ANTECEDENTS AND KEY SUCCESS FACTORS IN ADOPTION OF CONSUMER ELECTRONICS INDUSTRY INNOVATIONS

TOMI HAAPANIEMI
Sandvik Group
P.O. Box 100, FI-33311 Tampere, Finland
tomi.haapaniemi@gmail.com

MARKO SEPPÄNEN
Center for Innovation and Technology Research (CITER)
Department of Industrial Management
Tampere University of Technology, Finland
marko.seppanen@tut.fi

Abstract: Various factors affect the adoption of innovations. Despite the extensive research on innovations, research focusing on key success factors of successful innovation has remained thin. The objective of this study was to identify factors that can explain or significantly contribute to successful launch of an innovation. The study focused on early evolution of adoption of innovations and examined three successful consumer electronics innovations that have reached the takeoff point in their adoption life cycles. Possession figures of households for these innovations from five countries in three continents were used as the main source of empirical data. Hofstede’s cultural dimensions were utilized in assessing cultural aspects of innovations’ adoption patterns. The study suggests that each innovation has somewhat dissimilar pattern of adoption despite the industry similarity. Adoption seems to be mostly influenced by the characteristics of an innovation and earlier product generations. The study also reports that underlying factors, such as installed base, infrastructure, and national culture, seem to have an influence on innovation adoption.

Keywords: innovation, adoption of innovations, takeoff point, commercialization

Introduction
Finding and developing successful innovations seems to be a modern alchemy. Making transmutations of ideas and inventions into commercial success stories is a vision in many firms. Starting with an ordinary idea, taking a nugget of that and a touch of this, firms attempt to bring a successful product to the world. Still, a minor obstacle on our path to go from “Rags to Riches” seems to be finding the secret recipe. Because we have not yet found that formula, we usually tend to trust to the law of numbers. Great piles of ideas and inventions are harvested in screening potential billets that could encompass candidates for a successful innovation. Putting vast amounts of crude ideas in the beginning of the innovation funnel (Chesbrough, 2003), firms may eventually refine something that would generate commercially alluring products or services. The commercial potential that an innovation may possess is actually outlined in actions that are made during the nurturing phases of innovation billets. However, since we do not
Theoretical background

Characteristics of innovation
Schumpeter (1968) has divided technological change into three phases, namely: invention as the creation of new technologies; innovation as the commercial introduction of new technologies; and diffusion as the spreading of new technologies. The first phase, invention, is ultimately a process of recursive problem solving (Arthur, 2007). According to Arthur (2007), inventing is a process of linking some purpose or need with an effect that can be exploited to satisfy it. An output from this process could be an innovation.

For the second phase of technological change, innovation, Schumpeter (1968, p.66) defined innovation as follows:
1. The introduction of a new good – that is one with which consumers are not yet familiar – or a new quality of a good.
2. The introduction of a new method of production, that is one not yet tested by experience in the branch of manufacture concerned, which need by no means to be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially.
3. The opening of a new market that is a market into which the country in question has not previously entered, whether or not this market has existed before.
4. The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.

5. The carrying out of the new organization of any industry, like the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position.

Closely related with this paper’s topic, we want to especially accentuate that commercial success of an innovation is not a part of the definition of innovation. Its success is naturally a fundamental reason for firm’s engaged into innovating process but the degree of success will finally be solved at the markets.

Commonly, innovations have generated a vast amount of scholarly research (See e.g. Acha, Marsili, & Nelson, 2005; Damanpour & Wischnevsky, 2006; Fiet, Norton Jr., & Clouse, 2007; Souitaris, 2003). Multiple approaches have been used in order to understand different perspectives and issues related, for instance, to innovations, innovation process, and innovating as a willful act. The notion that there are different kinds of innovation, with different competitive effects, has been an important theme in the literature on technological innovation (Henderson & Clark, 1990). Based on the Schumpeter's emphasis on creative destruction, different kinds of innovations in terms of their impact are attempted to characterize. With their influential 2x2 matrix, Henderson & Clark (1990) pointed out how an innovation's impact on components and on the linkages between components can be distinguished.

