TOWARDS AN ONTOLOGY OF INNOVATION MODELS – A CONCEPTUAL FRAMEWORK

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TOWARDS AN ONTOLOGY OF INNOVATION MODELS – A CONCEPTUAL FRAMEWORK

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Abstract

Management literature is renowned for producing concepts and models but few of these are ever translated into software-based tools - even though they could offer value to managers. Innovation models are theoretical constructions that attempt to abstract from reality a set of interesting features that are useful in describing, explaining, and predicting the reality of the innovation processes in organisations. But it is troubling to find that even the latest models emanating from the academic discourse fall well short of organisational reality. The objective of this paper is to recast the concept of the innovation model but this time from a strong theoretical base. We, therefore, start by presenting a conceptual framework for the innovation processes in organizations. From this we set out to develop an ontology that defines the words and sentences that can be used to represent innovation models. So we do not seek to present yet another model of innovation but instead we work towards a conceptually derived ontology of innovation models that can provide a foundation for future software-based tools. We suggest that computer-aided innovation modelling is an interesting area of research deserving of future attention.

Keywords: innovation, innovation model, ontology, conceptual framework.
1 Introduction

Innovation is increasingly regarded as an evolutionary, non-linear, and interactive process involving a focal organisation as well as actors and sources of knowledge from both inside (e.g. R&D, production, marketing, distribution, etc.) and outside (e.g. customers, suppliers, universities, research centres, etc.) its boundaries (Kline and Rosenberg, 1986). While there is general acceptance of this depiction of innovation, we continue to fall short in our theorising of the phenomenon. Innovation research continues to be fragmented, poorly grounded theoretically, and lacking empirical justification (Crossan and Apaydin, 2010, Drazin and Schoonhoven, 1996, Wolfe, 2004). Indeed the most consistent result emerging from innovation studies is inconsistencies in their findings (Wolfe, 2004).

Mohr (1982) suggests that a major contribution to the problem is our insistence on adopting the multi-dimensional concept of the organisation - it is too inclusive to have constant meaning within and across studies. Instead some scholars (e.g. Abbott, 1992, Crowston, 1997, Damanpour and Wischnevsky, 2006, Mohr, 1982) recommend that innovation theory should recognize the substantive differences between organizations at the level of the innovation process. So the question becomes “not what structural form an organization has, but what process it uses to accomplish a particular task” (Crowston, 1997 p. 158). Adopting this advice, there have been numerous attempts at imposing some sort of conceptual order on the innovation processes of organisations. For instance, innovation models are theoretical constructions that attempt to abstract from reality a set of interesting features that are useful in describing, explaining, and predicting the reality of the innovation process (Padmore and Gibson, 1998). But the oft cited generations of innovation models presented by Rothwell (1994) and others are more likely to be artefacts of misguided inspiration than a true reflection of innovation practice within organisations (Hobday, 2005, Ortt and van der Duin, 2008).

The consensus is that even the latest innovation models fall well short of the reality of innovation in organisations (Crossan and Apaydin, 2010, Hobday, 2005, Mahdi, 2002). It is troubling to find that decades of effort at taming and putting some conceptual order on the innovation process has largely failed. The objective of this paper is to address this issue and to recast the concept of the innovation model but this time from a strong theoretical base. We do not seek to present yet another model of innovation but instead we commence development of an ontology, which addresses the research question of how innovation models should be described in order to provide a foundation for future concepts and tools. The work of Osterwalder and colleagues (c.f. references) in the area of business models has provided no small inspiration for what we attempt here. We see no reason why innovation models cannot bridge the gap between theory and practice similar to what business models are now doing for organisational management.

It is important to note the difference between an ontology, a model, and an implementation. An ontology is an agreed “set of concepts e.g. entities, attributes, processes, their definitions and their inter-relationships” used to represent a complex reality (Uschold and Gruninger, 1996 p. 5). Here ontology refers to the language to be used to represent the innovation models of organisations. A model is "a simplified description and representation of a complex entity or process” (Osterwalder et al., 2005 p. 4). Here model refers to a representation of the innovation process within an organisation. While the model is the conceptualisation, the implementation is the actualisation of that model in reality in an organisation. While a model cannot be a success or a failure per se, an implementation of a model may be.

