Ruling the Innovation Game: The Role of Flexibility, Transparency, and Participation

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Abstract

In this paper we put forward the notion that resources have three attributes that predominantly impact on their innovation potential: flexibility, transparency, and participation (FTP). The design of these attributes may be subject to delibarate limitation or expansion depending on the power balance between producers and users. Most importantly, not only are there benefits associated with FTP but considerable costs, too. Proper valuation and due pricing of those attributes suffer from the adverse effects of uncertainty. Hence, there is little prospect of fully overcoming the economic conflicts involved in innovation processes.

1 Introduction

Innovation is vital to any society based on continued and sustained growth, for it constitutes a crucial means of creating new sources of value. Consumers gain access to more value, and producers may accrue superior profits until the competition catches up.[1] Without innovation economic stagnation would likely ensue, for technological progress is *the* most important source of economic growth.

Most analyses, however, confine innovation to the boundaries of a single firm and their ability to innovate and incorporate outside contributions to innovations. While this approach is entirely reasonable if one assumes the locus of innovation to reside *within* the firm, it becomes much more futile if we subscribe to the somewhat more realistically view that innovation is a process that inevitably involves inputs from a whole host of sources that evade both the "command and control" of a firm and the fully efficient transactions of a market (von Hippel 2005). While there is a grain of thruth in our deep seated cultural understanding of innovation as the efforts of bright individuals far off the happy medium creating new knowledge, art, and artifacts in solitary and heroic efforts – all parts of an innovation may well be traced to individuals and their respective contributions –, the process of innovation is always a *social* process by definition involving more than one individual (Stefik and Stefik 2004).

Since innovation always builds on existing resources, both tangible and intangible, and a given context it arises from and may be put into a deeper look at the properties of those requisite existing resources and the institutional factors shaping them may offer direction as to due policy implications. The paper proceeds as follows. First we shall briefly introduce the notion of innovation and its known prerequisites. Then we shall introduce the notion of "innovation potential" as a property of resources, and draw conclusions as to the implicatons stemming from such modelling.

2 The Innovation Game

We may best think of innovation as the "use of an existing resource in an novel and nonobvious way such that new value is being created and dissipated through society". An innovation may be the result of an improvement of an existing ressources, the recombination of existing ressources, or a completely new ressource. Crucially, we may only speak of an innovation if the underlying invention diffuses in a sizable manner. An invention may well be novel, non-obvious, and capable of commercial application, yet it may not

[1] In a competitive environment an innovation typically allows for product differentiation resulting in an improved ability of accruing surplus to the producer until others find ways to substitute for or copy the underlying invention (Schumpeter 1942).

be taken up by anyone and thus not qualify as an innovation.[2]

While earlier models have considered innovation as a mostly linear process, it has been rather clear for some time now that a host of parties are involved in the successful creation of innovations. Innovation might best be understood as an interdependent process that involves feedback cycles "between research, the existing body of scientific and technological knowledge, the potential market, invention, and the various steps in the innovation process" (Kline and Rosenberg 1986). Drawing on modern innovation research and data from the EU and OECD Mytelka and Smith (2001) summarise the current knowledge about innnovation as follows:

- Innnovation happens both in high-tech and in low-tech industries.
- Firms invest in a host of innovation inputs, including training, prototyping, design development, capital goods acquisition, and market research.
- Firms rarely innovate without technological cooperation or collaboration with other firms, organisations, science, etc.
- Innovation involves serious economic and technological uncertainty that make prediction of paths of innovations practically impossible

These findings correspond with subsequent research by Segelod and Jordan (2002a), Segelod and Jordan (2002b) in the field of software development. They have found that external linkages are vitally important for a software firm's ability to innovate, and that consumers are the most important linkage in this respect. Glor (1998) summarises some of the research on the organisational conditions for innovations and concludes similarly that cooperation, collaboration, redundancy, variety, and intrinsic motivation are important factors affecting innovation.