For a firm’s perspective, recent studies focusing on radical innovations have attempted to gain more understanding on innovation activities within the firm. Herrman et al. (2007) examined consistent and complementary innovation activities indicating that specific organizational and cultural characteristics work as antecedents for the required capabilities for transformation. According to the authors, the observed capabilities increase the propensity of an established company to introduce radical product innovations.

Another widely studied perspective on innovations is its effect on competition. Abernathy & Utterback (1978) explained how the basis of competition varies with the stage of maturity of the product-process core of an industry. In the immature industry, firms typically invest mainly on developing new product innovations. As the dominant technology emerges, firms’ investments tend to shift to process technology, and subsequently they switch strategies to cost minimization from maintaining product variety. Despite the model’s limitations (See Ettlie, 2006, p.66), it serves as a framework to compare the results of investments in innovation.

Finally, the third issue in technological change is the diffusion of innovations. It has traditionally been believed that innovation process is basically a local phenomenon and “all good inventions and innovations are essentially played out locally before they go to the rest of the world” (Ettlie, 2006). On contrary to notions of techno-globalism and the
borderless world, the national barriers still remain. For instance, in the main OECD
countries, around 90 percent of production is for the home market as well as domestic
investments by domestic capital far exceeds direct investment overseas plus foreign
investment at home (Morgan, 2004).

Adoption of innovations
The adoption of innovations has traditionally been divided into phases from initial slow
growth to accelerating growth, and finally to maturity and decline (Bass, 1969; Gort &
Klepper, 1982; Rogers, 1995). Importantly, the customers in these phases differ
dramatically in their characteristics (Moore, 1999). The introductory phase is distinctive
in that it has a slow growth rate and customer segments adopting innovation at this time
have high level of technological sophistication and knowledge. At the early phases of
innovation adoption customers segment represents innovators (Rogers, 1995).

The first segment, the innovators, is crucial since the innovators validate, firstly, the
functionality of the innovation (Christensen, 1997) and secondly, the basic existence of
the markets for a new technological innovation (Agarwal & Bayus, 2002). Marketing
communications, product designs and advertising message, among others, should be
differing for the innovator segment when comparing to mass markets later in the
innovation adoption (e.g. Mohr, 2001). The second segment, the early adopters,
emphasizes usability and reliability. Since the early adopters’ technological expertise is
limited, they need more technical support than the innovators. Therefore, the shift from
early phases of innovation adoption to growth phase represents a major challenge for
companies selling new products in the industry (Moore, 1999). Especially in the
international settings, the dramatic change of customer needs, wants and preferences
can be quite disturbing to marketing operations due to heterogeneous nature of the
markets.

Besides technological sophistication and knowledge, innovators differ from majority
(i.e., the following customer segments) also in their price sensitivity, which is much
lower than in other segments. Further, innovators’ ability to understand technological
foundations, to tolerate unreliable products, prefer functionality over easiness of usage
etc. is much higher than for the later customer segments in adoption dynamics (Rogers,
1995).

Takeoff point
If an innovation succeeds to pass the intermediate point between the introductory and
growth phases, it has been achieved the takeoff point in the adoption. The takeoff point
in the product life cycle represents a critical point for a product’s success. It marks a
juncture when the customer requirements and preferences begin their shift from
technical functionality towards usability and reliability related matters and where
dominant designs are adopted (Utterback, 1994). Dramatic changes of this stage in
customer needs, wants, and preferences can be quite disturbing to marketing operations
because of the heterogeneity of the markets. The shift from pre-takeoff to post-takeoff
phase also represents usually a change in emphasis from product to process innovations (Utterback & Abernathy, 1975). Concurrently, it compels companies to change their competitive basis correspondingly.

