Enterprise Innovation Planning solution based on novelty-action model

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Topic

The Enterprise Innovation Planning (EIP) is about discontinuous innovation management. It is based on an interdisciplinary research on novelty, combined with issues found in innovation management. We define novelty as “the inherently unknown”. With learning based on experience the process of learning novelty seems paradoxical. Novelty can only be learned in a discontinuous way. For discontinuous learning, experience can be both a source for growth or the core for resistance. Learning is indeed a topic of the cognitive research, but the need to understand discontinuous learning seems to be a more pressing issue in innovation management. In innovation management we see dichotomies where innovation is split up in a standard / hard problem or a continues / discontinues problem. The most common dichotomies are: incremental / radical, component / architectural [1], sustaining / disruptive [2]. Discontinuous innovation was first described by Schumpeter as "creative destruction" [3]. According to Mokyr [4] long-term industrial growth is based on such Schumpeterian growth and traces can be found over our entire history of technology. The term discontinuous innovation has been more explicitly used by Hamel and Prahalad [5]. They suggest incremental development processes to manage it. Chesbrough’s book on open-innovation [6] shows how innovation needs to be taken out of the general business strategy to understand its potential strength. It illustrates how changing the context leads to discontinuity and how an open system is always a changing context. Christensen suggests theory as a solution to disruptive innovation, because data on profit only provides feedback about the past [7]. By creating a theory on discontinuous innovation, we see new opportunities, like the concept of a disruptive growth engine [2]. We expect our research to contribute in the development of a disruptive growth engine.

Our goal with EIP is to make discontinuous innovation more manageable and more profitable. The name EIP comes from the similarities with Enterprise Resource Planning (ERP). Before there was an ERP the access to a holistic overview of the company’s resources was only possible for so called super-accountants. We need a holistic overview to make the right discontinuous decisions. Today, only few visionary-leaders have the intuition to make correct discontinuous decisions. This is of course a pitfall from a risk management point of view. Take for example the effect Steve Jobs’ health has on the stock exchange of Apple. The similarities between ERP and EIP go on. Just as the ERP only works when implemented correctly, so do we expect the success of EIP to depend on its implementation. It is an architecture and tool that can facilitate innovation management, not automate it. ERP is supported by IT, we expect the same with EIP. In our proposed design, social software should be used to harvest experience while EIP should reduce the resisting effect of expertise. The effort of developing and implementing an ERP is sincere, we expect nothing less for an EIP. Taking into account that the research is based on an interdisciplinary and theoretical research, we are well aware that research on EIP has a long way to go.

Methodology

Our expertise is rooted in computer science and cybernetics research. Novelty research is based on *evolutionary cybernetics* [8], *Complex Adaptive Systems* [9] and the theory of *the artificial* [10,11]. The domain deals with discontinuity and fabrication as a natural phenomenon. Our first experiment was an agent simulation to understand the limits and the control for an agent to produce a creative action [12]. With the agent simulation we did however stumble onto the problem that complex embodiment is a requirement for discontinuous learning and so concluded that future simulations could not bring more insights. The research had a primitive design and the research continued to investigate upon it. This resulted in the Novelty Action (NA) model [13, 14]. We believe there is a model for novelty. This belief is based on three designs, which where confronted with the same problem of learning novelty, that came to the same structure independently. One design came by a neurological study on entries to the global workspace [15]. The other design was found in the science studies of Latour [16, 17]. The third is of course our own design, which was an artificial intelligence simulation. As all three designs are based on analytical research there is no evidence on the necessary and sufficient conditions of the NA-model. So we need an empirical research to investigate the necessary and sufficient conditions. The discontinuous innovation is a good candidate to investigate. It confronts us with a real

problem and not some simulation setting that can be tweaked. We needed experience in IT management. That experience came with a project on knowledge sharing over social software [18].

