

# Divergent Innovation: Fostering and Managing the Fuzzy Front End of Innovation

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**Abstract**—Early phases of innovation are hardly ever being addressed in a systematic way. We tend to assume that ideas fall like raindrops from the sky. Within the concept of open innovation the number of input channels has been increased, but the assumption remains that new ideas pop up by chance or brainstorming. The process of generating new ideas in engineering, science and design is usually considered ill-defined, or even random.

In contrast to this view we describe approaches of divergent innovation and search field analysis and three alternative methods that may be applied within: (1) futures-oriented approaches, (2) contextual approaches and (3) the resource-oriented derivation of product attributes from value propositions. We exemplify a divergent approach by showing a project to allocate potentially disruptive innovation for the telecommunication industry. Finally, we derive implications and guidelines for future market research within a divergent innovation approach.

## I. INTRODUCTION

The speed and quality of innovation is a critical success factor especially in dynamic markets like telecommunications and information technology (IT). Yet early phases of innovation are hardly ever being addressed in a systematic way. We tend to assume that ideas fall like raindrops from the sky: we just have to catch them and filter out the good ones. Within the concept of “open innovation” the number of input channels has been increased, but the assumption remains that new ideas pop up by chance or brainstorming and then just need to be collected, selected and elaborated upon. The process of generating new ideas in engineering, science, and design is usually considered ill-defined, or even random. In contrast to this view, we describe a process of divergent innovation and discuss alternative methods that may be applied within: (1) a futures research approach, (2) a contextual approach of search field analysis involving domain experts, creative triggers or customer-oriented idea generation from ethnographic insights, and (3) the resource-oriented derivation of product attributes from value propositions.

We discuss how various factors contribute to the generation of opportunities for rather disruptive or sustaining innovation by looking at a disruptive innovation project. It exemplifies our approach to allocate potentially disruptive innovation for the telecommunication industry. Finally, we derive implications and guidelines for future market research.

## II. IDEAS IN THE FUNNEL AND PREVIOUS WORKS

Critical management tends to focus on the evaluation and operationalization of ideas without really caring about how

they are being generated. Even large high-tech companies outsource early innovation phases, the so-called “fuzzy front end” such as ideation and strategic user and market research from the core processes of the organization and limit the scope of their innovation management to the funnel. Here a standard set of methods (from evaluation pumps to usability testing) is performed. Instead of introducing innovation and the creation of alternative futures as a great and curious endeavor and ordinary practice, many fear nothing more than real change. Not all of Gaul is occupied though – several authors deal with divergence in the business context. This chapter (2) discusses with and learns from some of them. Chapter 3 takes a closer look on some principles and methods of divergent innovation and assigns them to varying degrees of incrementalism. Chapter 4 exemplifies a contextual approach from our “next big thing” project aiming at the disclosure of overarching search fields in more detail, showing search field examples and presenting a set of evaluation criteria. Chapter 5 presents conclusions and proposes basic principles of divergent innovation practices. It also starts a discussion of how research results may not only serve as information for third parties. Following action research approaches, they may be put into practice to intervene, seduce, and activate by shifting perspectives by introducing artifacts, prescribing new rituals or imposing questions. Establishing a new sensibility to permanent change prepares organizations to act according to user needs and desires and to generate new potentials from given situations.

The role model or at least a parallel to this approach may be seen in the epistemology of critical rationalism. According to Popper [22] science starts with problems (not observations) and focuses on the falsification of tentative scientific theories. The definition of problems, however, and the specific construction of theories is being neglected as long as they are falsifiable [20]. A problem with critical rationalism and funneled innovation is not the rigidity of its methodology to select options by falsification, but that it has no idea about where it starts or how to get there. It reminds one of a parent refusing to deal with a child until the little one enters elementary school. Not knowing where things come from, business as usual rules and the future becomes a mere continuation of how things are developing now.

