of the form of the thing. And it allows recursivity both in form (an object can be composed of objects and can compose objects) and function (a function can use functions and be used by functions), which will answer the need for infinite analysis and synthesis.

We use this approach to represent information in the Impact Model. The requirements for the ability to integrate human perceptions, evaluations, projections and decisions is also satisfiable by this solution, as all those elements are functions.

As an information model based on a recursive representation of concepts through their form and function, the Impact Model answers the following requirements:

- Infinitive variety and precision
- Functional representation
- Functional analysis
- Functional synthesis

2.2. BUSINESS DESIGN OF THE SOLUTION

Because we need the ability to project the effects of an idea, we need a way to model an idea that allows projections of its effect without knowing its form, as well as a way to transmit its form so as to be able to return the result to the questioner.

- We've seen that we need to model the impact of a solution relative to alternatives.
- Because the impacts of the solution in time depend on the diffusion of the new solution, we'll need to model diffusion.

- Because we need to evaluate the means generated by the solution *in fine*, we need also to evaluate the means needed for the solution to generate impact (and value)

We propose to introduce the notion of "business design", which is composed of:

- A parametric *impact function* relating inputs and outputs resulting from use for the user, resulting from the "functional design" of the innovation.
- A parametric *propagation function* relating uses and diffusion of the new solution, resulting from its "growth engine"
- A parametric value extraction function, resulting from its *"business model"*.

We summarize this business design in Table 2 below

Table 2: The business design of a solution

The idea as form	**The idea as functions**
Functional design	Parametric Impact function
Growth engine	Parametric propagation function
Business model	Parametric value extraction function

This solution satisfies the requirement for projection and functional representation.

2.3. REALITY AND CONSCIOUSNESS

The requirement for concurrent representation and projection of effects, both in the single reality and in the many perceptions of reality (as many as conscious observants) can be answered by using two layers of representation: one for reality, and one reality as it is perceived by a consciousness. We'll define them as "reality layer" and "consciousness layer". Because the Impact Model is parametric, the consciousness layer can be derived from the reality layer through the user's perception filter. The same applies to the required functions of conscious evaluation, projection and decision.

This solution answers the requirement of duality human perceptions/reality.

The requirement for both effectiveness (existence of a considered goal) and efficiency coincide with the separation of layers between reality and consciousness, as only consciousness has a goal. Therefore we need a projective solution for each layer.

The function in the Impact Model will be represented as follows:

In the reality layer: F(SOLUTION,{INPUTS})->{OUTPUTS}, with F the transformation function of the solution of inputs into outputs without any goal involved. Efficiency is measured as the quantity of any considered specific output in regard to the quantity of inputs required to obtain it.

In the consciousness layer: U(SOLUTION, GOAL, {perceived INPUTS})->{Perceived OUTPUTS}, with U the utilization function of the solution that is a reconstitution of the transformation by a consciousness with a goal. Effectiveness is measured as the quantity of perceived desired specific output in regard to the quantity of perceived inputs required to obtain it.

In all of these notations, as the model must be able to function with non-exhaustive information, we only express the known inputs and outputs, but assume there exists unexpressed inputs and outputs.

2.4. IMPACT AND PERCEIVED IMPACT

We define the Impact of an innovation as the difference made in the reality layer by the solution on the inputs and outputs generated, compared to the previous state of reality. We define the perceived Impact of an innovation as the difference its use makes on the life of its users, compared to other ways of achieving the same goal (which we call alternatives). Zeithaml (1988) defines value as "the consumer's overall assessment of the utility of a product based on

perceptions of what is received and what is given" (p.14), implying that value is dependent on what benefits are brought to the user. Furthermore, the literature review by Sanchez-Fernandez and Iniesta-Bonillo (2007) highlights that perceived value is comparative, personal, and situational (Holbrook, 1994); meaning that the value of an innovation depends on the perception of the user, their context, their values, and the available alternatives.

