

Identification and Adoption of Disruptive Technologies – Perspectives of UK-Based Industry Major vs. Venture Capitalists

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Abstract

Since its conception in 1995, the theory of disruptive technology has been well established. Large firms around the globe are becoming increasingly active in assessing emerging technologies with the goal of adopting disruptive ones before smaller, more agile firms, commercialize them. While there is a surge in the number of academic studies performing ex ante assessments of emerging technologies, most of these are conducted with outside-in perspectives. This study aims to elucidate processes and perspectives used by technology firms as they try to catch the next wave. Surveys were conducted among two groups of UK-based respondents: (1) personnel of a high-tech industry major and (2) venture capitalists. Findings reveal substantial difference in practices among the two groups. Assessments performed by the industry major, representing the “large firm” mind-set, entail rigid processes and monumental amount of documentation, while those conducted at venture capitalist firms, representing the “small firm” mind-set, are less formal and unstandardized within the same firm. In terms of perspectives, it is found that all participants lack clarity as they make judgement to differentiate between disruptive vs. sustaining technologies. The scope of what is considered to be the top market success drivers of disruptive technologies also varies substantially between the two groups, with striking degree of consistency among the same group.

Keywords: Disruptive Technology, Disruptive Innovation, Technology Assessment, Innovation, Success Factor

1. Introduction

In the context of today’s rapidly evolving technology landscapes, it is crucial for companies to continually deliver new innovations to the market in order to ensure sustainable competitiveness. This issue is attracting the attention of major technology firms worldwide as new technologies are delivered by small firms and start-up companies at a rapid rate, posing an unprecedented degree of threat in driving the decline of major firms’ market dominance. In particular, the most threatening type is disruptive technologies whose concept has been well developed (Bower & Christensen, 1995; Christensen & Bower, 1996; Christensen, 1997a; Christensen, 1997b; Christensen, Johnson, & Rigby, 2002; Christensen & Raynor, 2003; Christensen, 2006; Christensen, Raynor, & McDonald, 2015).

In his landmark book “The Innovator’s Dilemma,” Christensen (1997a) categorized new technologies into two types: sustaining and disruptive. According to this framework, sustaining technologies refer to those that present incremental improvement to existing technologies, such as for instance the increase in memory capacity of computer disk drives. For this type of technology, major industry players typically find it easy to lead the market based on their high degree of customer centricity and profit margin (Bower & Christensen, 1995). On the other hand, disruptive technologies are new technological platforms that present performance trajectories which may initially underperform, but may eventually overtake that of the existing technologies, allowing them to gain prominent positions in the market (Bower & Christensen, 1995). Moreover, these technologies may also bring about new performance attributes. This concept is well demonstrated by the example of digital photography, which introduced resolution trajectory that is different from that of film photography, while offering new value attributes in terms of ease of image sharing.

In the initial stage, adoption of this type of technology may seem unattractive to the incumbent industry major due to conflicts with profitability goals and the pressure to deliver what existing customers ask for (Bower & Christensen, 1995), both of which are closely met by sustaining technologies. Disruptive technologies are, therefore, often delivered by small entrepreneurial firms and start-ups. As factors contributing to disruptiveness span beyond technological improvements, assessors of disruptive technologies must also take the broader context of market and strategic factors into account.

In response to the threat presented by disruptive technologies, major firms have become more active in scouting and assessing emerging technologies in the hope of catching the next waves. This trend has been reported for several industries including technology (Mortara et al., 2010), automotive (Gassmann & Gaso 2004) and publishing (Cozzolino, Verona, & Rothaermel, 2018). Since adoption and commercialization of disruptive technologies have become the focus of both established and new firms (Cooper & Smith, 1992), several frameworks to aid these firms in the assessment of disruptive technologies have also been developed within academia (Rasool, Koomsap, Afsar, & Ali Panezai, 2018; Kilkki et al., 2018; Hang, Chen, & Yu, 2011; Guo et al., 2019; Gatignon, Tushman, Smith, & Anderson, 2002; Govindarajan & Kopalle, 2006; Klenner, Hüsigg, & Dowling, 2013). In the literature, a vast variety of technological advances have also been assessed with respect to the potential for disruption in areas including electric vehicles (Hardman, Steinberger-Wilckens, & van der Horst, 2013), 3D printing (Al-Harbi, Buqawa, & Soud, 2018), on-line office applications (Keller & Hüsigg, 2009), and information and communications technology (Sainio & Puumalainen, 2007).