Several authors took systematic views on early phases of innovation. In the context of creativity research convergent thinking is understood as a reproductive way of thinking that is applied to problems with a specific solution. Divergent thinking is understood as productive and deviating from conventional habits. It is appropriate for problems, which don't have a fixed solution already or to which alternative solutions may apply. Within psychology creative thinking is

then understood as the interplay between convergent and divergent thinking [9].

Rhea [23] discusses the development of transformative products that disrupt the rules of the current marketplace. He works out the need for divergent thinking and proposes three steps: discovery, forecast, and opportunity identification.

- *Discovery*: Contextual research and observations help to assess the internal business context, the external market environment and the requirements of the customers by applying a range of traditional and non-traditional research methods.
- *Forecast*: Future markets research does not just track existing conditions and assumptions but aims at discovery. Contextual information is used to synthesize scenarios and an own point of view about what the future will look like and how the company, its market and customers may differ.
- *Opportunities*: Opportunities or search fields are not concepts or solutions. They rather identify potential problem areas and market needs that extend or expand the current business activities.

The early phase of innovation is of crucial importance since participants:

- discover what to make,
- decide whom to make it for,
- understand why to make it, and
- define attributes for success.

In the following section we will present some approaches and methods in order to work towards a methodology for the early phase of an innovation project. We differ between resource-oriented and customer-oriented methods to generate ideas for innovation.

In contrast to the view of a funnel that catches drops of ideas, we elaborate upon a “trumpet funnel” of divergent and

convergent activities within the early phase of innovation and focus on the generation and differentiation of search fields.

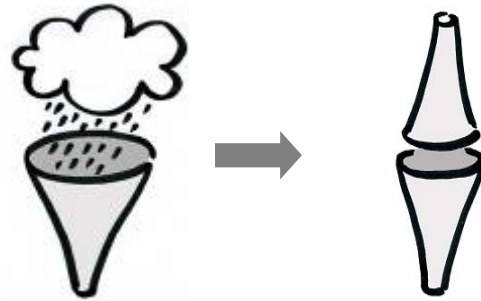


Figure 1: From the idea cloud to the trumpet, adapted from Rhea [23].

### III. DIVERGING STEPS BETWEEN SUSTAINING AND DISRUPTIVE INNOVATION

New products or services, which combine purpose (the need addressed) and means (the technology used) in a new manner, are considered as innovations [16]. However, applicable ideas do not fall out of the sky draining into a funnel of selection. Instead, we need to allocate time and budget for their generation and manage the ways they may emerge by introducing variation. Sources of variation provide new perspectives from positions parallel to established lines of development. Different sources of variation are more or less suitable to come up with ideas and concepts for rather disruptive or sustaining innovation. One of our theses is that methods can be related with decreasing degrees of incrementalism of results: While the methodologies of futures studies, like working with utopian perspectives or wild cards, or even user-driven approaches, which are inspired by ethnological research, have a greater potential to generate ideas for potentially disruptive innovation, resource-oriented approaches tend to result in sustaining or incremental innovations that fit well into existing business processes.

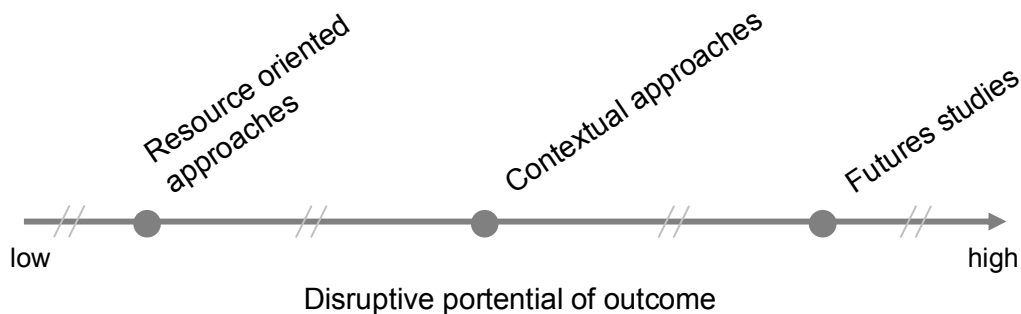


Figure 2: Classification of approaches according to their potential to yield potentially disruptive innovation.