The work presented in this paper is the result of an ongoing design science study involving the iterative design, build, and evaluation of an artefact for visualising innovation in organisations. The ontology presented in this paper is the foundation upon which the artefact is being built. As will later become clear, the ontology is built from kernel theories pertaining to organisational innovation, knowledge, and management. The ontology is being evaluated through observing the ability of academics and practitioners to use the visualisation to capture, communicate, share, measure and compare the innovation models of individual organisations. The remainder of this paper is structured
as follows. We begin by introducing the theoretical foundations for our work and the section culminates in the presentation of a conceptual framework for innovation in organisations. In the following section we use the framework to identify and describe pillars of a proposed ontology of innovation models. The paper terminates with some brief concluding remarks.

## 2 Conceptual Review of Innovation

Some scholars (e.g. Hansen and Birkinshaw, 2007, Kandybin, 2009, Kandybin and Kihn, 2004, Koen et al., 2001) albeit using slightly different terminology view the process of innovation as consisting of the generation, selection, development, and commercialisation of ideas – see Table 1.

<table>
<thead>
<tr>
<th>Generation</th>
<th>Selection</th>
<th>Development</th>
<th>Commercialisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The process starts with the generation of good ideas. Viable ideas are usually ignited when fragments of knowledge come together from different sources – both internal and external. Idea generation may be either market-pull (through market needs) or technology-push (through technology advances).</td>
<td>The pool of ideas generated in the previous stage is funneled into a smaller number of funded projects. Not only is it possible to miss some good ideas but accepting too many ideas is also an issue resulting in too many ‘bad’ ideas being funded and resources being wasted on projects that never reach market.</td>
<td>The funded projects are developed into revenue-generating deliverables. Expediting development lowers the costs (both direct costs of producing the deliverable but also opportunity costs of not being able to produce other deliverables) and allows the organisation more flexibility in its planning.</td>
<td>Attention now begins to switch from the innovation value-chain to the product supply-chain to ensure that deliverables are “where they need to be when they’re needed” and to promote and market them intelligently. This depends on getting buy-in both internally and externally.</td>
</tr>
</tbody>
</table>

Table 1: Stages of knowledge progression (after: Hansen and Birkinshaw, 2007, Kandybin and Kihn, 2004)

While there is considerable value in viewing innovation as stages it hides the variety and complexity of the individual activities that occur both within and across stages. These activities can be separated into two categories: (1) those that directly contribute to the process in achieving its purpose and (2) those that indirectly contribute to the process through managing the direct activities and the resources they require (Crowston, 1997). This conceptual separation is useful in distinguishing between different types of activities, which we refer to here as core and enabling activities respectively. The enabling activities are a particularly variable part of most processes and can differ widely from one organisation’s execution of a process to another’s (ibid). While many organisations may on paper undertake the same core innovation activities, differences in their performance is often down to how they enable the execution of these core activities. The influence of the enabling activities on the effectiveness and efficiency of processes should not, therefore, be underestimated. We suggest that both the core and enabling activities can vary significantly within and across the stages of innovation and their conceptualisation is crucial to our understanding of innovation.

### 2.1 Core Actions – Innovation Search Activities

In viewing the innovation process of organisations we adopt a knowledge perspective. The underlying knowledge of organisations can be conceptualized as consisting of stocks and flows (DeCarolis and Deeds, 1999, Dierickx and Cool, 1989, Gregersen and Johnson, 1997), where “[s]tocks of knowledge are accumulated knowledge assets which are internal to the firm and flows of knowledge are represented by knowledge streams into the firm or various parts of the firm which may be assimilated and developed into stocks of knowledge” (DeCarolis and Deeds, 1999 p. 954). Unfortunately many organisations face a knowledge gap whereby their current knowledge stock is not at a sufficient level to garner value from their innovation efforts (Hall and Andriani, 2002). They, therefore, undertake innovation search to combine knowledge from both internal and external sources (Katila, 2002, Katila and Ahuja, 2002).