This qualitative research study aims to elucidate processes and perspectives used by technology firms as they try to catch the next wave. More specifically, surveying the UK-based personnel of a high-tech industry major and venture capitalist respondents through face-to-face interviews, it seeks to determine fundamental differences between the practices of “large firms” and small entrepreneurial firms and start-ups, in this study, collectively referred to as “venture capitalists.” Whilst most of the foregoing frameworks and assessments offer outside-in perspectives of potential success factors of disruptive technologies, this study aims to elucidate the inside-out perspective as firms assess prospect technologies for adoption. A particular emphasis is also placed on comparing between perspectives between large and small firms.

2. Approach to the Study

- Disruptive Technology

The concept of disruptive technology has gained rapid traction among the academic community and has been widely debated and refined (Kawamoto & Spers, 2019). Though the original

definition of disruptive technologies focuses on characteristics of the technology (i.e., performance trajectories), recent developments suggest that disruptiveness is also a function of how technology interacts with the market and consumers. Govindarajan and Kopalle (2006) pointed out that new trajectories contribute to the technology’s radicalness, however, disruptiveness is attributed to market-based factors driven by receptiveness of customers in emerging market segment at the time of the technology’s introduction). Nagy, Schuessler, and Dubinsky (2016) also suggested three disruptive characteristics: new functionality, discontinuous technical standards, and new form of ownership. The latter correlates with how the market responds to the new technology as it is introduced. In addition, Petzold, Landinez, and Baaken (2019) have also proposed that disruptive technologies “can be understood as occurring through emergent dynamics” (p.158) including timing of entry, synchronization of events and adaptability of strategic actions, pointing out that disruptiveness of the technology is dependent on its market entry strategy. Likewise, Tsoukas (2017) also noted that disruption is a dynamic process which can be influenced by actions taken to manage the innovation.

- Research Framework

As noted earlier, small firms are generally perceived as more rapid adopters of disruptive technologies due to a higher degree of agility in the decision-making process as the result of their smaller size. This indicates that processes play a part in delivering disruptive technologies to the market. Apart from processes, perspectives also impact what firms consider to be disruptive. For example, large firms utilize customer centricity to deliver closely what the customer voices, blinding them from delivering discontinuous technological standards that can disrupt the market (Christensen & Bower, 1996). Therefore, it is hypothesized that the key differentiating factors behind assessments of small and large firms lie in the aspects of process and perception aspects.

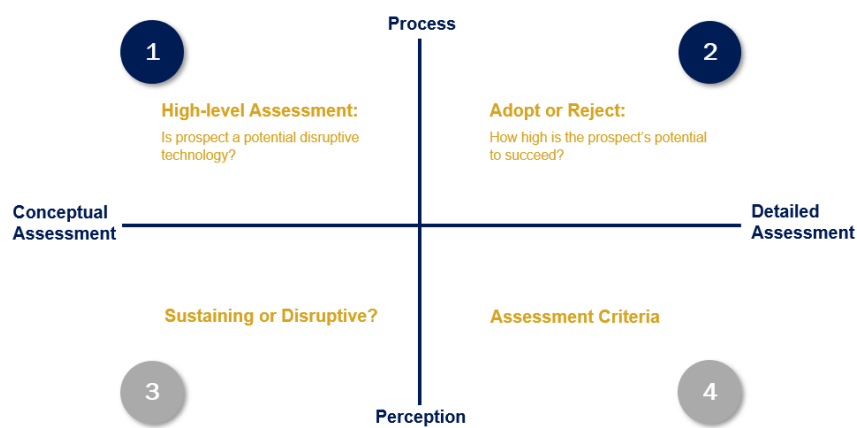


Figure 1: Four Components in Understanding Processes and Perceptions Firms Adopt in Assessing Prospective Disruptive Technologies (Created by the Authors for the Purpose of this Study)

