ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 4, Issue 3, March 2017

Disruptive Technologies

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Abstract— the term "disruptive technology" as coined by Christensen (1997) refers to a new technology having lower cost and performance measured by traditional criteria, but having higher ancillary performance. Christensen finds that disruptive technologies may enter and expand emerging market niches, improving with time and ultimately attacking established products in their traditional markets. This conception, while useful, is also limiting in several important ways. By emphasizing only "attack from below" Christensen ignores other discontinuous patterns of change, which may be of equal or greater importance (Utterback, 1994; Acee, 2001). Further, the true importance of disruptive technology, even in Christensen's conception of it is not that it may displace established products. Rather, it is a powerful means for enlarging and broadening markets and providing new functionality. In Christensen's theory of disruptive technology the establishment of a new market segment acts to channel the new product to the leading edge of the market or the early adopters. Once the innovation reaches the early to late majority of users it begins to compete with the established product in its traditional market.

***Index Terms*—disruptive, Christensen, attack from below, established products.**

I. INTRODUCTION

Joseph Schumpeter (1939) considered innovation both the creator and destroyer of corporations and entire industries. He was among the earliest scholars to note the disruptive nature of technological change observing that it could lead to waves of "creative destruction." Cristiano Antonelli, Pascal Petit and Gabriel Tahar (1992) note that, "in his early works Schumpeter insisted on the role of entrepreneurs in seizing discontinuous opportunities to innovate. Innovations were taken in a broad sense of new 'combinations' of producers and means of production, which includes new products, new methods of production, opening up of new markets, utilization of new raw materials, or even the reorganization of a sector of the economy." They continue, "This initial approach stressed the discontinuities of the innovation process." In later years Schumpeter (1942) began to place greater stress on the role of larger enterprises in innovation, seeming to believe that as scientific knowledge accumulated there was a threshold investment in R & D below which a firm could not be an effective player[1]. In the light of current thinking one might suggest that the former hypothesis is true for areas of emerging product technology and for firms involved in revolutionary product innovation, while the latter hypothesis might well hold for process innovation and product improvement within firms producing standard products and large systems. Following Schumpeter's path breaking work, researchers in the main focused on the concepts he laid out and studied invention (ideas or concepts for new products and processes), innovation (reduction of an idea to first use or sale) and diffusion of technologies (their widespread use in the market). Indeed this was the framework used by Myers and Marquis in their influential study (1969), by the author (1971) and by Project Sappho (1972), the first extensive study of matched successful and unsuccessful innovations. Cooper and Schendel(1976) were among the first to turn the lens in the opposite direction in a provocative analysis of major technological innovations from the viewpoint of firms in established industries threatened by innovation.

II. EFFECTS OF DISRUPTION

Not only do the sales of the established technology decline, but the traditional leaders in the industry typically also lose position. Why is this case when clearly the traditional firms are financially strong and possess sophisticated market knowledge and distribution channels? The most obvious explanation for the demise of established leaders in an industry would be that they have skills in the old product or process technology, while the entrepreneurial firms have a base in the new. However, the balance of evidence does not seem to support this view. Perhaps the most surprising observation from examining many cases of discontinuous change is that differences in technological resources do not much discriminate between invading and traditional firms in an industry either. Most threatened firms do participate in the new technology and often have pre-eminent skills in it. The basic problem seems to be that they continue to make their heaviest commitments to the old, which reaches the zenith of its development only after it is mortally threatened. Cooper and Schendel[2] conclude that a dual strategy is simply not a viable way to gain a leading position in the new. Threatened firms continued to make added commitments to developing old products even after their sales had begun

ISSN (Online) 2394-2320

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to rapidly decline. Their explanation for this difficulty is that, "decisions about allocating resources to old and new technologies within the organization are loaded with implications for the decision makers; not only are old product lines threatened, but also old skills and positions of influence." If one were to bet purely on the basis of technological resources that a firm would master a discontinuity, then one would probably bet on an entrepreneurial firm with a sophisticated technology base and a high degree of development spending (as a proportion of sales) in an industry characterized by rapid generational changes, each of which represents a relatively small step from the past. Surely such a firm would find it difficult to become entrenched. Henderson and Clark studied just such an extreme case in a comprehensive review of the semiconductor photo-lithographic alignment equipment industry. Every firm in the industry was studied through five generations of architecturally different product technologies, meaning that components were integrated into a system in different ways. Astonishingly, no important firm in one generation of product figured prominently in the next! Henderson and Clark (1990, p. 9) concluded that even relatively minor shifts that lead to changes in systems relationships have disastrous effects on industry incumbents [3]. Their explanation is that such innovations "destroy the usefulness of the architectural knowledge of established firms, and since architectural knowledge tends to become embedded in the structure and information-processing procedures of established organizations, this destruction is difficult for firms to recognize and hard to correct."

