

Critical Analysis on Innovation and Creativity in Management

INTRODUCTION

The paper performs an analysis of the 'Photovoltaic Breakthrough' case study that deals with innovative management practices of Palo Alto Research Centre, formerly called as Xerox PARC. Though the company has a promising product, there has not happened the required pace in commercialisation and transfer from the lab to manufacturing. A number of issues are behind the delay in the go to market approach and part of it has to do with organization culture, work methods and the mindset of the researchers. The paper has identified the issues that impact the case by discussing the main entities and then performing a SWOT analysis. Various models of innovation have been examined and applied to the case. Certain main issues have been identified and further analysed and a final set of conclusions and recommendations have been framed to provide answers for the trouble that the company faces.

PRELIMINARY ANALYSIS

The section provides a preliminary analysis to find out various issues. A brief discussion of main entities involved in the case has been presented along with a SWOT analysis and from this analysis, critical issues have been identified that would be discussed in later sections.

Main Entities. The section briefly lists main people, processes and other entities that play a role in the case study.

Frank Harlan. Team head of the Solar Sandwich photovoltaic technology unit that was improving and innovating the solar photovoltaic cell. He has been working with

the Toledo Speciality Glass company and pioneered research in solar cells but back then, he found few takers in the company for this product as it was not in the company's core business area. He does not have a college degree and resents people who are more educated than him. He has an ego problem and needs constant recognition and credit. He believes in empirical discussions but is not interested in knowing why and how a particular invention worked. Unfortunately all his team members have been adopted his behaviour and mindset (Fleming 2007, pp.1, 3-5).

Linda Choate. Corporate research and development director with a PhD in physics from Stanford who overlooks commercial technology transfers from research centres to production. She has to coax Frank Harlan into delivering results as the Solar Sandwich photovoltaic has been under development since 7 years, cost millions of dollars and has not earned any revenue. Initially she had combative relation with Frank on developing solar cells but she respects his inventions. She believes in combining science and invention with commercialisation and marketing and an opportunity to improve people's lives (pp.1, 5-6).

Robbie Heras. Industrial scientist who worked with development teams to hasten the commercialisation of technology. He regarded Frank as difficult but a very good inventor (p. 1).

Empirical Approach (Recombinant Search). Method practiced by Edison, the method used a combination of new and innovative materials and process to develop inventions. This method did create many useless inventions, increased costs substantially but gave innovative products. This process increases the inventory, bonds

the research team well but creates reticence as team members would not want to reveal their work to outsiders (p. 2).

Local Search. Process, where inventors used known materials they were familiar with. Subsequent tests would vary one component each time for research. This method reduces chances of failures and decrease costs but reduce the number of breakthroughs (p. 2).

Pilkington Process. An innovative process developed by professor Pilkington 'to manufacture clear, tinted and coated glass for buildings, and clear and tinted glass for vehicles with thickness from .4 to 25 millimetres'. The process is widely used in the glass manufacturing industry (Pilkington).

Toledo Speciality Glass Company. The case study is based on this company. The company was founded in 1909, and initially produced items such as windshield glass, headlight casings and others, and now produces speciality glasses, such as hardened glass, radiation proof glass and others. The company initially used the Edison recombinant approach and has funded research in solar cells. The company has research units in Toledo, Palo Alto and a production centre at Long Beach and there is a lack of cooperation and integration between these units. Long Beach wants documentation and Frank does not want to give the required documents. So engineers at Long Beach feel that Frank does not know how the thing works (Fleming 2007, p. 3).

Long Beach Centre. It is the manufacturing unit and takes technology transfers from Toledo research centre. Manufacturing wants a ready package of prototypes that would be commercialised and it wants full documentation. There is lack of integration between the two units (p. 6).

Technology. There are certain technology constraints and issues that are common to the solar cell technology. Since this is a technical subject, this issue has not been discussed as it is not in the scope of this management study. But the root of the issues is the lack of systematic procedures in the project (pp. 16-22).

SWOT Analysis of the Case. The section provides an analysis of the strengths, weakness, opportunity and threats that the Toledo Speciality Glass company is facing. The objective of the SWOT analysis is to find ways to increase the pace of commercialisation of research work.