The takeoff curves produce different patterns as e.g. Agarwal & Bayus (2002) and Haapaniemi & Mäkinen (2007) have suggested. For instance, some innovations crawl quite a long time before the takeoff finally occurs as the recent study shows inverted U-shaped relationships with the age of the innovation (Nerkar & Shane, 2007). For most innovations, the takeoff point is clear, because they typically penetrate the market rapidly upon reaching mass markets (Tellis, Stremersch, & Yin, 2003). Agarwal and Bayus (2002) reported that before sales take off, as shown by the “hockey-stick” or “elbow shape” pattern in sales histories, number of firms in the industry increases.

**Data Collection: Selection and Analysis Procedure**

As was presented above, the studies considering the key elements in successful launch and commercialization of innovations remain mostly missing. In this paper, we explore empirically successful adoptions of innovations and attempt to identify the key success factors and prerequisites which are commonly shared in these adoption life cycles.

We included in the analysis three innovations, namely CD, PC and video cameras, to explore the antecedents in-depth. These products have a long recorded development history thus allowing us to trace their developmental paths. Our empirical data consisted of yearly possession per household data of CD player, personal computer, and video camera innovations. The CD category covered the years 1981 through 2000, the PC category 1980 through 2000, and the video camera category 1976 through 2000. The source of the data was Euromonitor’s global marketing information database.

Five countries (Germany, United Kingdom, Hong Kong, Taiwan, and Canada) were selected for two reasons: firstly, each of them represent large potential user base for the commercial product in each country, and secondly, all five owe a remarkable market effect due to their size on the other countries within their continent. Furthermore, the selection leads to covering three continents (Europe, North America, and Asia) thus allowing us a global perspective on adoption of innovations.

Finally, in this explorative study we focus on wide range of attributes while attempting to identify the key factors that may explain the detected innovation takeoff. Hofstede’s cultural dimensions are used in identifying cultural characteristics in innovations adoption in different analysis (Hofstede, 2001; 2002). In addition, we used other public external sources of information such as the statistics of World Bank and OECD (e.g. gross domestic product) to support our examinations.
Results and Discussion

All the innovations under study belong to the group of consumer electronics innovations. However, the nature of innovations differs. Initially, CD players were mainly for entertainment and individual purposes. Even though the format of CD didn’t allow home recording in the early phases of its life cycle, it clearly represented a radically new next generation technology combining many benefits of earlier generations (C-cassette and LP-discs). CD technology improved performance and was more reliable and usable than earlier technologies. Thus, the innovation of CD player replaced the earlier innovations.

The personal computers are for both entertainment and business purposes. That is, different people use PCs and they use it for wide range of purposes. Initially, PC was something radically new and there existed no previous generations to replace. However, it rather generated totally new applications and usage purposes such as computer games and web between PC users.

The consumer video cameras are mainly for entertainment use. Typically users of a video camera belong to a group, in which people are close to each other, like in a family or sports team. By nature, it was a radical type of innovation, and it replaced cine cameras, which was unable to audio visual recording (only visual). The following Table 1 presents Hofstede’s dimensions in countries under the study.

Table 1. Country-specific indexes in Hofstede's dimensions for the selected nations.

<table>
<thead>
<tr>
<th>Index</th>
<th>Power distance</th>
<th>Individualism</th>
<th>Masculinity</th>
<th>Uncertainty avoidance</th>
<th>Long-term orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>39</td>
<td>80</td>
<td>52</td>
<td>48</td>
<td>23</td>
</tr>
<tr>
<td>Germany</td>
<td>35</td>
<td>67</td>
<td>66</td>
<td>65</td>
<td>31</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>68</td>
<td>25</td>
<td>57</td>
<td>29</td>
<td>96</td>
</tr>
<tr>
<td>Taiwan</td>
<td>58</td>
<td>17</td>
<td>45</td>
<td>69</td>
<td>87</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>35</td>
<td>89</td>
<td>66</td>
<td>35</td>
<td>25</td>
</tr>
</tbody>
</table>

Cultural dimensions may affect adoption of innovations in the early phases of adoption life cycle (Haapaniemi, 2007) and they can be considered while commercializing innovation (O’Reilly & Tushman, 1997). On the other hand, some innovations may more rapidly penetrate into a market (culture) depending on characteristics of an innovation itself. For instance, CD players are for individual purposes, thus it can be suggested that CD players may penetrate faster in individualistic cultures that, for instance, prevails in United Kingdom. Similarly, PCs with a modem can be used for communication between PC users. Thus people in collectivistic cultures (Taiwan & Hong Kong) may want to adopt PCs for these purposes. Further, video cameras are for entertainment of close communities, thus people in feminine cultures should be willing to adopt these kinds of innovations. However, as the results from earlier studies show,
the influence of culture’s masculinity dimension is in general found to be contradictory (Haapaniemi, 2007).

