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Competitive Dynamics of Artificial Intelligence Economy: The Wicked Problem of Cognitive Competition

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Abstract. The competitive dynamics of the early 21st century competition are being reshaped. Much has changed in recent years as the rise of artificial intelligence is emerging as a powerful force. Less understood, but overwhelmingly felt, the change is shattering the traditional vertical boundaries. With tech firms now encroaching the traditional verticals, the need for strategic realignment is apparent. Non-tech firms are responding with acquiring tech firms. Tech firms are responding with trespassing into the non-tech domains. This creates a wicked problem for traditional non-tech firms: traditional sellers of technology are now becoming fierce competitors andtraditional non-tech firms must adapt to this new reality by developing technology of their own. This paper adds to the literature in various ways. First, the paper presents a model that captures the unique properties of artificial intelligence competition. Second, the paper argues that to stay competitive non-tech firms would need to acquire multidisciplinary innovation capability as well as embrace high-performance innovation culture.
Keywords. Artificial intelligence, Cognitive competition, Business strategy, Autonomous agents.
JEL. O00, O30, M00, M10, L00, L10.

1. Introduction

The Artificial Intelligence revolution is distinct from the industrial and digital revolutions and its impact on society, life, and firms is expected to be extensive and profound (Makridakis, 2017; White House, 2016a; 2016b). In the first half of 2017 two business news were consequential to describe the new change taking place in the business world. Ford fired its CEO and one of the reasons given was the failure to move fast enough in the upcoming self-driving cars space (Vlasic, 2017). Second, Amazon announced that it is acquiring Whole Foods. Both news items demonstrate that the non-tech sectors (all sectors outside of the information technology sector) are under direct assault from the tech-firms. Now, it appears, tech-firms can as easily build cars as they can make software; they can create trading platforms or develop new drugs, or trucks that drive themselves, or drones that fly with little human intervention, or robots that can be nurses or guides or housecleaners or companions. For our purposes, the competitive dynamics unleashed by artificial intelligence can be termed as cognitive competition. Clearly, the pace of competitive change is overbearing and if you happen to be the executive on the receiving end of the assault, it comes as a terribly wicked problem.

2. The Wickedness of Cognitive Competition

Since Churchman talked about wicked problems (Churchman, 1967), and Rittel & Webber (1973) brought the idea into policy, and then Camillus (2008) showed that business strategy as a wicked problem, we have enough grounds to claim that

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it is not a stretch to depict the cognitive competition as a wicked, perhaps a wickeder, problem. Hard to formulate, unique, symptomatic of other problems, hard to test solutions, and not knowing when you have reached the solution are all some of the properties of wicked problems (Camillus, 2008). Specifically, the wickedness of the cognitive competition problem emanates from three areas:

Competitive Problem: Competitive problem arises when non-tech firms must directly compete with non-traditional, i.e. the tech firms, players who can alter the underlying fundamental competitive dynamics. The tech-firms alter that equation by introducing technology and data as the fundamental drivers of competition (Porter & Heppelmann, 2015).

Competence Problem: Competence problem stems from the fact that non-tech firms may notpossess the technical capability to develop advanced information systems necessary to compete under the new rules of the game. What complicates this even more is that the same firms that the non-tech companies once relied upon to obtain technologies thatgave them their competitive advantage in the first place are now their competitors. No more reliance on external providers implies that non-tech firms must build their own. Thus, the scope of competence includes processes, know-how, resources, processes etc. necessary to build technology.

Culture Problem: Culture problem arises when non-technology firms try to emulate the tech-culture of the tech firms but may fail to create the energy, discipline, work ethic, team orientation, and sheer determination that have all become distinguishable traits of technology firms.

3. The 6 Properties of Cognitive Competition

To understand the competitive dynamics of artificial intelligence based competition, we need to decipher the six unique properties that drive the competition:

Intelligence Property: Unlike the machines and tools developed throughout the human history, A.I. machines have the cognitive capability. This allows them to understand and assess their environment, reason, make decisions, and execute actions. While various definitions exist for autonomous agents (Franklin & Graesser, 1997), for our purposes we define them as machines that can sense, analyze, decide, act, and learn (SADAL® Model, pronounced as *Saddle*). Thus, the basis of the competition is "intelligence" and it is through intelligence that a strategic optimization shapes and delivers economies of scale or scope.