#### A. Futures studies

Since the mid-twentieth century, futures studies are well familiar with the limits of extrapolation to predict the future and developed an own history of working with multiple perspectives and alternative scenarios [18]. Within futures

research we briefly discuss futures workshops and wild cards as valuable approaches to foster divergent thinking.

A *futures workshop* runs through three phases: critique, utopian perspectives and implementation [17]. In the first phase, participants collect opposing dislikes and investigate existing problems within the subject matter, which are to be

solved. Then, using various materials, they elaborate upon utopian visions by suspending all real life limitations in order to draw an exaggerated image of future possibilities. Finally, they reason about how aspects of the utopian vision may be brought down to earth to become reality. The utopian byway is critical here since it intends to break with existing conventions and limitations and often boosts creativity.

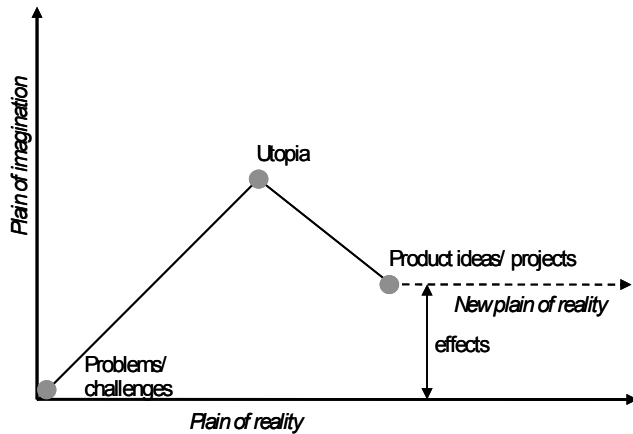


Figure 3: Three-Phase model according to Kuhnt and Müllert 1996 [19].

**Wild cards** address the blind spots in our futures expectations and are defined as “low probability, high impact events that, were they to occur, would severely impact the human condition” [21]. Acknowledging that adding up the various wild cards described in the literature increases the probability of some of them unfolding their impact, the concept was introduced into strategic decision making, thus, preparing organizations to inevitable future surprises [26]. As a severe but reasonable irritation to settled expectations and established conventions, working with wild cards within the early and divergent phase of innovation may help to broaden the end of the trumpet, to strengthen the robustness of ideas to perform well under varying circumstances and foster perspectives off the beaten tracks. Trying to come up with potentially disruptive innovations and business opportunities, we consider methods from futures studies as a most valuable approach.

### B. Contextual research

Contextual research methods face the “challenge of fitting into everyday life” [3] rather than fitting into the way the existing business is run. Therefore, we also consider them suited to take off from the established corporate playground, while still they tend to lead to results closer to the present reality. Parallel perspectives are introduced by the means of (lead) users and professional domain experts from neighboring fields. Methods span from ethnographic observation, lead user workshops or camps to “unfocus groups”, in which diverse participants from the target domain contrast their unique requirements against one another – think

for instance of an orthopedist, a salesman, a rubber recycler and a shoe fetishist discussing about shoes.

Disruptive innovation as defined by Christensen (1997) includes the behavioral angle of innovation and often is, amongst other factors, cheaper, more accessible, and more convenient to use. Providing these aspects in innovative offerings might activate market segments that have not been served by established solutions, due to barriers that bar them from consumption. Ethnographical study results from pure observation have the potential to bring about ideas satisfying such criteria since they do not rely on verbal statements of the user (or non-user) in cases, in which the user might not be able to articulate frustration or needs or in cases, in which she/he thinks, they might be too plain to enunciate. However, often it is the simplicity of an observation that breeds the disruptive impact.

