

## A WIDER ANALYSIS OF BRICOLAGE, BREAKTHROUGH AND THE RELATED PAPER BY GARUD AND KARNOE

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### Abstract:

Garud and Karnoe [1], discuss about the approach taken up by the Danish and the US wind turbine firms in developing wind energy turbine technologies and the subsequent success of the Danish firms in achieving good market shares in contrast with the US. The authors [1] propose that the technique adopted by the Danish firms and other agents could be viewed as 'Bricolage' and that by the US as 'Breakthrough'. This paper analyses the extent of bricolage and breakthrough definitions and also the other aspects of the Danish and the US wind turbine technology evolutions which during the energy crisis that have not been considered by Garud and Karnoe in their classic paper "Bricolage versus breakthrough: distributed and embedded agency in technology entrepreneurship".

*Keywords: bricolage, breakthrough, USDOE, wind turbine*

### 1. INTRODUCTION

The paper[1] proposes and builds on the concept that the Danish wind turbine 'agents' were involved in a bricolage technique for the development of their wind turbines and the US wind turbine 'agents' were involved in breakthrough method to develop their wind turbine technology. In this direction, the authors [1] discuss the contributions of the various 'agents' involved in the development of the wind turbine technologies in both these countries in a manner that supports their argument. While most of the discussions are interesting from the article, we find that bricolage and breakthrough definitions do not fully take into account the ensemble of various activities of the involved agencies of the two nations. We argue that not only for this example of wind turbine technology evolution in Denmark and the US, but also for the successes or failures of various innovations all over the world, there are several important factors involved, which cannot be categorized entirely as bricolage or breakthrough, but rather as combinations of various defined categories. Also, in some cases, there could be other factors like resources and experience of previous technological efforts to any nation, which can also influence how relevant agencies act upon using this knowledge.

#### 1.1 Literature Review about other approaches towards Wind Turbine Technology in different countries

In this section, we will briefly discuss about what the existing literature speaks about technology entrepreneurship with respect to wind energy technologies besides the distributed agents' approach of the authors. To start with, [2] addresses the influence of national and sub-national policies in fostering the development of successful global wind energy technologies. The paper proposes that for any wind energy firm's global success, what partly matters is its success within its own nation. This paper focuses upon the approaches of various governments in terms of their policies and ambitions towards the development of the wind turbine technology in countries. Another interesting feature the paper suggests is that most governments are not only looking to expand the domestic use of renewable energy, but also attempting to develop accompanying local renewable energy technology manufacturing industries to serve demand [2]. Another article [3], presents interesting discussion about some of the methods governments use for expanding wind technology uses like encouraging demand-pull, technology-push on one hand and declaring incentives for non-incremental technological changes on the other hand. How do these affect each other for the wind technology developers with regards to their innovations, R&D etc? Both of these two papers highlight and analyze the roles of the Regulating agencies with the wind technology developments when viewed from the diagram of distributed agents[1] involved in technological path. In [4], two key questions are analyzed with

regards to few examples of wind technologies in US: these questions are how do institutions affect entrepreneurial choices? And how is entrepreneurship related to changes in institutions? Also, [5] focuses on the influences of long term innovation policies and development trajectories of four renewable energy technologies with wind energy being one of those. This study suggests that major problems exist with regard to learning processes (high technology push and R&D), social networks (supply side oriented, narrow, closed) and expectations which include 'hype-disappointment' cycles, tensions and struggles [5]. The next article [6], discusses about the relationship between technology policy and industrial development by comparing the wind energy industry in Denmark and India. Like [1] this article compares the wind technology growth in Denmark and India proposing that India employed a method of interactive learning with the Wind energy actors from Denmark, which greatly helped this nation to swiftly develop its wind technologies and emerge as the fifth largest producer of wind energy globally.

## **2. BRICOLAGE DEFINITION AND DISCUSSION**

Bricolage, in general means the process of improvisation in a human endeavor[7]. There are subtle definitions of bricolage with respect to improvisation in various fields. For example, in arts, bricolage is the construction or creation of a work from a diverse range of things that happen to be available, or a work created by such a process [7]. In the modern business scenario bricolage means ability to improvise a solution to a problem without proper or obvious tools or materials [8]. In some cases, bricolage definition has appropriately been used to denote the assembling of the available resources and the identification of niche markets by entrepreneurs to establish small ventures. The authors[1], (using definition from Levi-Straus[9]) propose that the methods used by the Danish wind turbine firms follows the bricolage definition.

## **3. BREAKTHROUGH DEFINITION AND DISCUSSION**

On the other hand, Breakthrough is not defined in the paper unlike Bricolage, which is one of the disadvantages. The authors[1] simply use the term to denote the technique used by the US Wind turbine technologies in order to contrast them against the Danish bricolage technique. The basic definition of breakthrough (Google search) is: a sudden, dramatic, and important discovery or development; or an instance of achieving success in a particular sphere or activity. Article[15], proposes that breakthrough innovations involve unexpected leaps of creativity and insight and are a result of the exploitation of the tacit knowledge held by individuals and teams. Also, breakthrough innovations might bring about social uncertainties [16]. In certain fields like the medical field, breakthrough innovations have to be tested more in order to explore all the possible risks associated with their uses, before actually taking them further for the public to rely on [16]. Article [16] hence proposes that for such innovations, firms have to depend on their social networks and national innovation context which shapes the social epistemology around the new innovation. In case of paper[1], the authors use this term when referring to the rigorous developmental techniques by the US Wind power firms to come up with an entirely new technology of wind turbines which are new and also very efficient as compared to the other wind turbine technologies that existed then.