We have noted above that innovation is always grounded in existing and accessable resources of various sorts. And, while innovations sometimes happen out of serendipity or sheer genius, most of the time they involve sober and conscious efforts directed towards the solution of a *problem* (Hargadon 2003). It is very important to note that an innovation is typically a response to or, indeed, a function of a changed environment. Further, few if any things exist in complete isolation, most things derive significant value from the very context they reside in. In short, a change in an environment will likely give rise to problems not adequately addressed by existing solutions, and require innovative solutions different from the ones that earlier sufficed.

[2] Just enter "funny patents" into Google and you will come across patents granted for arguably utterly silly and useless inventions like an "Apparatus for facilitating the birth of a child by centrifugal force" or a " Light Bulb Changer".

The ease with which such innovations may be derived from existing resources and resource systems thus depends on the *innovation potential* of these existing resources. Such potentials may in turn hinge on more tangible and quantifiable properties of the respective resources subject to both conscious and unconscious design and implementation decisions of the stakeholders involved.

3 Transparency, Participation, and Flexibility

Sandvig (2003), critically discussing the merits of the end-to-end argument[3] as an explanation for the innovativness of the internet, has proposed a set of three properties that may better explain for the innovativeness of the internet: *flexibility, transparency, participation.*[4] The more general hypothesis we may draw for this paper is that metrics or indications of flexibility, transparency, and participation (FTP) make for a more generally applicable quantification of innovation potentials of resources serving as an inputs to innovation. Put briefly, the more transparent, participatory and flexible a resource, the better it allows for innovations adjacent to it, or innovative enhancements of the resource itself.

It is obvious that a resource's flexibility decisively impacts upon the possibility of using it in an innovative fashion. A resource that is dedicated to but one specific use will make it much harder to put it to new uses compared to a general purpose resource or one that may easily be changed. A similar argument goes for transparency. A resource whose inner workings and functionalities are transparent to the user will make it much easier to amend or to build upon it. Subsequent negotiations may be hindered not only by transaction costs but by strategic consideration on part of the producer, too. Last, allowing for participation of diverse and heterogeneous parties will tend to increase the cumulative utility of all parties involved.

Anecdotal evidence seems to support this claim. E. g. Shirky (1998) argues that HTML grew so tremendously successful as a basis of higher layer applications not due to its technical superiority but due to the fact

[3] The end-to-end argument has first been discussed by Saltzer, Clark, and Reed (1984), and has come to be increasingly popular in current discussions over innovation on the internet.

[4] We take the flexibility of a resource to refer primarily to the breadth of its possible applications. The existing continuum spans from resources that are a general purpose nature to resources that specifically target one application. Sometimes, of course, the breadth of usages may not be foreseeable and turn out to be larger than anticipated. Second, flexibility refers to the ease with which a resource can be amended such that it fits new purposes. Transparancy relates to the degree of openness and intelligibility of an artifact. In most cases this will entail a proper specification of all interfaces. Last, participation refers to the level of involvement of diverse and heterogeneous parties both potentially and factually.

that it was open and easy to understand, participatory in its evolution, and flexible in its application. Hence it provided for a maximum of unforeseen uses that resulted in the host of innovations based upon it.[5]

All three properties – flexibility, transparency, and participation – are interrelated. Participation as an "indirect property" of an artifact depends crucially upon the transparency and flexibility of that artifact. A resource can only ever be participatory if its functionality, i. e. its interface, is open and intelligible. And, it can only be amended if the resource is flexible so as to allow for amendments. In software this generally implies openness and intelligibility of the interface and availability of the source code.

[5] Let us briefly digress to look at the HTML example more closely. The history of HTML provides a good case for the claim that high degrees of flexibility, transparency, and participation allow for a maximum of innovation at subsequent stages. Starting from a clumsy document format that defied state of the art thoughts among computer scientists about hyperlinking it developed to the internet's most widely used document format and interface for server applications. HTML has been gradually improved by amendments to its specification and the supplementation with artifacts like CSS and JavaScript.

Had HTML from its inception been proprietary it would never have developed the way it did. Its openness provided for the opportunity for everyone to create websites not just people who had access to editors dealing with a possibly proprietary format. While Tim Berners-Lee chose to design HTML to be easily intelligable the repercussions were surprising to him as to anyone. Indeed, he did not anticipate or plan that people would look at the HTML code of websites at all. He then thought they would rather be using editors to this end (Berners-Lee and Fischetti 1999). History has shown that it was the very openness and intelligibility of HTML that proved a vital blessing to its dissemination and acceptance.