On the other hand, firms commonly conduct their assessment of disruptive technologies in a series of stages, beginning with understanding broad overview and with increasing level of details required in subsequent steps (Gassmann & Gaso 2004; Mortara et al., 2010, Ernstsen, Thuesen, Larsen, & Maier, 2018). Differences in process and perception factors between large and small firms may be present across both high-level and detailed assessment stages taken by

companies. Therefore, in light of the above discussion and with these factors in mind, the authors propose the use of the following framework (Figure 1) toward understanding how large and small firms think as they identify what would be the next big thing:

In setting up the fault line of process versus perception, which crisscrosses with that of conceptual versus detailed assessments, four quadrants are defined. Quadrants 1 and 2 deal with the processes which firms adopt to assess a technological prospect. For simplicity, these are categorized into 2 steps: (i) High-level Assessment (Quadrant 1), and (ii) Adopt or Reject (Quadrant 2).

- 1) *High-level Assessment* (Process/Conceptual Assessment, Quadrant 1): For large and small firms alike, the first step in the assessment process involves answering the question of “Is this potentially a sustaining or disruptive technology?” Once the prospect is classified as a potential disruptive technology, it can then be passed on to the next step in order to decide whether the technology should be adopted.
- 2) *Adopt or Reject* (Process/Detailed Assessment, Quadrant 2): In the latter step of the assessment process, firms assess the prospect in more detail in order to determine its potential for success. The outcome of this step is the decision either to adopt or reject the technology.

Quadrants 3 and 4 pertain to the perceptions which firms take as they follow different steps of the assessment process.

- 1) *Sustaining or Disruptive?* (Perception/Conceptual Assessment, Quadrant 3): Firms make judgment based on their perceptions in order to determine if a new technological idea has the potential to fundamentally shift the market and become a disruptive technology. Will it compete on the basis of incrementally improving the performance of an existing technology?
- 2) *Assessment Criteria* (Perception/Detailed Assessment, Quadrant 4): During the detailed assessment phase, firms use a set of assessment criteria to determine the potential of success of the new technology in disrupting the market. Of course, what are considered to be success factors may differ based on the perspective of each firm.

- Interviewees

Using the framework shown in Figure 1, this study therefore aims to determine fundamental differences between the practices of “large firms” and “small firms”. To this end, two groups of respondents were chosen for face-to-face interviews:

- 1) *Assessors from large firms*: This group consists of 10 Senior Scientists in a global high-technology major who work in a UK-based think-tank unit and are responsible for prospecting and assessing emerging technologies to be adopted by the large firm whereas the large firm itself has a global presence with number of employees in the order of several thousands. This group of respondents makes up the working group of think-tank of the firm; hence, their assessments present a material degree of influence on the firm’s adoption/acquisition of technologies.
- 2) *Assessors from small firms*: This group is represented by 6 UK-based venture capitalists (Director level) with successful track-records of disruptive technology investment. In this study, venture capitalists are selected to represent the “small firm’s” views for two reasons: 1) the small size of their organization which is typically limited to under 10 head-counts of full-time employees and 2) their role as an important assessor as to which emerging ideas from small start-ups get selected for funding as potential disruptive technology.

During the interview, each interviewee was asked a list of similar open-ended questions designed to elucidate the respective organization's practice on each component described in the quadrants of the above matrix (Figure 1). The questions are largely divided into 3 areas:

- 1) Description of processes used in technology assessment and information required for input at each step;
- 2) Top-of-mind criteria that drive success in disruptive technology;
- 3) Judgment on categorizing a list of technological developments into sustaining vs. disruptive technologies.

