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Towards a business model for commercializing innovative new technology

Abstract

The initial thrust of the paper is that the commercialization of innovative new technology needs to be underpinned by an appropriate business model. The paper summarizes what has been proposed to be the components of a business model and makes the case that this needs three extra elements in order to be appropriate for innovative technology commercialization. It is argued that the decision on what market to target may be crucial to the commercialization process in circumstances where initial failure may allow no second chances. A way of determining the most appropriate initial market is discussed as this market choice is a determinant for business model choice. Finally, conclusions are drawn on defining and devising business models for commercializing new technologies, particularly in circumstances of limited resources.

Keywords: commercialization, business model, innovative new technologies.

Introduction

Scientific research and the subsequent harnessing of new technologies are seen as the wellspring of future wealth in many countries (Decter, Bennett and Leseure, 2007). For this reason governments fund public investment in research and encourage private industry to do the same. However, gaining the benefits of this investment via the commercialization of the research outcomes is said to be disappointing, particularly in small economies. For example, "Australia's commercialization record ...remains low compared to other countries and is uneven across different research sectors" (Commonwealth of Australia, 2003). "...there is a dismal rate of adoption of research findings generated from Public Funded Research Institutions in Malaysia" (Thiruchelvam, 2004). The aim of this paper is to develop and propose a business model for the commercialization of new technology. It is still not always appreciated that "a dollar's worth of academic invention or discovery requires upwards of \$10,000 per dollar of private capital to bring it to market" (The Economist, 2002). Given that 'bringing it to market' implicitly involves creating a business model the choice of which should receive just as much attention as the originating research and may be vital for achieving a satisfactory and sustainable level of commercialization. In the economic literature little attention is paid to this topic.

1. What is a business model (BM)?

1.1. Definition. There is a lack of a universally accepted definition and taxonomy of a BM (Osterwalder, Pigneur and Tucci, 2005; Lambert, 2006). Indeed, most of the definitions are meta-definitions, consisting of lists of elements that could be included in a BM. Similarly, attempts at formulating taxono-

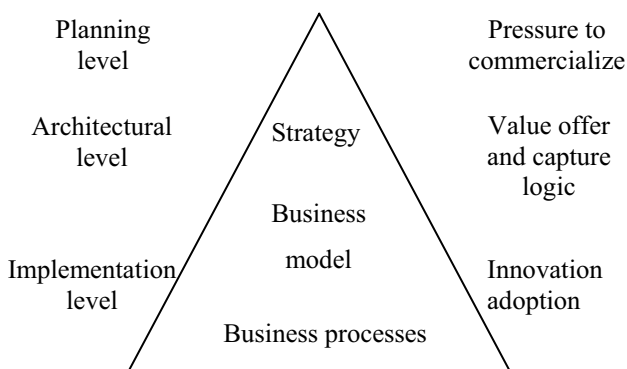
mies have generally been industry- or market-specific, as in Bienstock et al. (2002), Hemphill (2006), and Leem et al. (2004). There are several possible reasons for the limited academic research on BMs. Chesbrough and Rosenbloom (2002, p. 532) point to the fact that the BM concept "integrates a variety of academic and functional disciplines, gaining prominence in none".

It is quite possible that several definitions or taxonomies will coexist. In fact, Ghaziani and Ventresca (2000, p. 532) analyze this phenomenon in terms of "subcultural interpretation of the global category business model where different communities use their own language, yet need to communicate within a broader management discourse". A parallel exists among practitioners, with executives from dot.com companies having a clear understanding of the theory of their BM, and those from more established companies having only a tacit understanding of the working model (Linder and Cantrell, 2007). The latter is consistent with the notion that BMs "are, at heart, stories – stories that explain how enterprises work" (Magretta, 2002, p. 87) or "the overall gestalt" of the firm's external linkages (Amit and Zott, 2001).

Although there may be no simple, universally accepted definition of a BM there is a value in establishing the concept within a particular industry or set of circumstances like the commercialization of a particular technology in an industry.

1.2 Operationalizing the concept. A sound business model is essential for every successful organization whether it is a new venture from an established organization or a start-up (Lambert, 2006). Petrovic, Kittl and Teksten (2001) explain that a business model should not attempt to be a description of a complex system with all its actors, relations and processes but it should describe the logic of the

system for creating value that lies behind the actual processes. It is the conceptual and architectural implementation of a business strategy and should apply to that for the commercialization process. Osterwalder and Pigneur (2002) depicted it as follows:



Chesbrough (2003) has set out a way of operationalizing this general aim:

“The business model is a useful framework to link ...technical decisions to economic outcomes. Although the term *business model* is usually applied to the context of entrepreneurial firms, it also has value in understanding how companies of all sizes can convert technical potential into economic value”.