### C. Resource-oriented approaches

Finally, resource-oriented approaches towards innovation and ideation tend to match to, but extend existing business opportunities. Exemplifying resource-oriented approaches, we briefly discuss “systematic inventive thinking” [14;1]. Within one of our projects we adopted the method of systematic inventive thinking in order to come up with useful ideas to enhance the start-up experience [4]. Starting with existing products and their characteristics instead of user needs, it is intended to generate ideas that can be easily produced and marketed and that match the resources of the respective company. Therefore, we call it a resource-oriented approach to innovation. The thinking “inside the box” [14] approach applies a set of patterns. Patterns are not only used to categorize ideas – as Genrich Altshuller [1], originator of the approach, originally did in his analysis of patents – but also to generate new product ideas [5]. It deconstructs a product or service and its immediate environment into component elements in order to reassemble them using five “patterns of innovation” [14]:

- *Subtraction* removes desirable or even indispensable components, for instance the display from a digital device.
- *Multiplication* adds copies of components to achieve a qualitative change – the Gillette double-bladed razor is the classical example here.
- *Division* disintegrates physical or functional components to come up with new configurations. Separating the control from the device is an example.
- *Task unification* assigns new tasks to elements that may then acquire the function of other elements like the suitcase with wheels absorbs a function of luggage carts. An example of task integration for digital gadgets would be to integrate the instruction manual into the functioning of the device.
- *Attribute dependency change* dissolves or creates new dependencies between component parts. For example, the independence of lens colour and lighting conditions may be suspended with lenses darkening in sunlight.

The idea may then be visualized and evaluated in terms of benefits, drawbacks, challenges, market potentials, business fit and such. Resource-oriented approaches generate innovations that immediately suit the company and its resources and processes. For this reason, they may not be as suitable as user-driven or future-oriented approaches to generate ideas for potentially disruptive innovation.

#### IV. EXAMPLE PROJECT TO IDENTIFY “THE NEXT BIG THING”

In the following we will show one example to identify search fields for potentially disruptive opportunities in the telecommunication industry. Organizational life in a competitive environment is never linear. One way to classify the effects of an innovation on the competitive environment is labeling it as disruptive or sustaining. Sustaining innovations cause disruption of sales of previous product versions through cannibalization at most, starting first encroachment on the high-end of the existing market then diffusing downwards [8]. Disruptive innovations, on the other hand, have the power to redefine the market place, mostly encroaching on the low-end of the existing market and moving upwards. Thus, it is critically important that companies and their managers are able to recognize a disruptive innovation when they see one [24]. In a world of convergence, dynamic markets, and rapid technology advances, new upcoming disruptive technologies cause market changes in an unpredictable manner and pose threads but also opportunities to traditional telecommunication companies.

Within the next big thing project, we observe weak signals and analyze search fields in order to discover products and services that exert great impact on business models, user behavior and the allocation of market shares. The products and services do not need to be in the core business of a telecommunication company. We look out for innovative products, services or technologies that help to do and approach things differently and whose potential unfolds over a steep growth path by introducing a unique value proposition to the market. In the following, we exemplify our approach to explore search fields and ideas that feature such characteristics.

##### A. Search field workshop with experts

An initial workshop was dedicated to generate new search fields in order to find the „next big thing“. Within this workshop we focused on search fields for mobile communication services based on broadband technologies. Instead of conducting a futures workshop we just used future trends as a shortcut to trigger brainstorming with experts. We invited several in-house experts, industry experts, as well as experts from the neighboring field of interaction design to a one-day workshop.

At its beginning, we presented some future trends as a creative trigger and reference for an initial brainstorming

session. Trends included “Cultivated Testosterone” (new boom of showing masculinity and archaic power as design aspects of status symbols) and “Identity Management” in all of its complexity. Experts added relevant trends to work with that were not included in the initial presentation such as “Life Sucks”. Opposing the idealized images of ever-increasing happiness, the phrase refers to the unlucky moments when the complex details of a given situation overwhelm the helpless individual in a way that these two words come to mind. Imagine yourself, for instance, at the check-out of the supermarket with a crying child in your arm when the telephone rings reminding you of an important meeting you forgot.