Our theoretical method uses interdisciplinary as a method to make decision based on variation and selection. The variation comes by broadening up to more disciplines. The selection comes by finding similar (control-problem) patterns over the disciplines. We just illustrated the NA-model is reappearing over three disciplines. This method of variation and selection is a basic principle of evolutionary cybernetics and it is how the NA-model works. In a way this should not be a surprise as the NA-model is currently a novelty itself. We did find some patterns in relation to our current EIP problem. An EIP will have to be a socio-technical solution. The relation between socio-technical systems and social software is addressed by Ackerman [19]. The socio-technical comes back in innovation management as business ecosystems [20]. It also fits with Latour's actor-network theory [21]. Each of the three investigations acknowledges the interplay between social and technological elements and explains that a socio-technical system is one of continuous effort. It is like a dissipative system (f.e. a hurricane), it only exists by a continuous flow of energy through the system. In social software the flow is communication, used to construct: events, ideas, networks or even develop software. The web is making many scarce resources abundant; it is another emerging pattern. Like making workforce abundant [22] and making storage abundant [23]. Similarly, the goal with EIP is in an attempt to make innovation abundant.We are in the investigation of how to make that possible [24, this issue]. Our empirical method, which is creating software-architecture and apply IT-alignment to entrepreneurial challenges, is expected to follow.

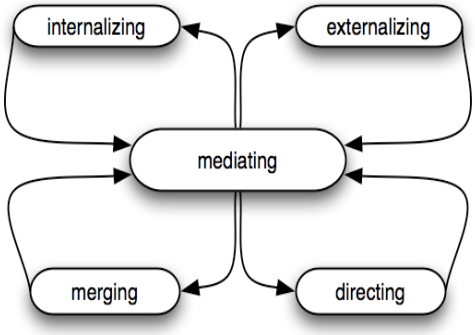
Model & design

We can split our research in two parts. There is on a general account, the problem of discontinuous learning and the control of novelty. It is a cognitive problem. There are many reasons why we can not continue the cognitive empirical research, going from problems with boundary conditions to a lack of motivation in the discipline. There is a keen interest to understand discontinuous innovation management. Discontinuous learning is for innovation management only a part of the problem. We will propose a structure for EIP where other elements are accounted for and are based on emerging patterns in innovation management. Before we can explain EIP we will need to outline the NA-model, although we will keep it brief. By projecting the NA-model to an organizational level, features of EIP should become clear. It is a markup and expected to need much correction before it can become useful. EIP can currently only be a markup as it is itself a novelty, so it follows the same development process as any novelty. Novelty always starts as a vague concept that is hard to defend by the existing knowledge base. The vague concept will get bootstrapped to a concrete one. We won't go into detail on what a bootstrap is, this is left for a separate paper. The basic principle is that you keep one part of the concept stable and use it to develop that other part. Next you turn around the process to develop the part you kept stable. This is how the NA-model can result in two specific learning processes called mastering and reflection, as we will outline in more detail now.

Cognitive research

Novelty-Action (NA) refers to the necessity of acting, in general, to learn the inherently unknown. The NA-model consists of five parallel processes. By acting on the cognitive network of the system, each of these processes contributes to the production of the situated context. Each process is going trough the cognitive network based on their specific relation with the context. Two elements of one process may have no relation, but by the interaction with the other processes they can appear together. So the specific situation can reveal the absence of a potential relation. It is potential by the triviality that both appear together and the absence of a relation means it is a novelty. The parallel process as such creates a variation and with it, the visibility of missing links. Not all novelties are useful. When there is no good reason for both elements to get together this incident can easily be discarded. However, when the other processes confirm the presents of both elements, the system will need to absorb the novelty.

The five parallel processes of the NA-model are: internalizing, externalizing, directing, merging and mediating. Each process has its relation to the information in the cognitive network. The mediating process connects all the links and creates nodes that result in situated concepts. Such situated concepts can be composed of tags, associations, motivations and experience. The externalizing process adds tags to the concepts. Tags are placeholders to the observed world, corresponding to what Whitehead calls proposition [25, 26]. Tags can sometimes be quite literally labels, sometimes they are merely virtual markers, only visible to the observing system. Internalizing will associate the concepts to other concepts, creating a rich knowledge landscape relevant to the situation the system is in. Directing can be seen as a loose control by a motivation. Without clear motivation the tags and associations are linked based on default relations. With a motivation such tags and associations may get a different meaning. For example a cup is by default used to drink, but in many offices cups are used to put pencils in.