He states that any organization seeking to commercialize a new technology needs the BM which covers the following requirements:

1. articulate the value proposition, i.e. the value created for users by the product or service containing the new technology;
2. identify the market (segment), i.e. the users to whom the product and/or the technology is useful and what for;
3. define the value chain, which is necessary in order to distribute and/or bring the product to the market, i.e. what complementary processes and organizations and assets are needed to ensure the ability of product or technology to get to the market, and stay there;
4. specify the revenue generating mechanisms for the organization, including the cost structure and (profit) margins of the product making, given the value chain assumptions;
5. formulate or specify the competitive strategy that will enable the organization to gain and maintain advantage over rivals (or competing technologies).

Point 4, above, requires an answer to the following question: how will money, or profit, be made? This begs a further question – for whom? Is the ‘money’ to be made by:

- a) the originating research organization, and/or,

- b) an organization to which the Intellectual Property is transferred, by one mechanism or another, and which subsequently implements the technology for commercial purposes, and/or,
- c) the community, which has directly or indirectly funded and supported the research organization.

A business model for commercialization needs to state to which of (a) to (c) the financial outcomes are required to apply.

In the next section the main methods, by which those who originate research outcomes typically can seek to gain financial reward, are summarized. Then the paper shows that the business model choice can make a difference to the subsequent performance of a firm. In the last section requirements 1 and 2 in Chesbrough’s set of BM functions are investigated, which are: identifying the value proposition that the technology can provide and identifying the likely market for it.

2. Revenue generation from new technology

Jolly (1997) has shown that broadly an originator of new technology can seek to gain financial return by:

- ◆ developing a commercial product or service using the technology and then marketing it themselves; or
- ◆ transferring the IP to some other organization and receiving financial reward for this, by a variety of methods, and/or
- ◆ gaining further support based upon the apparent research excellence and the assumed benefits of this to the wider community.

There are many specific mechanisms for achieving at least one of the above options and these are summarized in the Appendix. However, to investigate them is not the purpose of this paper as these mechanisms are well-known in research organizations vested with seeking to commercialize the output from them. A major point, though, is that any organization seeking to commercialize a new technology will need a sound business model which at least covers the five requirements set out by Chesbrough. As it will be shown, three additional requirements need to be added.

3. Research on the effectiveness of different business models

While Lambert (2006) points to Amit and Zott (2001) giving the only example of inductive empirical research on BMs, it is important to consider the contribution to the theory building that emanates from their integrative approach. By bringing together threads from entrepreneurship and strategy

theory they present the BM as a relevant unit of analysis.

The work of Zott and Amit (2007; 2008) shows that the BM employed by an enterprise can influence the marketplace performance of the enterprise. However, the dataset upon which this finding was based consists solely of firms that conduct some parts of their business activity over the internet. This is consistent with their earlier investigation of value creation in e-business (2001) but limits the generalizability of their findings. Nevertheless, they found four sources of value creation – complementarities, lock-in, efficiency and novelty. They used the latter two as (business) design topics for their analysis: ‘efficiency’ derives from reduction in transaction costs; ‘novelty’ derives from re-combining transactions to connect new participants, or to connect them differently. They prove theoretically and empirically that both topics can be woven into the BM adopted by a firm. Malone (2006) followed a very similar approach to data sourcing but considerably expanded the range of firms covered. They tested whether certain BMs perform better than others by analyzing every publicly traded firm in the US from 1998 to 2002. At a very general level, their study produced a similar outcome to those of Zott and Amit (2007; 2008): the BM is a useful analytical construct; BMs contribute to explaining performance.

If Zott and Amit analyzed BMs from their entrepreneurship perspective, Chesbrough and Rosenbloom (2002) did so from a commercialization point of view. The two approaches are complementary and overlapping in part, but still remain distinct. Chesbrough and Rosenbloom (2002) see the BM as the architecture that allows the value inherent in a technology to be unleashed, for the customer, and to be captured by the commercializing entity. They view value capture by the firm more as a strategic issue. Other differences between the BM and strategy decisions are that financial modeling is beyond the scope of the BM and that the choice of BM is but one of the decisions taken in strategy formulation.