Based on these trends, we first brainstormed those situations, in which the trend or expert topic becomes relevant. Then, we continued asking for new services or products (“concepts”) that might help in those situations. Situations and concepts were clustered, given a title and we discussed connecting properties in order to construct the basis for the generation of search fields. Again, we clustered the affinity clusters into strongly related clusters that then represented our search fields. From these, we selected the four that appeared most valuable and went on to specify them by providing initial descriptions.

This kind of proceeding is typical for creative workshops. Just as creative thinking is composed of divergent and convergent aspects, creative workshops typically run through iterations of diverging (brainstorming) and converging (clustering, naming, and prioritizing) steps. An important aspect, which is oftentimes neglected here, is the selection of initial triggers. Here, we tried to ensure that high impact issues like “Identity Management” were mixed with topics that have not yet excessively been communicated (like “Cultivated Testosterone” or “Eco Iconography”). While they provide for an initial frame of reference, the specific proceeding – like clustering of ideas independent from their initial triggers – ensures that a transgression of this given frame is likely.

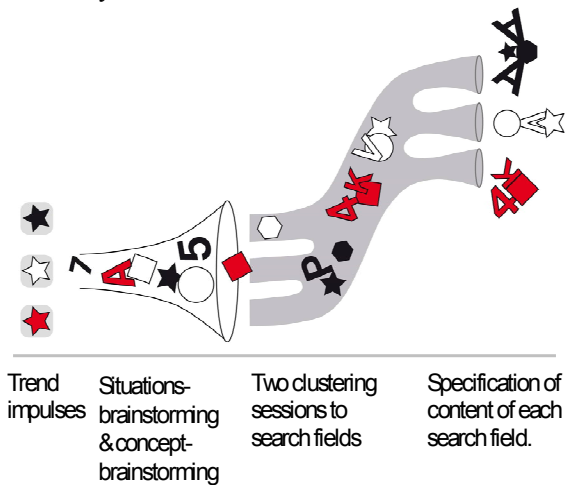


Figure 4: Iterations between divergence and convergence - search field workshop proceeding.

Unfortunately, we may not publish all but only show selected results in order to exemplify our approach. Search fields included “Trust”, “Identity Creation”, and “Ethical Codices”. One of the search fields we identified was called “Intelligent Simplification”. It addresses the individual as the center of complex relations dealing with diverse technical and social interfaces.

Two topics within this field were “Devices of Mine” and “Micro-Task Bots”. “Devices of Mine” intended to provide a consistent and device-independent representative of a digital self that is provided and tailored to different activity contexts. “Micro-Task Bots” aimed to simplify daily tasks in a reasonable and efficient way – either through automatic handling or by means of a micro market. A precondition here is a divide-and-conquer strategy for complex tasks that may be broken down into sub-tasks and synthesized again in the end to complete the original task. As one example, we discussed a system that automatically coordinates meeting schedules by comparing alternatives and following adaptive parameters. For other small tasks that require human intervention, more or less specialized service providers could be found using market mechanisms. Real life examples in this direction can be seen with Amazon's Mechanical Turk or Mycroft's New Human Microtask Aggregator (<http://www.mturk.com/mturk/>).

Regarding ideation workshops we generally differ between goal and focus topic definition, methodological approach and the selection of suitable participants. Involving



Figure 5: Storyboard example of the idea “Micro task bots/ Micro markets”.

We prepared a set of objective evaluation criteria and put it to discussion with the experts. The subsequent selection should rest on these criteria. The discussion and adjustment of the evaluation criteria was a crucial step to assure that the experts commit to the ideas and the selection in later phases. Commitment or the “buy-in” was the most important intangible outcome of the workshop, creating capabilities to cope with change later on. During the course of discussion, the set of criteria was slightly changed, leaving us with three primary criteria that were further sub-classified, partially ICT branch related (see Table 1).