The challenge for organisations is to turn this knowledge into exploitable knowledge (Kogut and Zander, 1996). This conversion concerns the absorptive capacity of the organisation, which Zahra and George (2002 p. 186) define as the ability “by which firms acquire, assimilate, transform, and exploit
knowledge”. The purpose of absorptive capacity can thus be seen as explaining why some organisations are able to effectively leverage knowledge while others struggle to utilize the same knowledge. The absorptive capacity of an organisation is related to its stock of knowledge, whereby a larger stock enables the organisation to benefit more from external flows of related knowledge (Dyer and Singh, 1998, Fabrizio, 2009, Lane and Lubatkin, 1998). So the ability of the organisation to leverage knowledge is also down to the absorptability or relatedness of the knowledge, whereby knowledge more proximate to its internal stock of knowledge is easier to leverage (O’Raghallaigh et al., 2010). But at the same time there is little to be learned by an organisation unless the knowledge is sufficiently diverse from its internal stock of knowledge (ibid). In summary proximity promotes learning while diversity promotes novelty. Two important dimensions of proximity and diversity are territorial and cognitive distances, where the former is the geographical proximity of the knowledge source to the focal firm and the latter is the familiarity of the knowledge source to the focal firm (ibid). Territorial proximity is important as smaller distances can facilitate more intense interactions, reduce institutional and culture differences, and thereby promote knowledge transfer, especially of sticky tacit knowledge (ibid). On the other hand cognitive proximity is important as larger distances promote novelty (ibid).

2.2 Enabling Controls – Innovation Control Activities

Enabling controls are part of the organisation’s management control system, which is an array of control mechanisms for organising, coordinating, and controlling to ensure that organisational objectives are met (Ditillo, 2004). While control generally is recognized as a fundamental management activity, historically control issues have received only fleeting and fragmented attention in the academic discourse (Ditillo, 2004, Jaworski, 1988). Traditionally control systems emphasise ‘execution rather than exploration’ (Davila et al., 2009). But innovation efforts prosper in environments that promote experimentation (Amabile, 1999). Management control, through imposing constraints on behaviour, would, therefore, be expected to reduce the creativity that may be necessary when innovating (Amabile, 1999, Davila et al., 2009, Ditillo, 2004). Indeed advice typical of the literature is that “the role of management control systems in ... innovation settings should be minimal” (Davila et al., 2009 p. 282). But if a control system is defined “in a broader, behavioral sense to include everything that helps ensure that the people in the organization are acting so as to implement properly the strategy that has been agreed upon” (Merchant, 1988 p. 40) then the situation is less clear. In recent years, changing business environments are challenging organisations to improve the management of their innovation efforts. “More prosaically, this means organizations need to be able, for example, to provide sufficient freedom to allow for the exploration of creative possibilities, but sufficient control to manage innovation in an effective and efficient fashion” (Adams et al., 2006 p. 32). The result is that a recent review of the literature finds that control is indeed relevant to innovation (Davila et al., 2009).

Management controls can be broadly categorized into formal and informal controls (Jaworski, 1988). Formal controls, which are mostly documented and are explicitly management-authorised (Anthony, 1965), influence behaviour through, for example, budgets, output targets, standards, policies, etc. On the other hand, informal controls, which are mostly unwritten and social controls (Jaworski, 1988), influence behaviour through organizational culture, norms, values, routines, etc. So unlike the latter, which result from worker behaviour, the former are ‘management-initiated mechanisms’ (Jaworski, 1988). Categorisation of controls based on formality makes sense as it divides those controls in which managers have a direct interest (i.e. formal controls) from the remainder (i.e. informal controls) (Merchant, 1988). For example, Anthony (1965) suggests that scholars should focus their attention primarily on formal controls because, by definition, managers can design such controls whereas they cannot design informal systems - although they may influence them.
2.3 A Synthesis - A Conceptual Framework for Innovation

From a pragmatic perspective knowledge is only valuable to an organisation when put to some commercial use. Schumpeter (1934) defines innovation as the commercial or industrial application of something new. The value of knowledge is, therefore, directly related to its commercialisability and this implies that knowledge further advanced in its journey towards market is more valuable than knowledge beginning the same journey. Here we depict the journey of knowledge from its initial generation towards market as an innovation funnel – see Figure 1. We are not the first in adopting the concept of the innovation funnel (c.f. Wheelwright and Clark, 1992) nor in viewing innovation as a journey (c.f. Van de Ven et al., 1999). Generation, selection, development, and commercialisation represent the evolutionary stages through which the knowledge passes. We do not intend implying a well-behaved single, orderly, and linear journey. While becoming somewhat more structured during its later stages, the journey is more often than not chaotic, unpredictable, and unstructured (Koen, 2004). As the knowledge proceeds through the funnel it becomes more constrained by different organizational factors such as goals, procedures, resources, etc. (Alves et al., 2007). The journey is marked by dead-ends, re-births, and reversals as the knowledge is rejected, re-introduced, or reworked (Cagan and Vogel, 2002).