The impact is always dependent on usage: my glasses only make a difference in my life when I wear them. As pointed out by Sanchez-Fernandez and Iniesta-Bonillo (2007) in their literature review on perceived value (on which success is dependent), perceived value implies an interaction between the user and the product. However, if the person is not conscious that the solution is responsible for the effects they are experiencing, then they cannot attribute a value to this solution, and it would be inaccurate to say that the solution is creating value for the user. Therefore, conscious awareness of causality is both necessary and sufficient to have a utilization, and should be taken into account when conceiving a solution.

Impact is also relative: the innovation will have an impact only compared to other solutions. Perceived value is comparative in nature (Sanchez-Fernandez and Iniesta-Bonillo, 2007). Plus, the goal of an innovation is to improve what already exists; thus, we believe the best way to optimize innovations is to always think relatively to what already exists.

Since the innovation is evaluated on the difference it makes when used, the Impact Model is based on what the innovation allows, its function, rather than its nature. Our definition of the term alternative, then, is based on the outcome of the utilization and not on the nature of the solution itself. An alternative, in our scope, is anything that can be used to obtain the same outcome, even if the firm does not consider this solution a competitor. Therefore, we hypothesize that if a new solution offers more of the outcome than its alternatives for the same

amount of resources, or offers the same outcome that its alternatives for a lesser amount of resources, or offers a new outcome that its alternative cannot offer, its perceived value will be higher (if the user can effectively perceive this improvement).

2.5. UTILITIES AS UNITS OF MEASUREMENT

Because anything can be a goal, we'll need to consider anything as a quantifiable unit, which we'll call utility. The value created by a product for a person is dependent on the utility it brings them. We define a utility as anything that can be deemed useful by a human being. Examples of utilities include money, reputation, serenity, acknowledgement, pride, shame, worry…. The literatures in neurosciences and psychology notably have long tried to build typologies and taxonomies of human needs and motives (Wicker et al., 1984; Reiss and Havercamp, 1998; Chulef et al., 2001; Talevich et al., 2017; Desmet & Fokkinga, 2020). These are deemed to be motivators and triggers for human behavior, notably consumption of products and services (Wicker et al., 1984).

To make the modelisation and the methodic maximization of the impact possible, we consider utilities as quantifiable and fungible units in and of themselves, that can only result from utilizations. For example, a sweatshirt can provide utility in the form of thermal isolation, tactile comfort, and image modification.

The utilities as measure of the outputs can express the "what is received" of the definition given by Zeithaml (1988). The "negative" outcomes are unwanted utilities (for example, a solution may bring me comfort but cost me some pride).

The "what is given", can take any form, but can ultimately be expressed in the Impact Model using 3 fundamental constituents:

- Resources that are exchangeable in human civilization, for example monetary resources or properties (For example, the price of a cinema ticket)
- Environmental resources, which covers all that is required but not expressed in the previous category (For example the air you breathe during the movie)
- Time of the user needed for the considered use (for example, the 2+ hours of your time needed to see the movie)

Every use of a solution can be expressed in terms of utility resulting and resources needed to obtain them. By using the utility units and the three fundamental equivalents, the Impact Model allows for an easy comparison of effectiveness and efficiency between solutions.

Depending on the success criteria defined by the questioner, the best solution, relative to the available alternatives, can:

- Bring specific utilities, not obtainable by an alternative,
- Bring specific utilities, obtainable by alternatives, but without the need for a specific resource
- Have a globally better effectiveness at providing given utilities for given resources

This solution answers the requirements for:

- Impacts as effectiveness
- Impacts as efficiency

2.6. EVALUATION FUNCTION: THE GLOBAL IMPACT

We now have to integrate the requirements for projection in the reality layer, as well as in the consciousness layer, which in turn requires exhaustivity of consideration.