Tables in the Appendix 1 show the adoption patterns in the selected countries. Based on these patterns, Table 2 represents our interpretations on takeoff times (dichotomic; short or long) for different innovations in each country. We see that time to takeoff in Canada was short in CD players and video cameras whereas the introductory period for PCs was quite long. It can be suggested that the distance from a big content provider country USA might explain this to the certain degree. Similar adoption patterns are in Hong Kong that indicates that circumstances might be similar as well. This might be explained by pirates, which are traditionally produced in Asia in these product categories. In Germany, the time to takeoff is short in video cameras whereas in other innovations the time is longer. However, as the pattern of adoption in video cameras shows, the adoption is not proceeding in a typical pattern, in other words, the dynamics is somewhat distorted. In Taiwan, takeoff times are short in all innovations. The Taiwanese culture is very collectivistic and long-term oriented, and therefore, people seek collective behavior and build firm relationships. The rapid adoption rate might be explained by these collectivistic intentions that people might want to belong to the mass.

Table 2. Takeoff time for different innovations in five nations.

<table>
<thead>
<tr>
<th>Product</th>
<th>Country</th>
<th>CD</th>
<th>PC</th>
<th>Videocam</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Canada</td>
<td>Short</td>
<td>Long</td>
<td>Short</td>
</tr>
<tr>
<td>Germany</td>
<td>Long</td>
<td>Long</td>
<td>Short</td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>Short</td>
<td>Long</td>
<td>Short</td>
<td></td>
</tr>
<tr>
<td>Taiwan</td>
<td>Short</td>
<td>Short</td>
<td>Short</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Short</td>
<td>Long</td>
<td>Long</td>
<td></td>
</tr>
</tbody>
</table>

We also attempted to explore possible key factors by examining the financial figures of each country. In many respects, the gross domestic product (GDP) has been used to describe the wealth of a nation and to explain overall adoption rate of innovations. It has been found that adoption proceeds faster in wealthy countries where people can spend more money on purchasing innovations. However, based on the OECD’s data on GDP’s between years 1976 and 2000, we cannot draw any conclusions on key success factors and adoption. For the selected countries, it seems that the GDP and the factors mentioned above, do not correlate at all.

Conclusions

Key findings
This study attempted to identify factors that can explain or significantly contribute to successful launch of an innovation. The study concentrated on early evolution of adoption of innovations that was examined in successful consumer electronics innovations that have reached the takeoff point in their adoption life cycles. The
following paragraphs summarize the key findings. Firstly, it is important to recognize the developmental paths of product generations. One of the selected innovations was CD, which has predecessors such as reel tapes, C-Cassettes and LPs. The latter two existed concurrently with CD thus competing as fulfillment of the same needs of customers. Exploring the figures of these products explains the co-evolution and underlying dynamics between substituting products.

Secondly, each innovation produces always a unique adoption pattern. For CDs and Video cameras the adoption takeoff time was short but PCs takeoff time remained quite long although all three innovations belong to consumer electronics industry. Thus, it seems quite reasonable that characteristics of innovations may better explain these adoption patterns.

Thirdly, some surrounding factors seem to have a certain effect, too. Especially, both official and pirate content production has had a clear effect on the adoption of CDs. We may therefore suggest that these surrounding factors act generally as enablers in adoption process. For instance, power distribution network eventually enables wider use of electronic devices, similarly as takeoff of mobile phones in developing countries needs both electric supply and telecom network. There may also be some disabling factors: for instance, existing installed base slows the adoption since consumers (buyers) have already invested in technology that becomes obsolete if a substituting technology is bought. A recent example in Europe has been the development in digital television; nowadays existing high definition (HD) ready television constitute the installed base that should be replaced before large scale adoption of full HD televisions can happen.