The criterion “Disruptive Potential” is derived from the definition of the term disruptive innovation by Christensen and Bower [7]. Does the idea have the power to render the common and established business model of a telecommunication company inferior to its own, and do we have a voice in implementation? We joggled the critical analysis of challenges to ones own core business or better, to

external experts that are not concerned with the companies’ resources, and providing general trends in society as inspiration for the discussions, but then again skipping the utopian phase of a full-fledged futures workshop would position this particular workshop somewhere in the middle between the above mentioned extremes of resource orientated approaches and futures studies.

### B. Evaluation workshop

The divergent step is followed by the one bringing convergence and creating direction to elaborate on the ideas. Even though the focus of this article is on the former, we want to share a set of evaluation criteria for selection that not only initiates the convergence, but also indicates the quality of ideas that were created during divergent steps.

As diversity management teaches us [2], we once again brought diverse in-house experts with different perspectives together, to evaluate and classify the search fields and ideas created before. The primary goal was to select up to three search fields or ideas for follow up work within the in-house R&D or by entrepreneurs that implement the ideas within a spin-off. To assure common understanding, the experts were informed about the ideas in the run up to the workshop – information included the title of the idea, a short description, a use case scenario, and (if present) evidence from similar ideas on the market or similar R&D projects. First, all ideas were presented again, using storyboards that illustrated a use case scenario in four to five steps.

the branches status quo that might emerge by the time the idea is introduced. A search field or idea scoring high on this criterion brings about threats to the current business, but also chances for future positioning.

The criterion “Potential size of business opportunity” covers rather market and consumer related aspects. It deals with the frequency the idea might be deployed in a user’s every day life, if it has emotional potential and how stable it performs under multiple future scenarios. Furthermore, it has a behavioral angel to it, asking if the idea does things different, more joyful, more accessible and affordable. A very powerful idea would be one that solves an obvious problem or frustration residing in the market. This encompasses the definition of disruptive innovation as Christensen [6] expanded it in his book “The Innovators Dilemma”. Note, however, that ideas not scoring high on the first criterion still might be good ideas to follow in terms of business opportunity, if scoring high on the second.

TABLE 1: EVALUATION CRITERIA

1. Disruptive potential	2. Potential size of business opportunity	3. Fit
1. Challenges technical foundations of current networks (e.g. peer-to-peer versus centralized; different transmission mechanism like digital versus analog, wireless versus cable; higher technical performance)	1. Applies in many parts of the segments life versus only rarely	1. Matches our mission, disciplines and skill sets and budget line
2. Challenges financial foundations (e.g. cost-based versus usage-based tariff; value of the service far outweighs costs)	2. Does it perform in a variety of future scenarios (e.g. recession, environmental disaster, change in market structure etc.)	2. Strategic fit to other projects
3. The market can develop fast because it can be tried out easily and cheaply with little disruption to current network (e.g. no critical mass required)	3. It excites the segments interest, same excitement extends to many segments	3. Being us provides for a strategic advantage
4. Limited mechanisms to "buy time" for telephone companies (it does not need companies or regulatory approval)	4. It solves an obvious problem; we are an enabler of new drivers in business (e.g. shift from cure to prevention in health)	
5. Hot topic for venture capital (e.g. matches to tracking done by analysts)	5. More units sold more often to the same customers, sales of additional products to the same customers, premium prices.	
	6. Decreases cost: lower unit costs, less waste, lower sales costs, lower channel & customer relationship management costs - attractive for many segments vs. niches.	

The criterion "Fit" simply seeks the strategic fit to our mission within the company, established R&D projects and the discipline and skill set. Furthermore, it addresses the question if we already have a strategic advantage in the implementation of the idea. An idea scoring high on this criterion is one that would be easier to implement, one that scores low might indicate white spots in ones R&D strategy.

To boil it down to three search fields or ideas, the experts were asked to indicate their three favorites based on the criteria. In the first round, this was done individually in order to avoid the group dynamic notion of compromise. Groups are smartest if they are made up of people with diverse perspectives who are able to stay independent of each other [27]. Each search field or idea got rated at least once, giving relevance and potential for disruption to all fields but since only one topic was clearly favored by all, three groups were formed. Each group discussed the topics and came up with a consensus top three. One of the three search fields/ideas the groups came up with reached consensus, making it two ideas that reached consensus all together

To differentiate and elaborate the two selected search fields/ideas, the experts were divided into two groups, each group focusing on one of the two. The task was to brainstorm possible applications for a product or service within the search field by exploring the needs and drivers of a representative customer in order to determine the workshop with a more tangible understanding of what the idea is about. So, once again, the convergence step is followed by a diverging one. However, this step is beyond the scope of this article.