Strength	Weakness
<ul style="list-style-type: none"> • Company has a long history of developing innovative products and has achieved commercial success. • It devotes impressive amount for research rather than hire an outside professor or join the government funded research consortiums • Members of the founders family on board and they operate on gut feel rather than facts and figures given by 'bean counters' and such an attitude has helped the Ceramic division to grow. The company very much supports innovation and 	<ul style="list-style-type: none"> • Company uses the Edison Empirical approach • Frank Harlan's lack of cooperation and openness that is proving to be a threat for the solar sandwich project. He is not formally educated and resents people with degrees. • No cooperation between the three development areas of Toledo, Palo Alto and Long Beach. • Company is mid sized but takes up research on the scale of IBM or Bell Lab and the costs are telling on the bottom line.

<p>research</p> <ul style="list-style-type: none"> • Company gives 500 USD for each patent filed, there are many excellent scientists and inventors • Company follows an expensive high tech strategy of using proprietary materials and processes. There is no outside investment, uses cost control and avoids unknown technology • The company has ties with institutions such as Stanford, Cal Tech, Berkley college, companies in Silicon Valley and a few others 	<ul style="list-style-type: none"> • Company does not reward for publication in research magazines and considers such activities as redundant. This attitude results in loss of recognition for the researcher and causes discontent • Involvement with institutions and colleges is slowing the process of research as teams get diverted from key tasks • It is easy to file a product patent but difficult to patent a process as it would be vague and if details are given, then competition can use them • Inconsistency in process used by Frank, produces non-repeatable results. It shows Frank works like an alchemist • Theoretical efficiency of different solar cells varies between 35 to 40 percent (p. 22). Process developed by the company varies between 16 to 22% hence the product is not efficient as per standards (p. 18).
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Opportunity	Threat
<ul style="list-style-type: none"> • The Solar Sandwich product has received firm enquires from NASA, off grid solar towns many universities and commercial product companies. • If the company successfully develops and commercialises the product, then it would see huge increase in revenues • Company has an option of joining industry research consortiums funded by governments and customers and this would reduce costs • Linda and Heras act as information gatekeepers, read academic journals, attend seminars and pass useful information, translation of works to other researchers. These people can be used to head the research in the proper direction 	<ul style="list-style-type: none"> • Company is fed up with a lack of results and may shut down the facility since it wants to cut costs. • Competitors are developing alternate products that could hit the market earlier than the company and such an event would make the current research obsolete. • Company insists that developments should be patented before they are published but filing patent takes a long time and delays publication. • In the industry, experts can understand the process by just reading a few journals and the company would lose its competitive advantage if results are published • Franks invention is subject to severe performance drop if raw materials used are impure or there are changes in the process. There is no control over raw material

Important issues in the SWOT analysis have been shown in bold font in the above table. These issues will be further analysed and merged to form critical issues that would severely impact the company operations.

Critical Issues. Based on the discussion done in sections '1.1. "Main Entities' and '1.2. SWOT analysis', a number of issues have been identified. From these issues, certain critical issues that severely impact the case are discussed.

Use of Edison's Empirical Approach. Edison worked in another era where the world could tolerate and fund endless research using various combinations of materials and processes. The method does not believe in building up on previous research, identifying and controlling individual parameters and leads to non repetitive results. Innovation and research requires proper log books, readings of test results, forward and backward regression, records and composition of raw materials to be maintained and hence researchers cannot know what and how results have been produced. There is no way in which the lab process can be duplicated due to the high uncertainty of materials and processes. The company should use the Local Search method for conducting research as this is more ordered and gives results that are predictable.

Frank Harlan's Unprofessional Attitude. Frank seems to forget that the company is a commercial organization and it should move to innovative commercialisation of research as quickly as possible. Since he is not educated formally, he does not realize the importance of documentation of materials and process that would help manufacturing and regards them as spies who would reveal his work to outside parties. Manufacturing does not trust him and is not ready to accept the 'half baked' inventions he has given because there is no clarity and no documentation that

would help in quick commercialisation. This mutual mistrust is not good for the company.