In particular, questions in Area 1 aim to elucidate conceptual and detailed assessment processes used by the respondents. Questions in Areas 2 and 3 further identify the perceptions applied along the assessment process.

3. Key Findings and Discussion

Overall, in terms of assessing prospective disruptive technology, fundamental differences exist between the industry major and venture capitalists, both in terms of processes and perceptions/perspectives.

- *Processes*

In terms of processes being used at the large firm, personnel of the industry major are required to submit lengthy documentation describing multiple aspects of the prospective technology. These include technical details of the new technology, product description, use cases, qualitative comments on market potential and projection on time to market. Documentation required at this stage may span several A4-sized pages and demands an intensive number of man-hours, typically between half to one working day. After the documentation is submitted, the team then discusses all candidate prospects in a regular meeting. If the prospect is selected to be further explored in detail, additional documentation is then required.

Next, the assessors are required to complete a scoring matrix which is a pre-defined template used at the industry major. This documentation is a form which contains a set of assessment criteria, each of which is to be scored on a scale of 0 to 5 in terms of potential for success. A member of one the teams interviewed deemed the use of the scoring matrix "difficult, lengthy, abstract and extremely inaccurate". This is because the same set of criteria is used across all prospects. However, some criteria only apply to sustaining technologies, not disruptive, and vice-versa.

On the other hand, unlike the industry major, venture capitalists are on the other end of the spectrum when it comes to the level of complexity in processes. Among the firms interviewed, most require no formal process across both high-level and detailed analyses. Documentation submitted in support for cases for funding often varies in format, even within the same organization.

- *Perspectives*

In terms of perspectives, both the industry major and venture capitalists have not formed a solid view in defining what is disruptive. A list of technologies which had gained general consensus among the academic community to be either sustaining or disruptive was presented to each respondent to perform his own categorization. In addition, definitions of sustaining and disruptive technologies according to Christensen (Christensen, 1997a) were given to each respondent prior to the survey interviews. However, every participant, both from the industry major and venture capitalists, found the task difficult. Each produced a list of categorization with limited agreement to those done by the academic community. For example, several interviewees incorrectly identified recent advances in digital radiography to be an incremental improvement from conventional film x-rays.

In fact, digital radiography is a potential disruptive technology in a similar way that digital photography was to film photography: presenting a new trajectory in a key value-driving attributes (image resolution) and introducing new attributes (e.g. ease of sharing across different digital devices). This finding is consistent with the trend observed by Hopp, Antons, Kaminski, and Salge (2018) in that the term “disruptive technology” is often mixed with that of “radical technology” (those that are merely fundamentally different from the predecessor, but would not cause the market to be disrupted).

Lastly, assessment criteria used by the industry major compared to those by venture capitalists in the detailed assessment stage differ substantially. When asked to identify the top three criteria in determining market success of a disruptive technology, interviewees from the two groups responded with sets of criteria that were different across the groups but generally similar within a given group, with minor overlap between groups. As this question was unprompted, responses received from the participants represent their top-of-mind factors. Frequency of responses was measured. The results are presented in Figure 2.

Overall, it can be observed that the industry major considers criteria pertaining to the product and its applications to be paramount, while venture capitalists focus on bringing the technology to market and defending its commercial value. An overlap exists, however, between the two groups particularly in the area of market size.