Chesbrough and Rosenbloom (2002) introduced an extra component that impinges heavily on the context in which the BMs are developed, chosen, modified, as well as on how firms, or managers, assess new technologies that might not fit their existing BM. They highlight the cognitive challenge of having the BM mediate between technology and market, when both of those areas display high levels of uncertainty and complexity in their own right. In this environment, they say that ‘sense making’ and having a dominant logic can help the commercialization process, at the risk of introducing other ri-

gidities into the system. Their context was in case studies within the Xerox Corporation. The cognitive difficulties might be exacerbated in science-intensive ventures, given that the technological uncertainty remains higher for a longer portion of the product development process (Malerba and Orsenigo, 2002; Pisano, 2006).

4. Categories of technology innovation

The term “innovation” is used loosely (Chesbrough and Rosenbloom, 2002). It is useful to define three categories. Discontinuous innovations, as first termed by Robertson (1967), comprise something with a completely new-to-the-world set of attributes and this usually gives rise to a new product category or industry. The opposite are Continuous Innovations and comprise something with small-scale alterations or enhancements to existing products. There is a third class, Dynamic Continuous Innovations, where the technology may be new but the product into which it is put is, to all intents and purposes and as far as the user is concerned, just an improved or different form of what already exists. The DVD as a domestic entertainment device would be an example of the Dynamic Continuous Innovation; it is a different technology to the videotape-based technology but it is used in the same manner and produces the same outcome. Major, or Discontinuous Innovations (DI), require and induce behavioral changes in the users, that is, the demand side of the market. Besides, the production and marketing of new product categories emanating from DIs they typically require new supply and distribution arrangements, and thereby induce new patterns of interaction in the market, that is, the supply side (Mohr et al., 2005).

The distinction between minor, continuous, and major, discontinuous innovations is important. A minor innovation has a combination of attributes that is similar to those of products that are already in the market. The set of competitive products as well as the majority of the market actors involved in production and marketing of these products remains essentially the same. The basic attributes and the methods of using these products are known by most potential consumers. Although the minor innovation may contain some new features distinguishing it from similar products in the market, its adoption will not require major behavioral changes on behalf of its users, and that is a very significant factor. The usage situations are mostly known for these products. So, consumer evaluations regarding their future adoption behavior, or expert opinions regarding the market developments are valid and possible prior to the introduction of a minor innovation in the market. Moreover, since the product category to

which the minor innovation belongs remains essentially the same, data about the diffusion of the product category can still be extrapolated (Veryzer, 1998; Garcia and Calantone, 2002).

5. Finding the best market for a new technology

There is evidence that many novel technologies are initially targeted at the *wrong* opportunity for commercialization (Friar & Balachandra, 1997). Some fall by the wayside because of this and demonstrate that the business model for commercialization is often inherently flawed.

To commercialize an innovative technology the originators would have to decide in what product, or service, to put it and then an appropriate market to target. How do they make these decisions? They often have only one chance at getting it right; if they, or others on their behalf, utilize their possibly limited resources to target what turns out to be the wrong market they can fail to generate enough income to keep the project going and/or satisfy their backers. Indeed, the evidence is that most of those who are first to market with an innovative technology, a so-called competitive advantage, are not those who subsequently profit from it (Teece, 1996; Tellis & Golder, 1996). The decision about what market to target is not easier made in circumstances of still evolving and being tested technology.

We also should pay heed to the following: “(The commercialization of innovations) is something that customers, rather than inventors or entrepreneurs do. They are great clients and organizations that make inventions successful in the marketplace of reality, and not just in the marketplace of ideas” (Schrage, 2005).

So, if for an innovation no ‘great customer’ has been identified and/or been attracted or has emerged this has implications for the method by which the innovation is sought to be commercialized. Any business model would have to factor in the availability of ‘great customers’ but do developers and commercializers of innovations always take this into account early enough?

Finding the right market for DI technological innovations is far harder than for continuous or incremental ones. They can generate a diversity of product concepts and uses that may fulfil many applications, or functions, both for the current customers of an originating organization and for entirely new ones. Once the crucial decision is made of “what product to what market”, conventional marketing practice and experience can be applied: the likely customers and competitors are identifiable and market research can be conducted on them, and then a marketing plan devised and implemented.