Lack of Management Control. Management has not moved with the ages and still believes that true innovation can only happen when researchers are given a free hand, plenty of resources and are not accountable to produce results. There is no direct pressure from the management to make Frank deliver. The company also has invested excessively in research when it could obtain results from academic institutions and the government.

LITERATURE REVIEW OF INNOVATION MODELS AND THEORIES

Hicks (2003) has argued that innovation is regarded as very competitive and smaller sized firms are in a better shaped to fully exploit innovations, put their focus on new innovative technologies, and take the advantage away from the incumbent. Lundvall (1992) suggests that small firms are regarded as more efficient in the employing funds and labour, and there is a certain extent, up to which they can go, and beyond this if results are not evident, the firms lose interest. Mytelka (2002) argues that there are certain advantages and disadvantages with small and large companies and much depends on the particular industry. Evangelista (1988) has studied the resource allocation in innovative companies and points out that competitive force sometimes foster innovation. The author shows that there are two entities: the agent and the principle and while the agent makes the invention, he does not carry any risks but accepts a fee or a salary while the principle who funds the invention carries all the risks

and in turn bears the rewards or losses. Different innovation theories and models have been discussed in this section and these would later be applied to the case.

Chain Linked Model of Innovation. The chain-linked model of innovation is illustrated in the following figure.

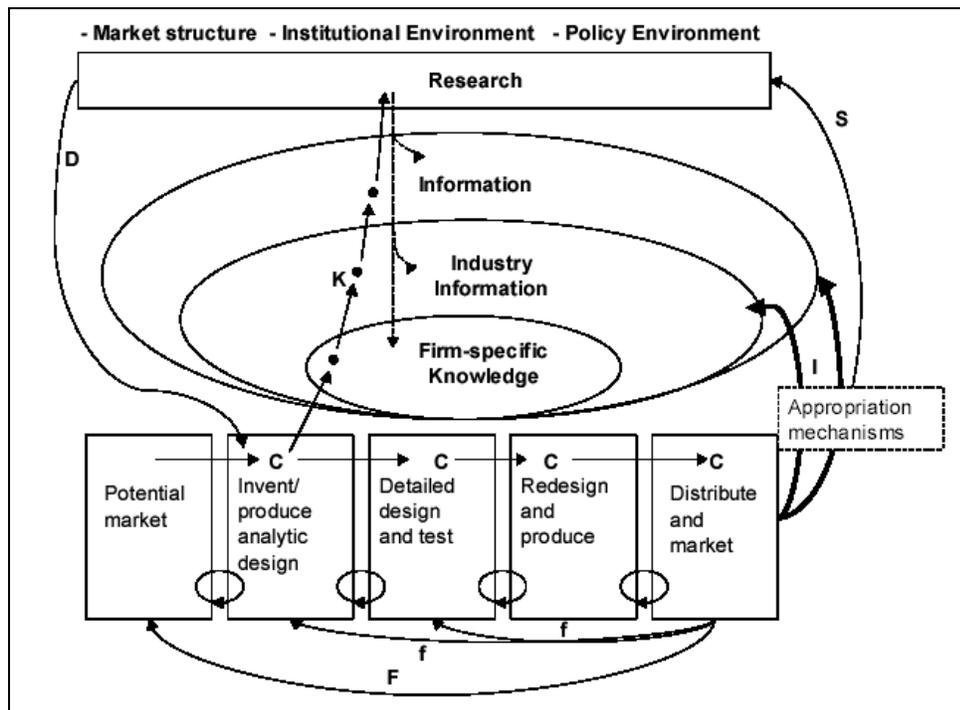


Figure 1. Chain Linked Innovation Model (Kline & Rosenberg 1986).

Kline and Rosenberg (1986) defined innovation as an exercise in the management and reduction of uncertainty' (p. 45). According to this model, researcher develops products that are designed for a potential market. After the invention and design stage is done, uncertainty is addressed by the technical performance and the market response. There are five main paths and these are the central chain of innovation 'C' that is initiated by the invention design that is based on market requirements; this is further developed, manufactured and sold. There are feedback loops 'F' 'f' that iterate the phases and monitoring for target market signals and

requirements and there are also links between science and innovation 'K' and they represent the knowledge body. The knowledge body deals with the learning's and processes that would be used for subsequent commercialisation of the product and is deemed very important as it is only after this stage that other teams of the organization are able to know how the product works and the process to be used for manufacture.