![Innovation: A conceptual framework](image)

*Figure 1 – Innovation: A conceptual framework*

Therefore for innovation in any organisation to prosper, the organisation must actively manage its innovation funnel through coordinating and integrating Actions and Resources. This is done through Controls, which periodically monitor the Results emerging from the end of the funnel (as well as the intermediate outputs from each stage within the funnel) and compare these with the Goals of the organisation. The Goals are the objectives of the organisation’s innovation efforts. Actions are the activities that seek out knowledge from various proximate and diverse sources in order to create value through new combinations. Actions are essentially the means through which knowledge is moved through the funnel towards market. But Actions are only effective when supported by sufficient Resources. Knowledge emerges from the funnel as Results, which are commercialisable deliverables in the form of innovative products, processes, etc.
3 The Pillars of an Ontology of Innovation Models

A critical dynamic for an organization is that a process exists to regularly bring its stakeholders’ mental models into the open where they can be discussed, appraised, and challenged (Senge, 1993). But the mental models in use in organizations are oftentimes poorly articulated (if at all) with the result that learning becomes dysfunctional (Mahoney and Sanchez, 2004). Allied to this is the absence of both a common language and a common means of representing many domains of knowledge within organisations. In this section we begin to address this language issue through developing an ontology that builds on the conceptual framework from the previous section to define the words and sentences that can be used to represent the innovation models of organisations. This task is far from straightforward as the extant innovation literature has to date provided little continuity in its use of concepts and definitions (Garcia and Calantone, 2002). The cornerstone of any ontological approach is a shared conceptual framework for modelling domain knowledge (Uschold and Gruninger, 1996). The ontology of innovation models presented here is built around the five pillars of Goals, Resources, Actions, Controls, and Results from the framework (see Figure 1). We further decompose these pillars into the building blocks that we suggest are necessary to represent models of innovation. We define the innovation model as a conceptual tool that contains a set of elements and their relationships that allows expression of the schema through which an organization generates (or might generate) innovations. It is a description of resource flows (with particular emphasis on knowledge flows) through a network of internal and external actors and activities with the aim of meeting the innovation goals of the organization. Or put more succinctly innovation models focus on the logic of capturing value from combinations of new and existing knowledge.

3.1 Goals Pillar

Innovation within an organisation is essentially about creating new value rather than new ‘things’ (Sawhney et al., 2006). While an organisation’s business model describes what value the organisation offers (Osterwalder et al., 2005), its innovation model explains how the organisation creates this value. The latter therefore describes how the organisation generates the value demanded by a new or changing business model. The innovation model ontology should, therefore, dovetail with business model ontologies. The Goals pillar (of the innovation model ontology) is a multi-dimensional concept that represents the value added to the business model through changes to its Product, Customer Interface, and Infrastructure elements (c.f. Osterwalder and Pigneur, 2002). This injection of value in turn contributes to the financial well-being of the organization, thereby impacting the Financial element of the business model (ibid). According to Osterwalder and Pigneur (2003) the Product element describes the value proposition of the organisation in terms of the goods and services it offers to customers. The Customer Interface element describes how the organisation interacts with its customers and what kind of relationships it establishes with them. The Infrastructure element describes what processes, resources, and partners are necessary to support these first two elements. We, therefore, suggest that the Goals of any innovation model should be expressed in terms of Product, Customer Interface, and Infrastructure Management building blocks. It should be noted that the Goals of an organisation may be both deliberate and emergent, where the former are formulated during a planning stage, whereas the latter are formulated at implementation (Mintzberg, 1978).