But not only was HTML open, it evolved in a participatory process where stakeholders such as browser makers implemented new tags that found their way into the HTML standard. One current example is the discussion on CSS3, a web standard by the W3C consortium, which will include a new CSS propertiy called *border-radius*. For some time people have sought ways to smooth the edges of boxes on their websites. To this end they have devised a host of intricate solutions typically involving the inclusion of image files. The desire to have smooth edges has led Mozilla developers to implement the *-moz-border-radius property* which considerably facilitates the smoothing of edges in web pages.

If a browser does not interpret this property it will rendered boxes with conventional sharp edges. That is, coding websites with the *border-radius* property will not break them in browsers that do not interpret the new property. The improvement of the standard is thus backward compatible. If a sufficient number of stakeholders consider this property useful it will likely find its way into the CSS3 standard, and other browsers like Internet Explorer will eventually follow suit. It is apparent that the need for this property could never have reasonably been foreseen be Tim Berners-Lee or anyone at the time HTML was first put forward. It is the flexibility and evolutionary nature of the development of HTML/CSS that has made possible this resonable and due amendment to the standard.

Attribute	Con	Pro
Flexibility	Incentive to control and restrict scope of application, costs due to dependency changes, complexity	Intensity of competition, market power on the demand side, backward compatibility of changes
Transparency	Incentive to control interfaces and knowledge about inner workings as scarce and thus commercially valuable knowledge	Feasibility of reverse engineering, market power on the demand side, intelligibility of interfaces
Participation	Cost of contracts, incentive to control access to private resources, cost of organising participatory property structures and development processes	Feasibility of participatory property structures and development processes

Table 1: Conducive and detrimental factors for flexibility, transparency, and participation (FTP)

4 Property Structures and Economic Incentives for Innovation

There is a relatively obvious conflict inherent to the process of innovation. Standard economic theory posits that private ownership will tend to avoid wasteful behaviour and put resources to their best uses. However, we have seen above that innovation requires cooperation that goes beyond mere spot market transactions over simple goods, or easily guidable and monitorable efforts within firms. The uncertainty involved with any process of innovation adds a premium on the cost of cooperation between otherwise independent parties. Thus private property utility maximisation considerations conflicts with the willingness of private parties to commit the optimum level of resources and cooperation required for successful innovation.[6]

If we look a little closer, however, we see that the property rights and the exertion of those rights crucially depend on the legal enforcement system in place. The conflict referred to thus stems at least partly from the underlying property rights regime. More importantly, the resources typically serving as inputs to innovation are intangible. Hence the notion of property

[6] A further issue is that of assigning value and price tags on FTP characteristics. This valuation problem lies both on the side of producers as well as consumers and may differ significantly for every party. Accounting for such heterogeneities again adds costs to the transacting of resources.

may not as easily be built upon the notion of possession as is the case with tangible property. Segelod and Jordan (2002a), Segelod and Jordan (2002b) have thus duly observed that the intellectual property (IP) rights regimes governing much of the intangible resources vital for the creation of successful innovations conflicts with the feasibility of external linkages and sharing of resources between private parties. Bessen and Maskin (2005) argue similarly that IP rights are at steep odds with an efficient use and dissemination of information goods on the internet. Also, open source software has often been taken as an example for a superior institutional framework to software development than the conventional proprietary model (Bärwolff 2006; Gehring 2005). To sum up, there is a very general feeling with growing empirical support that the existing legal IP regimes are ill-suited for our modern information society.

A general solution to the economic conflict between the resource holders and the innovation process depending on those resources is unlikely ever to be found. However, it seems worthwhile to pursue ways of ameliorating existing copyright and patent regimes so as to cater for flexibility, transparency, and participation in the utilisation of input resources to innovation. Yet, shaping new balances between the interests of resource holders and producers on the one hand, and the need for FTP on the other hand may not only involve blunt regulation efforts by the state but subtle private action, too. Table 1 summarises some of the factors impacting on FTP. No doubt, intensity of competition and the power and education of consumers make for significantly furthering FTP. It is thus not last up to consumers to voice their demands for resources exhibiting FTP characteristics.