## V. CONCLUSION AND GUIDELINES

We questioned the conceptual model of the funnel within innovation management and also its parallel in the epistemology of critical rationalism. Opposing the image of a funnel of rational selection, we introduced the idea of a "trumpet" in order to provide a mental model of what has to be done and managed at the "fuzzy front end" of innovation. We proposed divergent innovation as a means to play that trumpet and discussed some of the methods that may be applied within. Still, this concept of divergent innovation has to be elaborated upon – the form of the trumpet has to be filled with methodological discussion before we may hear the sound.

As a first approach to systematize methods that may be applied within the trumpet, we briefly discussed selected future-oriented, contextual, and resource-oriented approaches to drive ideation as well as innovation and discussed their suitability to foster sustaining versus disruptive innovation. These assumptions or hypotheses still have to be evaluated e.g. by comparing other methods that fall into the above mentioned categories of tools to drive innovation and the results they produce. As a guideline the classification may be differentiated along the objective of the outcome, the methodological approach itself and key individuals contributing to shift perspectives.

Concluding this contribution, we now look for a common denominator of the approaches within the trumpet we discussed and reflect upon the ways that creative and research

results may be driven into the core practices within a company.

#### A. Principles of detour

The methods applied within the divergent steps of innovation may all be characterized by detour: They do not go directly to the target, but work around what may appear as the most efficient way to hit the goal. They do not give a direct shot, but pass the ball to another player, even if she or he is not on the playground (like users, non-users, experts from other domains or future visions are outside the realm of an organization). Futures research applies wild card irritating well established expectations; contextual approaches involve users or experts of divergent domains; even resource-oriented approaches claiming to think inside-the-box dig into new combinations of existing resources and user values that might be out there (even though these are based on internal assumptions). This basic approach is supported by psychological research on “preinventive forms” [10;11] that may foster creative thinking more than targeting at a specific purpose. Preinventive forms are the outcome of a combinational play of basic forms that represent structures that at first seem useful in a general sense. Then, the forms utility and application in a situation or for a task is evaluated. This detour triggers creative processes that bring about inventions, which might not otherwise be conceived.

Principles of detour involve the idea that “function follows form” [14] and apply external points of reference in order to enable multiple shifts in perspective. Detour allows to find “new combinations” [25] of potentials inside and opportunities outside the box. Futures workshops, for instance, dig deep into wishful thinking and dreams of the participants before they even try to come down to earth and try to specify inventions or any pragmatic approach. Not only is the pre-inventive form of reference laid out in divergent ways, a variety of materials is being applied to stimulate divergence: Illustration and moderation kits provide new means for co-construction and “materialities for communication” [15]. Video, live footage, and notes from field studies feed into the development of empirically grounded theories [13], where the ground is not the home ground of the organizations operation. Challenging the limits of ethnographic research with an omnipresent observer, “cultural probes” [12] are used to capture and reason about “felt live” in environments that are difficult to observe directly. Divergent innovation provides a frameset and tools to take off the ground and flexibly to take multiple perspectives. From there, we may discover new opportunities and possibilities whose generation is left up to chance to everyone inside the funnel.

#### B. Final remark

In order to avoid misinterpretation, we finally want to state that divergent innovation should not be perceived as an exercise an organization performs or externalizes in order to cope with a fuzzy front end but as a matter of organizational

learning: how to introduce learning into an organization. It is not a matter of informed decision making by delivering missing pieces of information on potentially innovative ideas. Instead, it aims at an intervention into the core processes of an organization and an alteration of practices – instead of relying on local participation ask for commitment to change.

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