## **4. BREAKTHROUGH VERSUS BRICOLAGE AND INCREMENTAL INNOVATION**

We propose that breakthrough cannot be defined set of processes which can be viewed as the precursors that lead to it unlike Bricolage. It is rather a process, which may or may not happen through constant research and several failures, but might also occur accidentally or unexpectedly. Also, the people who try to come up with new designs already are aware of the several failures they might face to come up with something new. Importantly, breakthroughs are not planned, or even expected, but might occur accidentally or might also be spun off from other researches.

Furthermore, in most cases, breakthroughs are within a particular organization or within a particular research undertaking entity. Generally, breakthroughs do not happen between several 'agencies' or players who work together or contribute ideas.

Also, the use of the term Bricolage in the context of Denmark developing its wind turbine technology doesn't seem convincing. In fact the Danish process of coming up with their technology, appears to be more of incremental innovation or various stages of incremental innovations with bricolage, but not bricolage alone.

## **5. HISTORICAL BACKGROUND OF THE DANISH WIND TURBINE TECHNOLOGY**

The Danish firms began developing and using designs that were made by Danish people with no technical research expertise, but were rather involved in professions like carpentry and mechanics. Danish firms hence did not invest high front end costs into the initial design assignments for the wind turbine technology, but instead, took up the existing designs from the society or the general public. This was a competitive advantage for the Danish firms when compared to the US wind turbine firms since most US wind turbine firms did not use this approach.

When discussing about the history of wind technology evolution in Denmark, the authors[1] have indicated about Juul's design. However, it is important to mention here, that this was not the first designed wind technology in Denmark. The earliest wind technology designs were successfully developed by the Danish inventor Pour la Cour [11]. Pour la Cour established the first windmill in Askov, a rural village in Denmark, which became a prototype wind power technology in 1902 and was operational till 1958[11].

## **6. HISTORICAL BACKGROUND OF US WIND TURBINE TECHNOLOGY**

The historical technologies from the US of which the authors[1] have mentioned are the ones developed by Jacobs in 1920 and the Putnam's 1.5 MW wind turbines from 1934 to 1945. During the energy crisis, the period of context for the comparison of the two performances by the authors[1], they claim that the US was approaching towards a solution for the wind energy requirement from a very research approach. The history of wind turbine technology in US is even older than the Danish one. The earliest invention would be the invention of the steel blades for windmills in the year 1890[14]. The first Wind Energy company in the US was established in the year 1850[14].

## **7. DISCUSSION ABOUT THE ARGUMENTS PRESENTED IN THE PAPER AND THEIR LIMITATIONS**

Authors[1] did not use the same bricolage model of the Danish wind industries in contrast with those of other countries apart from the US. The authors[1] did not demonstrate how the Danish wind energy turbine was successful when compared with the wind turbine technology evolutions of other countries like Japan, UK, France, etc.

Also, was Denmark investing more into only wind turbine energy sector? Or was it investing equally as much as the US was? Denmark's commitment towards wind energy technology was far more than that of US comparing on common grounds. As was the case, the US government tried to invest more into other sectors of renewable and other energy technologies and not just wind. Many other countries have been investing in different other renewable energy sources and not just wind energy like Denmark. Hence all the factors need to be considered while comparing.

## **8. TECHNOLOGIES WHERE 'BRICOLAGE' ONLY OR 'BREAKTHROUGH' ONLY CANNOT BE RELIED UPON**

From the context of definitions of the terms bricolage and breakthrough used by the authors[1], we can identify areas where neither of these alone can be relied upon. For example, research happening in the fields of technologies which involve crucial safety aspects. We cannot use bricolage while doing research on the technology of radiotherapy, which is used for treating cancer. Even the development of nuclear reactors, cannot rely entirely on bricolage and breakthrough. Chernobyl and Fukushima accidents can be seen as examples.

## **9. PRIVATISATION OF TECHNOLOGY RESEARCH VERSUS GOVERNMENT INITIATIVES TO TAKE UP TECHNOLOGY RESEARCH**

In the US, over the course of time, the government established several laboratories to work on the development of several renewable energy technologies. These organizations solely worked on the renewable energy sectors they had been allotted to by the government of the United States. Hence unlike some of the

disadvantages of competitiveness within the private firms to come up with innovative solutions, competitions are more open and knowledge is more efficiently shared among the various laboratories of the US DoE. As a result of this, there was better collaboration between the various laboratories doing research on the development of technologies.

## 10. COMPARISON BETWEEN THE GOVERNMENT OF DENMARK AND THE GOVERNMENT OF US IN DEALING WITH WIND ENERGY

The Danish government, had very efficient initiatives in place well before the governments from other countries would do the same, with regards to the wind technology. Many countries tried subsidizing green technology, but failed, except Denmark which provided 30% of initial capital cost in the early years which were gradually reduced to zero, but still maintaining a feed-in tariff [12]. On the other hand, the US was not as fast as the Danish government, for example, the Department of Energy itself was established in the year 1977[13].

## 11. CONCLUSION

We conclude this paper by saying that breakthrough definition cannot be applied for the example of the US development of their wind turbine energy technology. Also, we see huge difference between the Danish and the US government in their roles for taking up initiatives for the development of the wind energy. This shows that very often the efforts of a particular 'agency' in the development of a technology might far outweigh the roles of other agencies involved in the development of technology. Breakthrough is more uncertain and cannot be looked upon as a technique deployed per se, but rather an outcome of several research attempts which in most cases, would not be directly aiming to achieve the same goal achieved by breakthrough. Bricolage, by definition means self improvisation; and cannot be the only term which can define all the elements that helped develop the Danish wind turbine technology. This development was also caused by various incremental innovations in addition to bricolage.

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