For the potential product from a DI the market may not exist and/or customers’ needs may be latent so that gaining information from any that might be targeted is very difficult (Trott, 2005). The literature suggests that Exploratory and Interpretive research should be conducted and this is captured by such approaches as “Probe and Learn” (Lynn et al., 1996) and Empathic Research (Leonard & Rayport, 1997). These are drawn from, and illustrated by, a few case studies. A pragmatic approach is captured by the term Expeditionary Marketing (Hammel, G. and Prahalad, 1991). Here, a company puts out a range of versions of products that utilize the technology in various ways and waits to see what happens, that is, it lets the market tell it where the best application is. This can require considerable resources and time and also has risks: alerting competitors to opportunities, damaging organizational reputation and support if some versions fail in the marketplace together with loss of internal morale.

There is, however, a complementary approach to those having a reasoned basis for making the product-market decision.

5.1. The product-market options for a discontinuous innovation. Friar and Balachandra (1999) suggest and cite evidence for the four existing product-market strategies open to those who seek to make this decision for a DI (see Fig. 1). A company with a DI can offer it:

- ◆ to the existing customers, or
- ◆ to new customers, and as
- ◆ a replacement, or substitute, for what the customer already has or is using, or,
- ◆ a solution to a problem or requirement that a customer possesses but has not found anything that would work and/or realizes that the new product or technology allows him/her to do something novel and beneficial.

		<u>Customers</u>	
		Existing	New
<u>Applications</u>	Existing	Substitute	Diffusion
	New	Expansion	Creation

Fig. 1. The four product-market options for a DI

In Figure 1:

Substitution – means that the new technology replaces the currently used one. For example CDs replaced audio cassettes; iPods replaced CDs.

Diffusion – once a technology has replaced/substituted another for a particular set of customers, or uses, then it is progressively expanded to further groups and similar uses. For example, ABS brakes were first used for trucks, then for luxury cars and finally for mass market cars.

Expansion – means applying the new technology to novel uses and often to solve a problem for which no existing technology provides a very good solution. The outcome is usually the establishment of a new market or industry. The so-called ‘disruptive’ technologies do this (Christensen, 1997).

Creation – means the process of imagining the new technology application to create novel products, services and capabilities, but for groups with whom the originating company has had no prior experience.

In the Friar & Balachandra (F&B) framework, a Continuous Innovation product would be targeted as a Substitute, or Replacement, for example, a PDA with a color screen is a continuous innovation and will be aimed at existing PDA users. Where should a DI be targeted? F&B state that most organizations creating DI-based products target it, wrongly, as a ‘Substitute’. Mostly they do this because such apparent markets are well-established, large and potentially lucrative. They present data showing that for some innovations in the medical equipment and computing fields, the technology originators always had the ‘Substitute’ strategy in mind but in all their cases the actual adoption of these technologies was via ‘Expansion’, that is, the customers who did adopt it used the innovation for purposes different to the originators’ intentions. Their further evidence suggests that DIs do eventually replace older technologies (‘Substitute’ them) but it is often made via demonstrating their worth and reliability first, in their ‘Expansion’ applications, or ‘solving a problem’ that no other technology seemed to be capable of doing before.

5.2. Some evidence in support of F&B’s findings.

According to F&B DI technologies can find their first successful markets not by replacing well-established, prior technologies of major industries but by solving novel problems or by stimulating new markets and industries. These are initially niche applications.

In the early 1970s the Orbital Engine was developed by an innovative engineer in Perth, Western Australia. It was of innovative design, lighter than a con-

ventional auto engine, used less fuel and produced less pollution. It was marketed to the major US auto makers. The engine was put in a fleet of Australian government cars and performed reliably, it was tested by well-credentialed international authorities and financially backed by BHP, one of Australia’s biggest companies of that time. However, up to this day the orbital engine is not used in any car. Somewhat against the initial will of the originator it was used by a US maker of outboard motors for speedboats, because this manufacturer was under pressure to reduce pollution and was under competitive threat from Japanese imports (Morkel, 1999). This illustrates a principle that often DI technology does not substitute the established, installed-base technology but solves some niche-based problems.

5.3. The Technology Adoption Lifecycle (TALC) and the Chasm. In the popular practitioner’s book “Crossing the Chasm”, Geoffrey Moore (2002) asserts that there exists a Technology Adoption Life Cycle (TALC): new technology products tend to progress through the TALC during which they sequentially penetrate into different customer segments. These segments differ dramatically in their readiness to be adopted and therefore, need to be targeted with very different value propositions. Moore (2002) identified the five categories of potential, eventual customer segments for an innovation, which enter a market in sequence. They are: Technology Enthusiasts, Visionaries, Pragmatists, Conservatives and Skeptics or Critics. He proposes descriptions of their profiles and motivations and that a ‘Chasm’ occurs between the adoption by Visionaries and by the Pragmatists.