Disruptive Innovation. Christensen (2007) speaks of disruptive innovation as a process or product that is emergent and would seriously endanger the viability and use of existing products, rendering them obsolete. Companies that have not anticipated this type of innovation and taken appropriate actions would soon be out of business. Disruptive innovations have to be providing a new way of addressing problems and should provide benefits such as paradigm shifts in utility, new applications, vastly reduced costs of manufacturing or use of cheap and alternate materials.

Radical Innovation. Christensen (2007) has pointed out that radical innovation is a subset of disruptive innovation and the risk of uncertainty is very high. The innovation would require the market to be taught to use the product and there would be initial high acceptance barriers for such products. With a high risk of failure, the company that takes up such projects needs to develop a strategy that would produce quick results and avoid prolonged research and development cycle.

Schumpeter Model of Innovation. Schumpeter (1934) has provided a generic model of innovation. He suggests that innovation happens when a new product is introduced that customers are not aware of and for which there is no substitute; new method of production that leads to better productivity; new market that can make use of the new product; new source of raw material that allows better goods to be

manufactured; creation of a monopolistic product that gives the company a greater advantage. He suggested that larger companies are better able to develop innovative products.

Porter's Sustainable Competitive Advantage. Michael Porter propounded the sustainable competitive advantage model in which a company is able to develop a competitive advantage over its rivals when it innovates a product, process or a market that cannot be duplicated by others. Such companies are able to derive sustained competitive advantage over the rivals and this can only happen if the product is innovative and cannot be duplicated (Porter 1985).

Intellectual Monopoly Model. Hellwig (2001) has discussed the intellectual monopoly that is caused by innovations. According to the author, when companies or individuals develop innovative products, they tend to take IPR measures that prevent the duplication of the product by other companies and this allows the company to have a monopoly where they can dictate a price and control production and this gives them an unfair advantage. The authors point out that even individuals who are working for a company and who have developed the product tend to think in a monopolistic manner and are reluctant to reveal all details as they feel that they have a proprietary right over the invention.

Time Management. Evangelista (1988) has suggested that projects that operate in new technology domains need to use time management concepts very early in the project and that time management should be a part of the corporate culture. Companies that operate with venture funding need to demonstrate advances and periodic results else further funding will slow. Since Toledo speciality Glass Company does not have

any investor participations, the need to produce results seems to have taken a backseat and consequently with no pressure to show results, target oriented work has slowed.

Organisational Culture. Martins and Terblanche (2003) argued that organization and corporate culture plays a very important role in defining the shared values and norms, behaviour with peers and colleagues, beliefs and work practices. An open culture helps employees to innovate and come up with new ideas and concepts. But the authors have suggested that only providing an open culture may not help the company to innovate in the required direction and produce desired results. Performance of employees and their projects should be benchmarked with the best practices in the industry. With the implementation of systems such as ISO 9000, there needs to be transparency and order in documentation and work methods and these should be made available to authorized users in the organization. Managing and leading teams is a different set of skills that have to be taught in many instances and a very reputed scientist may not be very good at instilling discipline among his team members and he may lack adequate administration skills.

APPLYING THEORETICAL MODELS TO THE CASE

The previous two chapters have pointed out certain key issues in the case and also given various theories on innovation. In this section, the theories would be applied to these issues to create an understanding of the innovation at the company.

As per the Chain Linked Model (Kline & Rosenberg 1986), the innovator is expected to be market ready and watch the market needs and requirements closely. When the product is designed, it has to be tested in a sample market and problems

identified and rectified and an improved product should be offered. After this advance prototype has been tested in the market, it should be detailed, redesigned, manufactured and sold and a proper set of documents should be created. In the case, it can be seen that while the market is interested in the product and there has been some initial interactions with the market, the rest of the model falls in disarray. The product that has been developed has not been tested extensively in the company itself and the only prototypes that are fabricated have been manufactured in the lab. The results are not reproducible and there is no proper documentation available to help manufacturing teams to go ahead with the production. This is the state of affairs even after 7 years of continuous research and after spending millions of dollars. The risk of the present state of uncertainty being continued is very high, and there is no guarantee that the company would be able to recover the expenses, let alone make a profit. The project can be deemed as a failure.