3.2 Resources Pillars

To foster innovation within organisations, resources must be distributed deliberately based on pre-defined goals (Alves et al., 2007). Christensen (2006 p. xvii-xviii) argues that “organizations successfully tackle opportunities when they have the resources to succeed, when their processes facilitate what needs to get done, and when their values allow them to give adequate priority to that particular opportunity in the face of all other demands that compete for the company’s resources”. Here resources are what the firm has, processes are how a firm works, and values are what a firm wants to do. Innovation resources are widely portrayed as including Funding, Human, Facility, and
Investing in basic search allows organisations to embrace the concept of knowledge spillovers where innovation is not restricted by traditional market boundaries (Souitaris, 2001). Unlike market activities, which are essentially arms-length transactions of goods and services, dynamic activities require the active participation of the recipient organisation in the process of knowledge acquisition (Cassiman and Veugelers, 2002). Territorial proximity heightens the likelihood of knowledge spillovers between organisations (Saxenian, 1990) and dynamic activities are, therefore, more likely to thrive at lower spatial levels than market activities. We suggest that the Actions pillar of any innovation model should be expressed in terms of the six resulting categories of search activities – see Table 2.

<table>
<thead>
<tr>
<th>Funding</th>
<th>Adequate funding is clearly a critical input into the innovation process and funding may need to be designated to specific activities.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>People factors include the number and mix (with respect to their cosmopolitanism, propensity to innovate, skills, experience, and education) of people committed to the innovation tasks. Members with higher levels of education and self-esteem from diverse backgrounds increase the effectiveness of innovation project teams.</td>
</tr>
<tr>
<td>Facilities</td>
<td>Facilities or physical resources is a broad category that ranges from buildings to computer equipment. Slack resources or unused capacity can in some cases be an important catalyst for innovation, whereby slack provides the opportunity for diversification, fosters a culture of experimentation, protects against the uncertainty of project failure, and allows failures to be absorbed. However, in other cases slack becomes synonymous with waste and is a cost that must be eliminated.</td>
</tr>
<tr>
<td>Tools</td>
<td>Use of systems and tools is an important support for innovation in organizations. Tools can be of various sorts, including tools and techniques for promoting creativity and systems of quality control ranging from informal methods to specific techniques such as total quality management (TQM).</td>
</tr>
</tbody>
</table>

**Table 2 - Building Blocks of the Resources Pillar (after: Adams et al., 2006)**

### 3.3 Actions Pillar

O’Raghallaigh et al. (2010) categorise activities according to the cognitive and territorial proximity of the searched knowledge to the existing knowledge base of the organisation. They divide the cognitive dimension into basic and applied search activities, where according to Cassiman and Valentini (2009) the former pertains to developing new knowledge, while the latter is the exploiting of existing knowledge. Similarly Li et al. (2008) distinguish between search for knowledge or technology within and outside an organisation’s existing technology field. We adopt this distinction to define the concepts of applied and basic search respectively. Investing in basic search allows organisations to expand their technological boundaries, and hence enhance their performance, not only through facilitating the emergence of breakthrough results, but also through increasing their understanding of the potential implications of applied research (Gambardella, 1992). On the other hand, applied search is more often associated with incremental-type innovations (Li et al., 2008). Organisations need to decide how much of their innovation efforts to devote to each.

Activities along the territorial dimension can be divided into internal, dynamic, and market search categories (O’Raghallaigh et al., 2010). Internal search activities focus on the acquisition of knowledge within the boundaries of the organisation. Market search activities focus on acquiring external knowledge through market-driven transactions, such as inward-licensing, purchasing of patents, purchasing of equipment, etc. The knowledge may be acquired in either an embodied (e.g. in machines and equipment) or disembodied (e.g. through licensing agreements or R&D outsourcing contracts) state. Although most of the existing studies on the effects of external acquisition focus on disembodied knowledge sourcing, the impact of embodied knowledge is by no means negligible and should not be underestimated (Evangelista, 1999). It is also possible to acquire external knowledge without engaging with the market. Dynamic activities refer to efforts at acquiring external knowledge through cooperating with external organisations (such as suppliers, customers, and universities) and scanning external information sources (such as by attending conferences, reading scientific publications, and reading technical reports) (Souitaris, 2001). Unlike market activities, which are essentially arms-length market transactions, dynamic activities require the active participation of the recipient in the process of knowledge acquisition (Cassiman and Veugelers, 2002). Territorial proximity heightens the interactions and knowledge spillovers between organisations (Saxenian, 1990) and dynamic activities are, therefore, more likely to thrive at lower spatial levels than market activities. We suggest that the Actions pillar of any innovation model should be expressed in terms of the six resulting categories of search activities - see Figure 2.
Three types of formal controls can be distinguished by the timing of management intervention (i.e., input to output) (Jaworski, 1988). **Resource Controls** are measurable actions taken by management prior to implementation of a process (i.e., through resource allocations). An example is a budget which constrains the expenditure on and hence the allocation of human, material, and financial resources (Daft, 1998). **Process Controls** are actions taken by management in order to influence the behaviour of actors and/or activities involved in a process (i.e., through altering operating procedures and behaviours). An example is a reward system which provides incentives to staff to demonstrate desired process behaviours (Daft, 1998). **Result Controls** are actions taken by management in setting, monitoring, and evaluating performance standards (i.e. through altering output targets). An example is a statistical report which provide information about volume, quality, and other outputs (Daft, 1998).