Moore compares the difference in profile of those who initially have adopted the, Visionaries, and those who wait until the product and/or technology are fully tried and tested in the marketplace, that is, there is no risk in adopting them. In an industry there are far less Visionaries than Pragmatists. Moore describes strategies to involve Visionaries, to cross the ‘chasm’ and then to win the subsequent segments. His descriptions and prescriptions have undergone very little systematic testing but are widely believed by practitioners (Muller and Yogev, 2006). If he is right, new technologies need to be adopted first by the naturally enthusiastic – but not necessarily commercially wise – technology enthusiasts, followed by the more astute and numerous customers, the Visionaries.

5.4. The relationship between F&B’s finding and Moore’s TALC. From the description of Moore’s TALC framework and process of adoptions, it can be seen where they fit into the F&B framework (see Fig. 2).

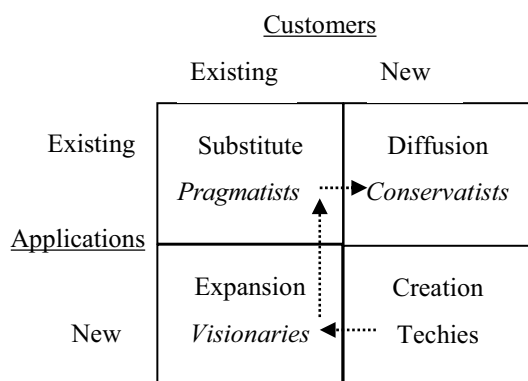


Fig. 2. F&B’s product-market strategy options and Moore’s TALC

The expected adoption sequence is indicated by the arrows. Then it is possible to propose the target product-market sequence of strategies for a discontinuous innovation which is not initially aiming to replace the product that the bulk of the customers, Pragmatists and Conservatives, are using and happy with but seeking out the Visionaries and, maybe, observing the Techies; keeping the aim of learning necessary to serve and enter the Pragmatists’ market later.

5.5. An explanation for the market location. One explanation for F&B’s observations and Moore’s prescriptions is that if a DI-based product is aimed at replacing the incumbent one it will inevitably meet strong competition from the products and services providers that utilize the existing technology. Also, breakthrough technologies are often produced by small organizations that do not have the resources to sustain a competitive battle. A further explanation is that customers do not like changes. A reason for a breakthrough product being adopted by some customers, but for a different application or ‘Expansion’, is that such customers have a problem and are keen to support something new that offers them a possible solution.

6. The need to manage risks

Many authors pointed out (e.g. Mohr, J., Sengupta, S. & Slater, 2005) that an organization that is seeking to commercialize new technologies, or products containing them, have to manage two risks:

- ◆ the risk that the technology does not work or does not deliver its full promise when it has to function under scaled-up, everyday working circumstances. This is the ‘technology risk’;
- ◆ the risk that the expected or hoped-for customers do not buy or use the product. It is very hard to get reliable information on likely demand for a DI-based product. This is the market risk.

The principle that Friar and Balachandra (1999) enunciate should reduce the market risk, but not

eliminate it, at least enabling a technology commercializer to choose an appropriate product-market strategy.

Further support of this strategy comes from Millier and Palmer (2001). They describe a process of identifying potential market applications for a new technology and then an assessment of the technological and commercial/market risks. They advocate that the choice of potential market to target should be made according to the level of risk that the organization can sensibly carry. They propose and illustrate how this can be assessed through the Market Attractiveness – Business Position Strength procedure (Abell, and Hammond, 1979). An organization with limited resources may not wish to carry a large amount of risk. Millier and Palmer cite examples showing that the ‘Substitute’ market is mostly a high risk for small organizations, although often resulting in high reward. However, the ‘Expansion’ market usually carries a much smaller risk. The authors advise that small organizations should follow an ‘Acceptable risk’ strategy and work towards initially ‘High Risk’. Following this strategy such organizations would continue learning to reduce both technological and market risks. They are, in effect, also advocating the strategy of ‘Expansion’ followed by ‘Substitution’.

Christensen (1997) argues that the commercialization of DIs is disruptive and more promising in small organizations that will view the development of the capability to use the innovation as being critical to growth and success rather than distracting from their main business. This idea supports the need of small organizations to choose the right product-market strategy for commercialization to be successful.

7. The importance of network adoption

If a new technology can substantially reduce operating costs of a process or a product then it is likely to be attractive to major producers. Major producers tend to be ‘pragmatists’, that is, not risk takers. So, the technology has to be very proven and not disruptive to existing systems and logistics of supply and delivery. In other words, the total costs in the logistic network cannot decrease in one part – due to the new technology – while increasing elsewhere.