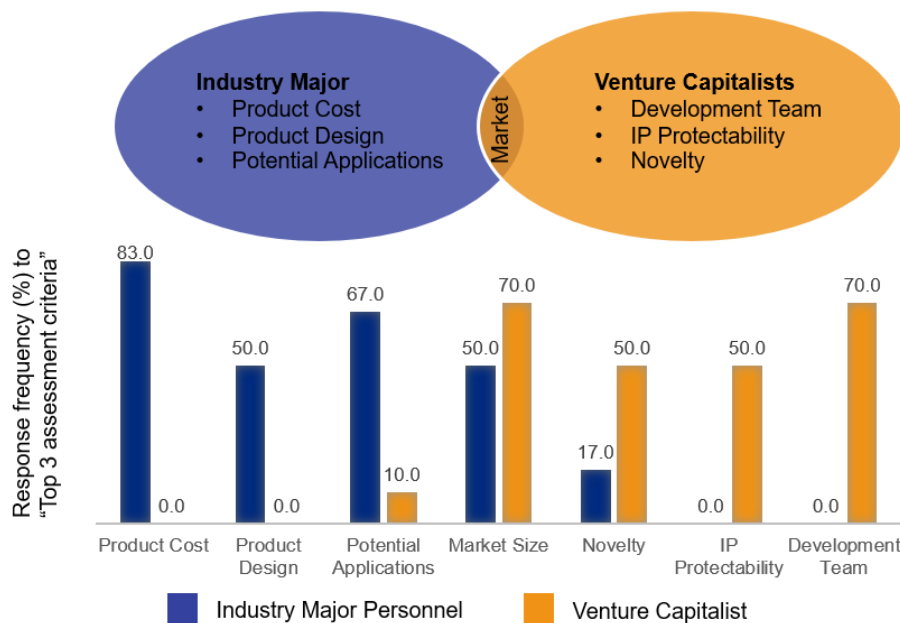


Figure 2: Industry Major vs. Venture Capitalists’ Perspectives on Important Success Drivers of Disruptive Technologies (Based on Responses from Face-to-Face Interviews with Respondents)

For the industry major, great emphasis is placed on product costs, potential applications, product design and market size, with 83%, 67%, 50% and 50% of respondents considering the factor within their top 3 criteria, respectively. Moreover, 17% of respondents in this group also consider novelty of the technology to be within their top three criteria. On the other hand, for venture capitalists, the following criteria are in the spotlight: the capability of the development team in commercializing the technology, market size, novelty of the technology, and IP protectability. These are mentioned among the top 3 criteria with 70%, 70%, 50% and 50%

frequency, respectively. Moreover, 10% of respondents in this group also considered potential applications to be among their list.

5. Conclusion and Recommendations

The “large firm” and “small firm” mind-sets differ substantially with respect to the question of what would be the next wave of disruptive technologies. This is evident in the difference in processes with which they use to filter prospects, as well as the perspectives used in determination of potential degree of success. In terms of processes, the industry major is more rigid, requiring a set of detailed documents to be completed from the earliest stage of the assessment; hence, demanding an intensive amount of staff’s efforts. In order to offset this, it is recommended that a prospect filter be implemented at the earliest part in the process so that unpromising ideas can quickly be identified and discarded. For example, a filter that separates between sustaining and disruptive technologies can present a quick-win as this helps simplify both high-level and detailed assessment stages.

At the high-level assessment, the scope on the right type of prospects can be quickly refined, while at the detailed assessment stages, the set of assessment criteria can be streamlined as the current set used by the industry major currently contains factors that are more specific to the success of sustaining technologies. In order to use the proposed process successfully, further refinement in the dimension of assessors’ perspectives needs to be addressed.

As this study has shown, misunderstanding of what are sustaining versus disruptive is pervasive. Personnel should be trained in order to shape their perspective of sustaining vs. disruptive technologies based on the following applicable and simplified interpretations:

Sustaining Technology

- Improvements on existing technology platform

Disruptive Technology

- New technology platform; hence new performance trajectory
- Performance trajectory can overtake existing technology and disrupt the market
- May bring about new attributes that become valuable to the customers

Moreover, the current study has shown that perspectives on most important drivers for market success also differ substantially between the industry major and venture capitalists. Although there is an overlap in the criterion of market size, the “large firm” mind-set is found to be geared more towards product design and costs, while the “small firm” mind-set is particularly focused on capability of development team and IP protectability. In order to mimic the rate of disruptive technology adoption of small firms, large firms may consider increasing the importance of the top factors used in the “small firm” mind-set in their own assessment criteria.

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