The Schumpeter (1934) model of innovation is vague and does not spell out the specifics but as per the model, the product being developed can be called as innovative since the product is new and customers are not aware of any substitute product and new applications such as space shuttles and satellites, solar power for small towns and the fact that the product would give the company a monopolistic edge over rivals. So the product is an innovation.

When Porter's model of sustainable competitive advantage (Porter 1985) is applied for the product, it can be seen that the product would certainly give a competitive advantage over the rivals. But IPR and patents can be clearly taken for a product and it is possible to patent the product. The production process would be

difficult to patent as it becomes generic and rivals can make the required changes to the product and manufacture a competing product themselves. So in effect, the product is not able to provide innovative sustainable competitive advantage for the company.

As per the Intellectual Monopoly Model, the product can be called innovative in case the company that has provided it is able to patent it. But once the product patent is filed, details of the product, its manufacturing process and explanation of how it differs from other product, including detailed drawings have to be submitted and this information becomes a part of the public domain. Rival companies would be able to reverse engineer the product and develop alternate methods and products that would pass the scrutiny of the IPR issuing bodies (Hellwig 2001).

When we apply the disruptive and radical models of innovation as suggested by Christensen (2003), we find that the product cannot be called as disruptive or radical since it does not provide a paradigm shift in the use but it is an improvement over existing processes that are being refined. The market is aware of such technology and besides the company has spent 7 years in developing the process without success. Only factor that holds true is the high risk of failure but this has happened due to the Edison method of research where there is no control of individual parameters.

The organizational theories, as suggested by Martins and Terblanche (2003), show that while the company has provided an environment that encourages growth and innovation, Frank has not kept his side of the deal and used haphazard means of research, fostered a closed culture among his employees where information is not shared with other members of the organization. The company in its turn has not taken efforts to control its employees or set individual goals for them. The company culture

still reflects the culture of the bygone era of the 1900s when Edison created his invention. Such an approach should be done away with and professional management of people, projects and resources should be introduced.

CONCLUSIONS AND RECOMMENDATIONS

The paper has discussed the case study and performed a preliminary analysis that gives details of the main entities such as Frank Harlan, the team head of the solar sandwich photovoltaic technology unit, Linda Choate, the corporate R&D development director, Robbie Heras, the industrial scientist and the research methods that are used. A SWOT analysis has been performed to list a number of possible issues. From the list, three main issues have emerged that would cause the maximum impact and deem the project a non-starter and a failure. The issues are Use of Edison's Empirical Approach in the research process that does not require systematic scientific method of research; Frank Harlan's Unprofessional Attitude and a Lack of Management Control over the research process.

As mentioned in the case, Linda has a few options left and these include Harlan and Lampert transfer a poorly understood process to manufacturing or ask Harlan to straighten out the inefficiency and use proper research method (Fleming 2007, p. 15). If the first option were used, then it would probably lead to a bad product that would fail in the market and ruin the goodwill that the company has developed over the years. If the second option was to be used, then Frank was sure to take offence and stonewall all her further attempts and the company would suffer.

Recommendations that Are Made. Appraising and involvement of the CEO of the company who wants to shut down the unit. He should be told that the product could still be launched if proper research methods are used. Efforts should be taken in making him realize that by shutting down the unit of integrating the units, all expenses incurred so far would be lost.

The organization should use professional and target oriented management of people, finance and other resources. ISO 9000 concepts should be used that places a high importance on documentation, something that Frank does not like, but which when implemented would bring more transparency and order into the project. Since Frank does not have a formal education, he should be taught about documentation from the different universities that the company has relations with. The organization should force the message through that all employees work for the benefit of the organization.

Making Frank listen to Linda is not feasible given their bitter relations in the past. The board members should be involved in making Frank improve his work process and adopt proper research methods. A deadline should be given and he should be warned that if no results were produced in this duration, then the project would be closed. If Frank does not accept these recommendation and shows positive evidence that instructions have been followed, he should be removed and another competent person hired in his place. It must be made clear that one in the company is irreplaceable and that interests of the company are paramount.

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