Chakravorti (2003) explains another major reason why often new beneficial technology is not adopted swiftly. Essentially he proposes that many organizations and activities are linked into many other organizations and networks. It is not possible for one company to decide to use something new if its important partners do not adopt it as well or agree to adjust to the consequences. Each ‘player’ in a net-

work has to consider what other players might do: “I will adopt the technology, if others in my network do that”. This can be the explanation of the conundrum: an originator of a new technology is able to produce it and the eventual user organizations may wish to acquire it but cannot because there is no benefit to some intermediary. Kline (1985) has found evidence for this fact.

To assist a new technology getting into a targeted market requires an appraisal of the vested interests of the necessary players in the commercialization network. This may make the commercialization process much more complicated and demanding to organize.

Conclusions

There are several potential beneficiaries of the DI commercialization, from the originator to the eventual user. The entity that may have funded the research leading to the development of the DI shouldn't be forgotten as well. The choice of business model needs to be made bearing in mind who is required to receive a return from the commercialisation.

The initial target market for an innovation should be informed by the degree of innovativeness it possesses: a continuous innovation should be targeted at ‘Substitution’, with ‘Diffusion’ through all segments of the market to follow. A DI should be positioned in the bottom half of F&B's Matrix (Fig. 2) with the aim of working towards eventual ‘Substitution’ over time. An inevitable consequence is that the initial market for a DI-based product is likely to be a niche. The behavior of large companies in mature markets is not usually visionary. So, it will be visionaries in SMEs who are possible initial commercializers.

This idea is supported by the seminal work of Schumpeter (1948) who examined the economic effects of innovation and found that the size of an organization was a very influential factor; bigger firms were more able to adopt innovations. However, he found that the relationship was of an inverted U-shape in relation to the degree of radicalness of the technology: the more

novel the technology was, the more likely small organizations would be able to adopt it successfully.

It has been suggested that ‘great’ customers rather than the originators actually commercialize an innovation. If no such customers exist or are likely to emerge for an innovation this has to be factored into the choice of business model for commercialization.

Even if a potential ‘great’ customer exists his/her commercialization activity must still be supported by the network of other organizations with which they will necessarily have to interact.

It can be concluded that three conditions need to be specified to give the context to the five as set out in the definition of a business model by Chesbrough (2002) in order to be appropriate for the commercialization of a DI:

- ◆ a business model for commercialization must state to which entities it applies: (i) the originator, and/or (ii) the organization to which the IP is given or transferred, and/or (iii) the community that (financially) supported the original research;
- ◆ a fully capable, visionary potential customer has to exist; and
- ◆ the commercialization has to be shown to be in the individual interests of each in the network of other people and organizations necessary to the commercialization process.

A final cautionary note about the ability to prescribe a business model for small economies is needed. Garvin (2004) concludes that: “a new venture simply has to prototype its initial concept, get it into the hands of users, assess their reactions and then repeat the process until it comes up with an acceptable version. IBM calls these efforts in-market experiments; scholars call them probe-and-learn processes”. Attempting to commercialize really is an experiment – ideally the initial purpose should be learning rather than making money.

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Appendix A

Some of the main methods by which a research organization can gain (financial) reward from a new technology are:

- ◆ licensing out the IP (intellectual property) to a third party. There are many issues to be dealt with, including: terms of payment, upfront fees, royalties, territories covered, exclusivities offered;
- ◆ selling the IP. Apart from the same details as above and extra issue is that of 'freedom to operate' for the originator to themselves work with the IP;
- ◆ forming a joint venture with an outside party to develop and commercialize the IP. Issues of risk and reward sharing have to be decided;
- ◆ engaging in some form of incubation for the originating team and then consider some form of later commercial company spin-off;
- ◆ forming an immediate commercial company spin-off and taking an equity stake;
- ◆ selling the IP to a professional licensing organization;
- ◆ license out the IP via a third party and paying them a commission;
- ◆ auctioning off the IP, perhaps via an e-market specialist site;
- ◆ offering the IP to a Technology Standards organization that further arranges licensing all of its members;
- ◆ granting royalty-free rights to not-for-profit lead users so that they can help to make the new technology more pervasive;
- ◆ widely promoting the scientific and technological achievement to those bodies (a) which endorsement of the excellent is desirable, and (b) that support and fund research so that further grants become available and other forms of support are given.