Cost	Traditional Performance	Added Performance	Examples
Lower	Lower	Higher	Christensen case Hard Disc Drives
Lower	Higher	Higher	Compact disc/ vinyl album
Lower	Lower	Lower	Wafer board/ plywood
Lower	Higher	Lower	Oriented strand board/plywood
Higher	Lower	Higher	Digital/ film camera
Higher	Higher	Higher	Fuel injection/ carburetor
Higher	Lower	Lower	Wartime substitutes
Higher	Higher	Lower	Electronic calcu-lator/slide rule

Fig 1 – A map of Possibilities of Competitive Advantage due to Technological change of disruptive technology.

III. EXAMPLES OF DISRUPTIVE TECHNOLOGIES

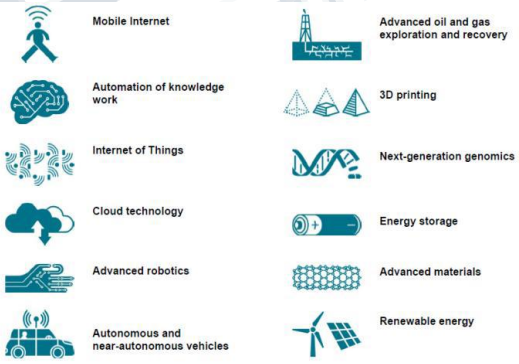
Examples mentioned below are few disruptive technologies which the world witnessed in past,

1. Compact Disk Disrupt Record albums and tapes
2. Wafer Board Disrupts Plywood
3. Oriented Strand Board Disrupts Wafer board
4. Digital camera disrupts Silver Halide Film
5. Fuel Injectors disrupt Carburetors
6. Electronic Calculators disrupt slide rules

IV. CASE STUDY - KODAK

Focused on preserving its leadership in the photographic film market. Developed and marketed “film based digital imaging”. Underestimated competition from Fujifilm. Made unrelated acquisitions to diversify its business. Belatedly transitioned to digital photography. Bankruptcy in 2011[2].

V. 12 POTENTIALLY DISRUPTIVE TECHNOLOGIES



VI. WHY IS DISRUPTION HARD TO SEE

Of course, the problem with disruption is that we tend not to recognize it for what it is until it’s too late. Just ask Encyclopedia Britannica. With the benefit of hindsight from the vantage point of a world where Wikipedia almost always comes up in the first three results for any online search, the expensive and massive collection of heavily edited, bound volumes seems an anachronism, both ostentatiously authoritative and hopelessly static, out of touch, and out of date before the ink even dried upon the

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page. But what did it look like in 1993 when Microsoft introduced Encarta Encyclopedia for PC, or in 2001 when Wikipedia began attracting contributors? Or imagine that you are a hotel executive hearing murmurs of a service for renting out a spare room or sofa bed. Does Airbnb[4] look like a threat to your continued viability? And if it does, what constitutes an effective response?

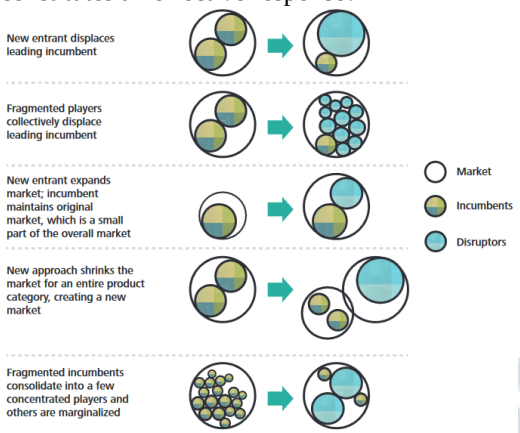

Fig 2 – Incumbents may walk multiple paths to displacement

VII. CATALYSTS FOR DISRUPTION

Following are the condition that effect the nature of disruption,

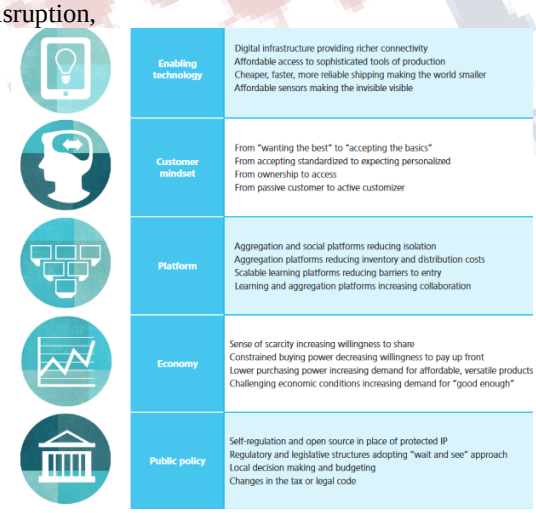

Fig 3 - Some representative catalysts describing shifts that occur in the global environment[3].

VIII. CONCLUSION

Initially, disruptive technologies were described as "innovations that result in worse product performance, at least in the near term... (that) bring to a market a very different value proposition..." The products are "typically cheaper, simpler, smaller, and, frequently, more convenient to use." They subsequently become "fully performance-competitive in that same market". If tamed well disruptive technologies will be able to create better job opportunities for a better world.

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