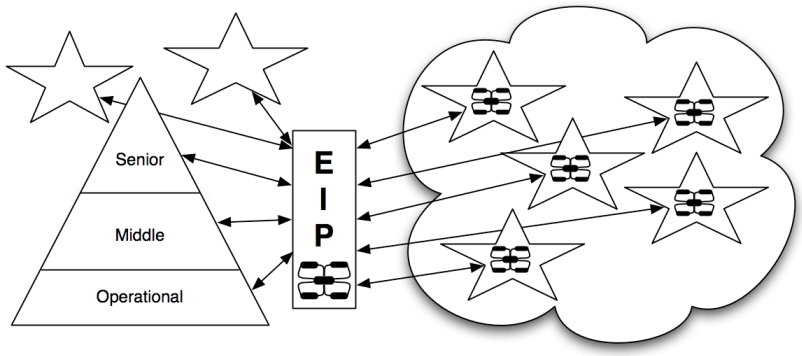
Tags, associations and motivations only exist to the extent that there has been prior experience and that experience has been categorised, abstracted or merged into these three categories (tags, associations and motivations). This is the merging process that works on experience. It may happen that no experience exists of a specific situation, so the output of the merging is blank. This is a more advanced case of novelty as now we have the whole situated context being a novelty. The merging process will only record the experience in case no prior experience existed. When the merging has a similar prior experience, it can strengthen or weaken the relations between concepts. Merging has one variable: the novelty of the experience. The variable can go from “too novel” to “negligible novelties”. When a situation is too novel it is incomprehensible and confusing, leading to dismiss the experience as a whole. The other end of the variable is when novelty is so trivial it won't be considered. To illustrate this, think of driving a car. The first time too much needs to be learned; the driver has several blind spots for danger and needs a co-driver to guide him through the first attempts. When driving a same route for years the driver starts doing it on "auto-pilot" and can be left with no memory whatsoever of the event.

Directing also has one variable, being the focus of the motivation. It can variate from low, having no interference but the default categorisation, to high, in which case the motivation dominates the system. The novelty and focus can create two auxiliary learning processes: reflection and mastering. Reflection denotes the internal learning taking place in a learning system. Connections are made based on the connections that already exist within the system. In this case the focus goes to associating and the systems shuts itself off from external variations. Do not confuse the external variations with externalising of knowledge. We see the use of externalising knowledge (f.e. using blackboards) as a way to keep the focus on knowledge and allow out of the box thinking, but this is still part of the internalizing process. The internal learning does not necessarily result in a knowledge model that is consistent with the external world. During mastering, the internal knowledge model of the learning system is applied to the external world (f.e. prototyping). The external world produces feedback, which in turn causes learning, bringing the knowledge model in line with the world outside the learning system. Notice that mastering and reflection have a bootstrapping relation. Both mastering and reflection have a similar behavior. They harvest the novelties out of experience. It is a specific case where the motivation results in creating a situation where no prior experience exists. For mastering, the experience contains external mediators or variables, which need to be tagged. For reflection, internal mediators have to be constructed by as few associations as possible. We end up with a cognitive network containing tags and associations to solve a particular problem in a particular context. In a way we see mastering as a means to create implicit knowledge, while reflecting will shift the knowledge from implicit to explicit. The motivations can also be harvested out of the experience. You can be confronted with rather pragmatic problems, but by this, create a rich knowledge base of problems and motivations. For example, we can have bad and good experiences that may be transformed to a pragmatic motivation to avoid or enhance a peculiar behavior. Motivations, like intentional learning, are more refined, that requires a more refined experience of problems. So, in the end, motivations seem to be harvested, quite similarly to tags and associations, by a constructive learning process.