In addition, country’s culture has affected on innovation’s adoption. For one’s part, cultural aspects should be carefully considered when designing innovation’s test marketing as well as launching sequence and strategy. To summarize, demographical factors could be used in explaining innovations’ successful takeoffs but further studies are evidently needed.

**Other implications**

Furthermore, we may draw the some additional implications from our findings. These managerial implications are illustrated by examples to provide ideas to conducting global business. Firstly, when considering the supporting elements for successful adoption and the success of innovation commercialization, dynamics of test markets should be carefully selected. So-called “high tech” countries could be a proper selection in making marketable product from innovation. Typically, in that phase of product’s lifecycle, the commercial product is still in its infancy and users are mainly innovators which can tolerate even severe shortcomings in usability. In addition, being very typical, the innovators may provide valuable information to the firm in preparing the mass market launch. Moreover, the innovators oftentimes act as content producers. Therefore, these guidelines may provide help in designing proactive actions in pre-commercialization phase.
Secondly, demographic factors such as age structure of population, literacy, level of education etc. are important when selecting proper countries for launch. For instance, user interfaces must be designing differently for the countries where illiteracy is high. Text-based user interfaces do not function properly and may cause severe problems. Another example of environment’s effect on product attributes are mobile phones shipped to Africa. A must-be feature in those phones is flashlight; in these countries it is the most important single feature that a phone may comprise. One possibility how to approach demographical needs is using Maslow’s hierarchy of needs; when the basic needs are fulfilled, then the higher level needs such as esteem and self-actualization come forward. For instance, emphasizes on environmental issues seems to unfold only when the deficiency needs are constantly fulfilled.

Thirdly, the above information is particularly helpful to a firm that has to meet the challenges associated with international scope of operations. The results can be generalized for similar types of innovation. Further, the outcomes of this study can be utilized not only in selection of the sequence of national market launches, but – more extensively – also in planning strategies and tactics for competition. One cannot underestimate the importance of doing right things. It is important to achieve an overall awareness of influencing agents, or critical factors, but solving the right problem is far more important. Since we do not yet have found the secret recipe how transmute all our innovations to commercial success (i.e., to gold), designing and following a proper strategy is of utmost importance.

**Limitations and suggestions for further research**

The study has several limitations. The method of the study is based on explorative analysis, thus generalizations are not possible. Further studies should attempt to make hypotheses on the identified factors in order to test more rigorously their existence and also their effect. In addition, the study examined only three innovations in consumer markets that were also quite similar. Therefore, further studies should widen examination to other types of innovations, for instance, business to business innovations such as automated rock crushers or consumer goods such as ubiquitous clothes.

In this study, we employed the Hofstede’s framework for cultural dimensions that has been criticized (See e.g. McSweeney, 2002) and the responses, e.g. Hofstede, 2006; Kirkman, Lowe, & Gibson, 2006). Thus, another methodological possibility would be to use the GLOBE (House, Hanges, Javidan, Dorfman, & Gupta, 2004) instead of Hofstede’s framework.

Another limitation concerns the data used in the study. The number of innovations and countries were limited, thus increasing the possibility of some anomalies. Further studies could therefore expand in both respects. Finally, the study is retrospective in essence. As a result, it may enable us to make reasoning based on the correlation although in the real-time cases, the factors do not encompass causal relationships.
<table>
<thead>
<tr>
<th>CD</th>
<th>PC</th>
<th>Video camera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>Canada</td>
<td>Canada</td>
</tr>
<tr>
<td>Germany</td>
<td>Germany</td>
<td>Germany</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>Hong Kong</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>Taiwan</td>
<td>Taiwan</td>
<td>Taiwan</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>United Kingdom</td>
<td>United Kingdom</td>
</tr>
</tbody>
</table>
References