5 Concluding Remarks

There is one major drawback to the set of attributes FTP advanced here that must not go unmentioned. We have yet to come up with a proper set of metrics to properly quantify the attributes and empirically test for the link proposed here. The problem is that all three properties – flexibility, transparency, and participation – likely escape a trivial one-dimensional metric, for they derive much of their value from their interdependence with one another and the environment they reside in. A resource may be flexible, transparent, and participatory – and thus very conducive to innovation – in one respect but not in another. Indeed, it is very unlikely that the properties ever take what we may call an "optimal value" in an absolute sense.

Still, the framework put forward in this paper may provide a lens through which we may obtain a better understanding of how innovation works and what may be done to aid its process.

References

Berners-Lee, T. and M. Fischetti (1999). *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web*. London: Orion Business Books.

Bessen, J. and E. Maskin (2005). Geistiges Eigentum im Internet: Ist alte Weisheit ewig gltig? In B. Lutterbeck, R. A. Gehring, and M. Bärwolff (Eds.), *Open Source Jahrbuch 2005. Zwischen Softwareentwicklung und Gesellschaftsmodell*, pp. 425–433. Berlin: Lehmanns Media. http://www.opensourcejahrbuch.de/2005.

Bärwolff, M. (2006). Tight prior open source equilibrium. *FirstMonday 11*(1). http://www.firstmonday.org/issues/issue11_1/barwolff/index.html.

Gehring, R. (2005). The Institutionalization of Open Source. *Poiesis und Praxis 4*(1), 54–73.

Glor, E. D. (1998). What do we know about enhancing creativity and innovation? a review of literature. *The Innovation Journal*. http://www.innovation.cc/peer-reviewed/creativ7.htm.

Hargadon, A. (2003). *How Breakthroughs Happen: The Surprising Truth about How Companies Innovate*. Boston: Harvard Business School Press.

Kline, S. and N. Rosenberg (1986). An overview of innovation. In R. Landau and N. Rosenberg (Eds.), *The Positive Sum Strategy*. National Academy Press.

Mytelka, L. K. and K. Smith (2001). Innovation theory and innovation policy: Bridging the gap. Paper presented to druid conference, aalborg, june 12–15 2001, UNU/INTECH, Maastricht. www.druid.dk/conferences/nw/paper1/mytelka_smith.pdf.

Saltzer, J. H., D. Clark, and D. Reed (1984). End-to-end arguments in system design. *ACM Transactions in Computer Systems 2*, 277–288. http://web.mit.edu/Saltzer/www/publications/endtoend/endtoend.pdf [11.04.2006].

Sandvig, C. (2003). Shaping infrastructure and innovation on the internet: The end-to-end network that isn't. In D. H. Guston and D. Sarewitz (Eds.), *Shaping Science and Technology Policy: The Next Generation of Research*. Madison: University of Wisconsin Press. http://www.spcomm.uiuc.edu/users/csandvig/research/Communication_Infrastructure_and_Innovation.pdf.

Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy*. New York: Harper & Brothers.

Segelod, E. and G. Jordan (2002a). Software innovativeness – knowledge acquisition, external linkages and firm developmental processes. FE rapport 2002-392, School of Economics and Commercial Law, Gï¿½eborg University, Gï¿½eborg, Sweden. http://www.handels.gu.se/epc/data/html/html/PDF/gunwba392rev.pdf.

Segelod, E. and G. Jordan (2002b). The use and importance of external sources of knowledge in the software development process. FE rapport 2002-391, School of Economics and Commercial Law, Gï¿½eborg University, Gï¿½eborg, Sweden. http://www.handels.gu.se/epc/archive/00002211/01/gunwba391rev.pdf.

Shirky, C. (1998). View source . . . lessons from the web's massively parallel development. http://shirky.com/writings/view_source.html.

Stefik, M. and B. Stefik (2004). *Breakthrough : Stories and Strategies of Radical Innovation*. MIT Press.

von Hippel, E. (2005). *Democratizing Innovation*. Cambridge, MA: MIT Press. http://web.mit.edu/evhippel/www/democ.htm.