Infringement Property: Infringement implies that with the advent of artificial intelligence, traditional information technology companies will now leave their native territory of "information technology" and will infringe into other sectors such as auto sector, drone manufacturing, groceries etc.

Invincibility Property: Invincibility implies that the nature and ontological design of artificial intelligence technologies is such that the artifacts accumulate experience and learn and therefore acquire evolutionary invincibility with time. This means that the products developed early on may become better with the passage of time and hence acquire tremendous competitive advantage. For example, an artificial intelligence based automated tax accountantor an artificial intelligence based psychological counsellor will become better with each experience and hence would eliminate the need or motivation for any competitor product.

Intransience Property: The examples of A.I. accountant or counsellor also imply that one artifact will be sufficient to serve the tax needs of the entire market or that one psychological counsellor agent will be able to help the entire world. When combined with the invincibility property, this will give the solution an exclusive permanence.

Integration Property: As technology that attempts to automate human work, artificial intelligence includes both physical and cognitive work (for example robots). This integration of cognitive and physical work enables it to become ubiquitous and general in its application potential. Hence, it can be applied in all

conceivable work streams, work types, industries, and points in value chain. This implies all the jobs that humans can do – and potentially the ones humans cannot do currently (e.g. travel to distant planets) will be done by an integrated solution of physical and cognitive capabilities.

Independence Property: The state of being independent and autonomous to behave in manners which may extend beyond the expected or intended design as developed and predicted by the designer. This implies that unlike all other artifacts developed by humans that can only perform strictly within the confinements of their intended purpose, autonomous agents can learn, evolve, and develop.

4. Can A.I. be a Fad or Fashion?

Is it possible that the rise of artificial intelligence is a fad or fashion? Abrahamson cautioned us about the management fads and fashions (Abrahamson, 1991; Abrahamson & Rosenkopf, 1993; Abrahamson & Fairchild, 1999). Information Technologies are also culpable of being fashions and fads (Hirschheim *et al.,* 2012). However, when we think about technologies and innovations that can be management fads, they typically involve technologies developed by technology firms that are marketed to other firms. Adoption becomes a factor of selecting between various suppliers and designs, being influenced by salespeople and consultants, and by riding the bandwagon. The difference with many A.I. technologies is that they are not marketed for external consumption but instead are designed for the self-consumption of the designer. For example, an A.I. based financial trading system by a California based firm Sentient is designed for self-consumption for the firm to act as a hedge fund – even though the company could have stayed a technology firm and sold the system to firms such as Goldman Sachs or JP Morgan, it decided to act as a hedge fund.

DiMaggio & Powell (1983) identified that as early as 1968, Hawley introduced to us the concept of Isomorphism (Hawley, 1968) -the constraining process that forces one organization to mimic other organizations when faced with the same environmental conditions. In their seminal book Organizational Ecology, Hannan and Freeman proposed that isomorphism results from course adjustment by management teams as learning develops (Hannan & Freeman, 1989; 1977). They expanded to highlight that large organizations would rather dominate than simply adjust the course. But DiMaggio and Powell provided a more comprehensive insight into isomorphic change -exploring homogeneity they highlighted the three types of isomorphism: coercive, mimetic, or normative. Coercive results from being forced from external forces; Mimetic from uncertainty inherent in the environment; and Normative from pressure form professionalization. The underlying assumption of the entire debate in isomorphism is that somehow there will be enough time that common practices will develop, that shared learning will manifest in a manner that it will iterate to some type of a standard learning, that through a process of socialization a dominant design will emerge, and that the technology being adopted will be the one that others will have both *utility for* and *access to*. In other words, the adopters in the chain who follow the early adopters will have utility for the technology and that they will be able to acquire it. With respect to isomorphism manifesting in competitive dynamics of a firm, as the 6-Properties show, the first mover would easily monopolize the market and would leave neither utility nor access for the followers. In some ways, we observed this phenomenon when bookstores and retailers began losing business and went out of business as Amazon took over the market.

Even a cursory search in the field of "patent specs" in US patents shows that the usage of the term "artificial intelligence" has grown 180,000% in the last 35 years (Figure 1). The recent investment trends also show significant investment flowing into the A.I. field (Insights, 2016). Far from fashion or fad, the patents and investment trend shows real innovation is taking shape.