From extant literature we identify two types of informal controls – **Self Controls** and **Clan Controls**. Through Self Control individuals establish personal objectives, monitor their own performance, and adjust their own behaviour if off course (Jaworski, 1988). While Self Control is not a traditional management control it is not the same as having no control. Clan Control is a broad term that includes the use of social characteristics, such as corporate culture, shared values, commitment, traditions, and beliefs, to control behaviours (Daft, 1998). “[C]lans rely upon a relatively complete socialization process which effectively eliminates goal incongruence between individuals” (Ouchi, 1979 p. 833). The socialization process within an organisation is unique and is achieved through the “slow accumulation of organizational stories, rituals, legends, and norms of social interaction” (Jaworski, 1988 p. 27). This information cannot be easily accessed by an outsider unless the individual goes through an ‘acclimation period’ within the organisation (Ouchi, 1979). The directives come from the resulting internalization of values and mutual commitment toward some common goal (Jaworski, 1988). When the values of the clan are violated, the clan exert covert and/or overt control on the ‘deviant’ member to comply (ibid). We suggest that the Controls pillar of any innovation model should be expressed in terms of the following categorisation of control mechanisms - see Figure 3.

### Figure 2 - Building blocks of the Actions Pillar (after: O'Raghallaigh et al., 2010).

<table>
<thead>
<tr>
<th>Cognitive Proximity</th>
<th>Internal</th>
<th>Territorial Proximity</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>New knowledge is generated, usually intentionally, by employees. The generation of new knowledge is the primary purpose of the activities.</td>
<td>New knowledge is generated by employees through direct (e.g. collaboration) and indirect (e.g. scanning) engagements with knowledge providers.</td>
<td>New knowledge is generated through the acquisition of knowledge typically disembodied from assets through contracting, licensing, training, consultancy, etc.</td>
</tr>
<tr>
<td>Source: R&amp;D department, R&amp;D projects, etc.</td>
<td>Source: Private and public research institutes, universities, etc.</td>
<td>Source: R&amp;D outsourcers, licensees, consultants, etc.</td>
<td></td>
</tr>
<tr>
<td>Applied</td>
<td>Knowledge is generated, usually unintentionally, by employees in going about their day-to-day activities. The knowledge is highly related to existing knowledge.</td>
<td>Knowledge is generated by employees through direct (e.g. collaboration) and indirect (e.g. scanning) engagements with value chain partners. The knowledge is pre-existing in the value-chain.</td>
<td>Knowledge is generated internally through the acquisition of knowledge typically embodied in assets. The knowledge is pre-existing in the market.</td>
</tr>
<tr>
<td>Source: Internal operations (e.g. engineering, manufacturing, production, sales, marketing, etc.)</td>
<td>Source: Vertical partners (e.g. customers, suppliers) and horizontal partners (e.g. competitors),</td>
<td>Source: Vendors offering machinery, equipment, software.</td>
<td></td>
</tr>
</tbody>
</table>

### 3.4 Controls Pillar

Three types of formal controls can be distinguished by the timing of management intervention (i.e., input to output) (Jaworski, 1988). **Resource Controls** are measurable actions taken by management prior to implementation of a process (i.e., through resource allocations). An example is a budget which constrains the expenditure on and hence the allocation of human, material, and financial resources (Daft, 1998). **Process Controls** are actions taken by management in order to influence the behaviour of actors and/or activities involved in a process (i.e., through altering operating procedures and behaviours). An example is a reward system which provides incentives to staff to demonstrate desired process behaviours (Daft, 1998). **Result Controls** are actions taken by management in setting, monitoring, and evaluating performance standards (i.e. through altering output targets). An example is a statistical report which provide information about volume, quality, and other outputs (Daft, 1998).
Formal

Allocations of financial (e.g. budget, quotas, etc.), human (e.g. skills, experience, innovativeness), facilities (e.g. buildings, R&D laboratory), tools (e.g. equipment, software, hardware) and material (e.g. raw materials) resources.