When designing an innovation, many methods are based on and limited to the customer perspective. However, this perspective is not suited for the optimization of potential for success, as pointed out for example by Adner (2006), but also Akrich, Callon and Latour (1988). To maximize its chances of success, an innovation must take into account every actor that will be impacted, directly or indirectly, by it. That includes customers, but also partners (like repairers for the product sold), non-customers affected by the innovation, bearer of complementary products and services, etc. All these actors have their own interests and issues.

In the Impact Model, a user is therefore any actor that can consciously receive utility from a use of a solution, even if they did not choose the solution, even if the solution is not utilized directly by them, and even if the result is not desired or desirable. In this definition, every inhabitant and wanderer of Paris is a user of cars even if they never set foot in one, because they are impacted by them (through noise, for example), the instant they become aware of the noise being a result of the cars.

When designing an innovation, considering only customers bears the risk that the firm misses a misalignment of its business model with its users ecosystem, thus putting it at least in a suboptimal position. For example, electric scooters companies like Lime failed to consider pedestrians when designing their free-floating service. But pedestrians complained to public authorities of the scooters left in the middle of the sidewalk. As a consequence, in some cities scooters parkings were created where direct users have to park their scooter at arrival, which deteriorates the utilities brought to them and leads to a suboptimal solution where one of the main advantages, the freedom to take and leave a scooter wherever, is suppressed.

When designing the innovation, all impacts may count, it is therefore essential to consider the entirety of the ecosystem, not only of the firm, but of the innovation itself. Who is conscious of the innovation? Who can potentially benefit or be disadvantaged by the innovation? How can

we optimize the business design so that those disadvantages disappear or are compensated, and the benefits are maximized for all the users in this broader definition?

This ecosystemic perspective satisfies the requirement for exhaustivity of consideration of perceptions.

We define the unitary impact as the difference made in utility for one user and one utilization, in a specific goal and context, compared to the alternatives. They can be expressed as parameters and allow the analysis of their influence, but they don't describe the entirety of the impact of the innovation on human society as a whole, through time.

Therefore, we define a *Global Impact* function for each layer:

- In the reality layer, the global impact will be defined as the sum of all difference created by the considered solution, compared to an alternative
- In the consciousness layer, the global impact will be defined as the sum of all perceived differences created by the considered solution, compared to an alternative

At one point in time, the global impact thus designates the footprint the innovation has left on the human society as a whole. This is the evaluation function used to assess the potential for success of an innovation.

We have presented the main principles of the Impact Model, which allows the design by impact approach of innovation conception. We will now rapidly express the two use cases in which the "design by impact" approach.

3. USE CASES

By hypothesis, the questioner can ask any question to the IIFE, as long as he provides the required information. But to provide an answer, the IIFE can proceed in two ways: from an

existing context to be changed (generally designated as market pull), or from a new ability (the change) to a context in which to insert it (generally designated as techno push).

3.1. "EXISTING CONTEXT LOOKING FOR A NEW SOLUTION"

In this case, the question to answer is: what can I change to the existing context to improve it?

The starting point is a context (generally an activity, a firm, an industry) with a potential for improvement, be it expressed or to be identified. This could be, for example:

- What would be the best way for my firm to benefit from the new expectations of my customers linked to CSR?
- What would be the best change in the organization of my operational teams to improve communication?
- Sometimes the innovator already has a vague idea of what the innovation could be, for example "What would be the best way to optimize my existing business by offering a premium predictive maintenance solution?".

3.2. "NEW SOLUTION LOOKING FOR AN EXISTING CONTEXT"

In this case, the question to answer is: which existing context would be the most improved by changing it through my solution?

The starting point is a solution, generally a newly developed technology, an organizational, a business model, or any specified solution, and the goal is to find the applications that would benefit the most from this solution.

This could be, for example:

- What would be the best application for a fabric that can perfectly burn without smoke or soot?
- What would be the best B2C application for NFC tags?
- What would be the best way to valorize the waste of my current activity?