New Businesses Development (NBD)

We stayed general while explaining the NA-model to not lose ourselves in the details. It is after all our goal to focus on EIP. By projecting the NA-model to innovation management we can see development in the discipline in a quite different perspective. While our NA-model has a smooth transition from little to much novelty and from loose to strong focus we do see a distinguished setting in management practice. New-Businesses-Development (NBD) is the responsibility of senior management (even for ambidextrous organizations [27]). On the other hand we see incremental innovation being pushed to the operational level and see good practices emerge in a self-organizing way. The current innovation solutions seem to cut out the middle management. We would like a smooth transition and middle management is also expected to make the system scalable. It is our attempt to make innovation more accessible, so we have searched for designs where middle management would be involved in the process. One such design is suggested by Applegate and colleagues [28]. In their so called Big-Small Business design, middle management is responsible for the learning process. The Big-Small design fits well with our NA-model. In our design the difficulty of the learning depends on the degree of novelty. When the novelty is low, learning is continuous towards the existing knowledge base. Such learning is often referred to as operational innovation and can best be executed on the operational level. When most of the problem is unknown, we are entering a realm of discontinuity that will be disruptive. Gifted insight and engaging leadership is required to deal with the problems. However, both very low and very high novelty are exceptional. In many cases it is not an issue of how much novelty you can handle in one iteration, but how to continuously increase the growth of novelty over time. In a way this is how giftedness works. A person or a team may have spent a lot of time working on a problem before they come out with their solution. By intentionally applying discontinuous learning we intend to increase the growth of novelty over time. Each level and each group should be heavily connected, as illustrated below.

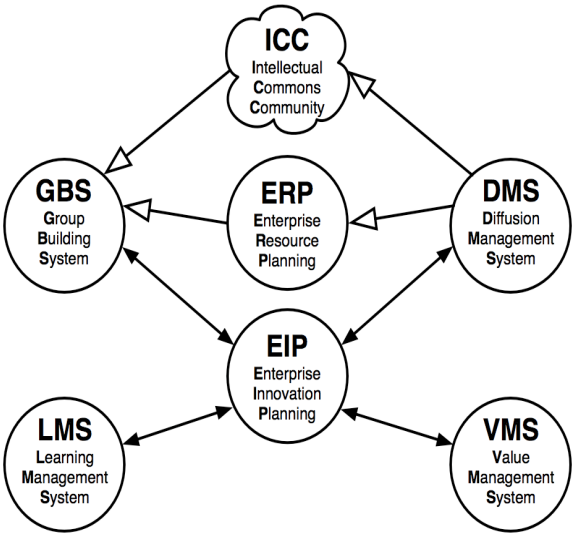
Illustration Triangle = organization, starts = NBD-groups, rectangle = EIP-system, Cloud = NDB-groups in EIP-system



The NA-model appears twice in the system. On the EIP-level, to discontinuously grow groups and on the groups-level, to discontinuously grow knowledge. In total, we see five EIP management systems related to the five NA-processes. Three of the management systems are recognized as existing or emerging business models, the last two are our own constructions:

1. Internalizing: **G**roup **B**uilding **S**ystem to create and manage NBD-groups.
2. Externalizing: **D**iffusion **M**anagement **S**ystem for spin-offs.
3. Directing: **V**alue **M**anagement **S**ystem to define the focus of the NBD -groups.
4. Merging: **L**earning **M**anagement **S**ystem to reduce the resistor effect of experience (to manage novelty).
5. Mediating: The **EIP**-system to connect all previous management systems.

Let us schematically represent the input/output to the EIP as well. There is the external company or profit part we represent as ERP. Parallel we have an Intellectual Commons Community (ICC). ICC is a general term grouping all existing public interest groups like NGO's, academic groups, grassroots or open source development communities. We can simply call ICC the non-profit part of the ecosystem or call it the community. The specific input-output relation is based on the concept that an organization should nurture its business ecosystem. Moore [20] describes the ecosystem as the production of goods and services for customers, who are part of the system themselves, it is intrinsically an open system. The role of an organization is to expand or open-up its leadership to the common good of the ecosystem. After all, the community is the partner for growth. The ecosystem will contain other companies. Even with hostile competitions on the operational level, there can still be innovational collaboration between the companies. The rules of competitions seem to be different between operation and innovation.