Process

Enforcement of plans, procedures, organizational structures, rules, regulations, policies, and reward systems.

Results

Enforcement of targets (e.g. output type - product, process, etc., volumes, quality, efficiency goals), statistical reports.

Informal

Organizational traditions (stories, rituals, legends, ceremonies), commitment, norms, values, beliefs, and culture.

Figure 3 - Building blocks of the Controls Pillar.

3.5 Results Pillar

Innovation is not restricted to technological advances but instead can take place along any dimension of a business model (Sawhney et al., 2006). We expand on the previously discussed pillars of a business model to identify a broad range of innovations. One or more innovations are generally required in order for the organisation to achieve its innovation goals. For instance a new product that is technologically superior to those of competitors can still fail because it lacks an effective distribution or sales channel. We suggest that the Results pillar of any innovation model should be expressed in terms of the categorisation of innovation presented in Table 3.

<table>
<thead>
<tr>
<th>Offerings</th>
<th>These are goods and services offered by the organisation and that are valued by its customers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform</td>
<td>This is a set of common components, assembly methods or technologies from the organisation that serve as building blocks for a wider portfolio of offerings.</td>
</tr>
<tr>
<td>Solutions</td>
<td>This is the customized, integrated combination of offerings from the organisation that solves a customer problem.</td>
</tr>
<tr>
<td>Customers</td>
<td>This is the discovery by the organisation of new customer segments or the uncovering of unmet (and sometime unarticulated) customer needs in existing segments.</td>
</tr>
<tr>
<td>Customer Experience</td>
<td>This includes everything a customer sees, hears, feels and in general experiences while interacting with the organisation and its offerings.</td>
</tr>
<tr>
<td>Value Capture</td>
<td>This is the mechanism that the organisation uses to capture revenue streams from the value it creates.</td>
</tr>
<tr>
<td>Processes</td>
<td>These are the configurations of business activities that the organisation uses to conduct internal operations.</td>
</tr>
<tr>
<td>Organization</td>
<td>This is the way in which the organisation is structured, its partnerships, and its employee roles and responsibilities.</td>
</tr>
<tr>
<td>Supply Chain</td>
<td>This is the sequence of agents, activities and resources required by the organisation to move its offerings from source to the customer.</td>
</tr>
<tr>
<td>Points of Presence</td>
<td>These are the channels and the outlets that the organisation employs from which its offerings can be bought or used by the customer.</td>
</tr>
<tr>
<td>Networking</td>
<td>This is the network through which the organisation and its offerings are connected to the customer.</td>
</tr>
<tr>
<td>Brand</td>
<td>This is the set of symbols, words or marks through which the organisation communicates a promise to the customer.</td>
</tr>
</tbody>
</table>

Table 3 - Building blocks of the Results Pillar (after: Sawhney et al., 2006)

However, we need to recognise that an organisation can innovate by either producing deliverables through its own inventive activities or alternatively obtaining them from external sources (Arundel et al., 1998). The latter involves “no intellectual, inventive, or creative effort whatsoever”, while the former does (ibid p. 31). These two aspects of innovation are referred to as innovation through inventive effort and innovation through adoption (ibid). The ways in which each approach is managed is likely to differ greatly.
4 Concluding Remarks

Management literature is renowned for producing concepts and models but few of these concepts have been translated into software-based tools, even though they could bring considerable value to management (Osterwalder et al., 2005). The designing, visualizing, and evaluation of innovation models could be done quickly, once software-based tools have been developed. We suggest that computer-aided innovation modelling is an interesting area of research deserving of future research attention. “Once the objects, elements, and relationships of ... [a] model concept are defined, a set of software-based tools can be built to simplify the life of managers” (Osterwalder et al., 2005 p. 26). A fundamental contribution of the ontology of innovation models presented here is, therefore, to provide an initial but important foundation for a set of new computer-assisted innovation management tools. To paraphrase, Osterwalder and colleagues (2005 p. 24): “In fact, specifying a set of innovation model elements and building blocks, as well as their relationships to each other, is like giving an innovation model designer a box of Lego stones. He can play around with these stones and create completely new innovation models, limited only by his imagination and the pieces supplied”.

References


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