CONCLUSION

Until now, firms that develop an innovation are mostly focused on the technical feasibility (when applicable) and the business model conception. However, the business model is a constituting element of the design of the innovation, and is not the evaluation function of the resulting success, not anymore than the technical solution is. Moreover, the front end innovation process (which designates the ideation stage of the conception) is mainly considered as problematic and leading to the generation of too many ideas, few of them having an actual potential for success. Our analysis led us to the conclusion that no approach relying on a divergent process to generate ideas can guarantee the emergence of the best possible idea, (given a context, constraints and defined success criteria), without the need for infinite resources.

We propose an alternative, convergent approach to idea generation, the principle of which would be to start from the given criteria for success, deduce the best possible impacts an innovation could have, express the functions needed to obtain those impacts, and decompose them until known or trivial solutions that could accomplish those functions in the respect of the constraint emerge. We call this approach "Design by Impact".

We call Impact Model the model used by that approach, that enables representation of the impacts made by an innovation, that is, the difference in utility brought by the innovation to all users compared to its alternatives. Using the Impact Model, the idea seeker can focus on maximizing the global impact, considering impacts on all users. This implies alignment of the solution for all actors, thus taking into account the innovation's ecosystem rather than the firm's ecosystem.

By designing to maximize the global impact over time, which implies durability, we hypothesize that the firm can increase the value creation potential and value extraction potential of the innovations it develops. Ultimately then, the Impact Model acts as a tool for the conception and design of innovations, by providing a projection of the impact of the innovation as a function of its form, users, goals and context, as a guide.

Our work about this design by impact and the Impact Model constitutes both a theoretical and a managerial contribution.

From a theoretical perspective, it enriches the literature on innovation, and especially innovation conception. Faced with the issue of the "fuzzy" front end of the innovation process, many authors have proposed paths for a better idea selection (Du Preez et al., 2006; Kempe et al., 2012; Schuh et al., 2020). Our paper participates in this discussion and proposes a new approach to idea generation, so that the front end innovation process is not fuzzy anymore.

From a managerial perspective, the Impact Model would act as a guiding tool to maximize the difference an innovation can make for its ecosystem, thus maximizing its chances of success. We believe it can help innovators focus on the right questions and targets, while minimizing the need for creativity. Rather than building an innovation blind, the innovator can analyze how to make the most possible difference and build a business design that benefits from it in order to generate the most revenue for him, through generation of the most favorable impact for the ecosystem.

This article is conceptual in nature. The analysis leading to the model creation is based on logic, and needs to be criticized at this level of abstraction. Although we have used the "design by impact" approach and the "impact model" itself on several projects as well, at this stage, the benefits of the Impact Model for designing innovations needs to be thoroughly validated

through empirical studies. Such studies could include comparing approaches for generation of new innovations, as well as explaining the success of past innovations. Moreover, the mechanisms that link the Impact Model and the construction of the business model need to be studied further if we want the Impact Model to be as useful to innovators as it can be.

The work presented here brings another interesting perspective. By turning any kind of utility resulting from a use into a unit, taking into account all types of users as previously defined, and all resources mobilized for the use, the Impact Model opens the way to an approach of innovation design based on efficiency of production of outputs, maybe not numerically, but at least on the algebraic level. If confirmed, this would allow for an interesting use of existing techniques of operational research in innovation design.

Most firms are aware of the critical importance of innovation for their long-term success, but still struggle to create successful innovations. The business model concept and research has been of great help in this matter, but focusing directly on the business model bears the risk of conceiving a suboptimal solution. In the same way the business model emerged as a missing link between innovation and strategy, we believe the Impact Model can link innovation and business model concepts, as a decision guide to the choice of the optimal business model based on the maximum difference the innovation can make for all users in the innovation's ecosystem. We believe that by aligning impact and value at the design stage, we could facilitate the emergence of more socially favorable and profitable innovations.

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