1-3 Emerging systems

The first three business systems are recognized as emerging in the current innovation practice. Groups are created to allow autonomy in the pursuit of the innovation and at the same time avoid contamination of the current business. The team should be allowed to test and learn how to put the idea into practice, especially to create their own specific business processes. To build groups in an ecosystem, methods as un-conferences or open-spaces [29] are very useful. The structure of such an event allows maximum brainstorming by self-organization attendees. The self-organization can partly shift to a pre-event organization by using wiki's or other collaborative website tools. This helps organizations without limiting the brainstorming effect of the event itself. The shift to wiki's is a good example of how we see social software supporting EIP. Diffusion happens to groups that are ready to go commercial. We know diffusion mostly as the classical way of a company, or a university, to start making profits. We do expect some changes to the structure to make it more inline with an ecosystem. Less evident, but quite present in today's innovation literature is the focus on creating, capturing and protecting value. Examples are widely discussed in the literature, f.e. Xerox PARC, which created but didn't capture value. We see related studies, f.e. how Apple lost the leadership to IBM in the PC market and how IBM didn't capture the benefits of being the leader of its industry. Today open models of IP bring quite interesting solutions, like creating a foundation to protect the agreements, and thereby the values, between partners. We notice a shift from

"contracts" to "partnership" between the business and its community that nicely illustrates the shift from closed systems to ecosystems. A good case of contracting, is the collaboration between IBM and Apache [22]. IBM helped in building the legal structure of the Apache foundation, but built its property software on top of the open-source license. Today, with the concept of business ecosystems, we see organizations creating partnerships, f.e. the yearly "Google summer of code". The initiative gives student scholarships over a three month period to develop their project in one of the many open source communities. The initiative is in full partnership with the open source communities and with the goal to nurture open source development.

4-5 Missing management systems

We recognize the absence to systematically managing discontinuous innovation. Today this is solved in a trial-and-error fashion where only a small part of the projects is expected to succeed. This, is calculated as a cost into the risk management in venture capital. By translating the NA-model to management methods we can create some suggestions to manage discontinuous innovation. The problem with various good discontinuous innovation is the co-evolution with the ecosystem, making it impossible to create any specific data beforehand. Novelty is learning by a bootstrapping interaction between mastering and reflection. In management the two types of learning exist by different names. Reflection would be similar to SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis, while mastering is action-planning. Currently SWOT analysis and action-plans are based on specific data, we suggest a method to use the two learning processes to go from “vague and general” to “concrete and specific” (for both groups and knowledge). This can be done by bootstrapping the knowledge using specific iteration between SWOT and action-plan. The first rule is that the one type always needs to be followed by the other type, so you can’t do a SWOT on a SWOT, it will lead to internal knowledge that is not inline with the external reality. The second rule is that a breakdown should be expected at any time for both SWOT analysis and action-planning. When that occurs, the learning process has to stop and a new iteration has to start for the opposite type of learning. With vague ideas it is expected that a breakdown will occur often and we observe an intense interaction between the two opposite learning processes.

The NA-model can visualize the strength or weakness in the context. We have described how the NA-model has five processes, each working on their own kind of relations. In the table below we see the last two columns illustrating NA processes and their knowledge relations. The first part of the table gives a translation to the management system. In the management system we can recognize business relations and also the type of actor involved in that relation. We can actually apply SWOT analysis to each of the actors and their business relation to make the context more visible. Such analysis may result in an action-plan to enhance one of these relations. It may become more concrete when we illustrate the role and influence of each of the actors.

Table Relation between the management systems and the NA-model

Management System	***Business***	***Actors***	***NA processes***	***Knowledge***
Group Building System	Strength	Resources	Internalizing	Associations
Diffusion Management System	Market	Public sphere	Externalizing	Tags
Learning Management System	Opportunity	Allies	Directing	Motivations
Value Management System	Growth	Competitors	Merging	Experiences
EIP	NDB	Entrepreneurs	Mediating	Nodes

The internal of a business defines its strength by its resources. Sometimes a business can recognize one of its strengths that was not useful for its existing business plan. An example is the London Underground, which become a player on broadband-networks. It is quite clear that a resource defines the possibility to act, this is less evident with the external actor. Public opinions have their own dynamics. A good example of the change in public sphere is with nuclear power. During World War II the public opinion was in favor of developing nuclear power, an atmosphere of fear that the enemy will have nuclear power stimulated the development of it. Today the public sphere has changed and even nuclear power for peaceful goals gets a lot of resistance by the public opinion. This time because of its long term effects. In many cases a New-Businesses-Development (NBD) will depend on the opportunities seen and alliances that can be established. This will direct the NBD and be defined as business plan or business motivation. We see several examples of discontinuous change in motivation when a large company is under stress. Like the turnover of Apple when Steve Jobs reentered the firm. He focused the whole business around only four models [30]. The merging may best be illustrated when a new market has several NBD-groups and becomes a dominant design. We see that a dominant design solves its growing pressure by acquiring the competition, this way it is merging the experience in the new market. Merging is also useful for killing projects, we may find it a better solution to dissolve groups and merge their experience into other groups. The actors for the merging have been called competitors, but they may equally be

colleagues. Let us see it in contrast to allies. Allies will work on a similar project but have different motivations to do so, competitors/colleagues will more likely hold the same motivation.

On the last row in the table we see what connects all the rows in one columns. Latour describes mediators [16]: breakdown, blackboxing, composition, delegation, interference. We have used breakdown before, it sometimes is “creative destruction“ but it can also be accidental and with negative effects. Breakdown can happen by new insight or by a change in the external context. Blackboxing is what the system tries to do: matching the group or the concept so that it becomes a useful and autonomous entity. Both ‘breakdown’ and ‘blackboxing’ are part of the constructive growth. We distinguish them against the last three mediators. ‘Composition’ means: the sum is more than its parts. ‘Delegation’ is replacing one element by another, mostly shift from scarce (or expensive) resource to abundant (or cheap) resources. By ‘interference’ one element can changes function or purpose of another element. Latour illustrates this f.e.:”You only wanted to injure but, with a gun now in your hand, you want to kill.” Mediators are complex, situated and in need of interpretation. The necessity for interpretation should clarify why innovation can not be automated. Reducing the access cost by bringing more visibility to otherwise unknown or implicit aspects of discontinuous innovation does seem feasible.

Roundup and current issues

Our research mainly focuses on the control of novelty, but now it does require an empirical part. We have understood that innovation management is most concerned with discontinuous learning and so suggest EIP as a translation of our NA-model. EIP may create the wrong impression that we want to create a classical enterprise solution. Let us explain why this is not the case. The web is making many scarce resources abundant (labor, storage), our EIP should be a web solution trying to make innovation abundant. The shift form scarce to abundant is a disruptive change and Christensen explains how disruption also changes the supply channels [2]. We can see confirmation for this statement from the theory: it is the co-value creation and bootstrapping nature of novelty. Consequentially we are searching and studying other shifts-to-abundant-resources like renewable energy, computer based learning and open-source development. The latter is very important to us as EIP should be a web solution. Another issue Christensen addresses frequently is that you shouldn't try to cram a disruptive innovation into an existing solution. We are currently creating a project to investigate EIP and we are looking for collaboration on any project that can help us co-evolve.

With the knowledge sharing over social software projects we did become involved with Drupal. Drupal is an open source content management system that is a good framework for investigating web development. It is seen as a very good framework to investigate EIP, but there is no concrete project yet. With the buildup knowledge we did see an opportunity in teaching, by creating an alternative to a programming course. After a two-years-tryout the course got named Web Service Development for Business. In the course we teach students how to make a web service using open source solutions. Students are required to develop their service by using Drupal. It is a living lab setting that mimics the community collaboration. We will continue to explore this opportunity, but again it will depend on the alliances that can be made. For both the teaching as the research projects we stay explicitly vague. We do have several ideas, but ideas are cheap. From the theory, a great pressure to act is imposed on us. Currently we are in a constant battle. On the one hand it is clear that we still need to polish the theory so that people can understand and approve it. On the other hand, we need to act to get facts. The theory is under pressure (by itself) to be applied and co-evolve with other projects to retrieve feedback from its environment.

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