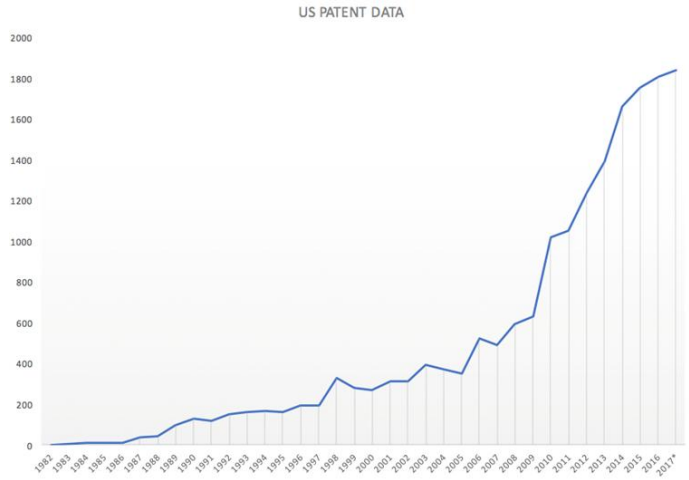

Figure 1. *US Patent Analysis*

5. The Case for Multidisciplinary Innovation

When companies call themselves "innovative" they don't necessarily imply being innovative from the use of "information technology". For example, a financial services firm may consider itself innovative from the perspective of launching new financial products, a pharmaceutical company from inventing new medicines, an auto company from launching new features such as a new braking system, an airline from deploying a new business model (e.g. Southwest). We can term such innovations as *native* as they dwell in the research and development centers of various firms. Information Technology, on the other hand, is typically acquired from external suppliers such as IBM, Oracle, Microsoft etc.

However, as indicated by Baskerville *et al.,* (2014) information technology is now becoming the reference discipline for others. In fact, it is now being considered as more than a reference discipline, as an irreversible change, and being at the center of almost all human activities (Brynjolfsson & McAfee, 2011). For example, a pharmaceutical company can innovate via biochemistry – but bioinformatics is at the core of modern innovation. A logistics and distribution company, for example FedEx, can barely function without information technology. A financial services firm can design complex derivatives but cannot do much without computers to launch, design, and distribute the product. The advent of artificial intelligence will make things even more dependent upon AI machines (McAfee & Brynjolfsson, 2016). Almost 50% of jobs can be replaced by machines (Frey & Osborne, 2013). This implies that the basis of innovation now has shifted from other fields to information technology, and specifically to A.I – and therefore companies must develop multidisciplinary capabilities that include their native innovations as well as they must lead in developing their A.I. capabilities and solutions.

As previously discussed, under the new competitive dynamics, since the A.I. tech firm will be reluctant to share the artifact, it leaves no choice for the non-tech firm to develop the technology itself or to acquire a tech firm. Interestingly, recent data shows a powerful increase in the M&A activity of non-tech firms acquiring technology firms (Picker, 2017).

6. How to Respond to the Wicked Problem?

Form previous discussion it appears that two factors are at play here. First, a non-tech firm must seek and implement multidisciplinary innovation path (both via capability building and M&A). Second, the firm must establish a culture consistent with innovation. In fact, this gives us two dimensions of Innovation Capability and Innovation Culture, and their intersection creates four positions.

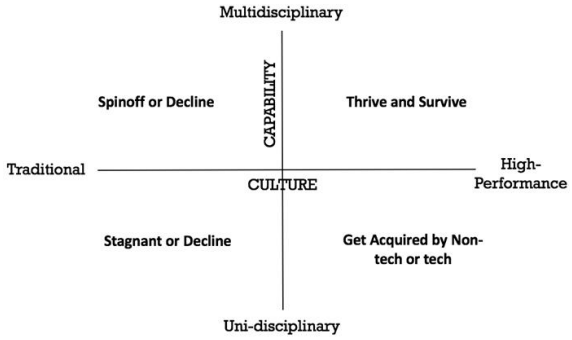

Figure 2. *Innovation capability vs.culture.*

Multidisciplinary Innovation Capability with High-tech Culture: These firms will embrace the challenge of becoming competent in developing A.I. technologies, innovative business models, data management, processes, and creating a powerful combination of strategy, technology, and high performance culture.

Uni-disciplinary Capability with High-Performance Culture: These firms will have a singular focus. If tech firms, they will likely become acquisition target from non-tech or tech firms. If non-tech, they could be acquired by tech firms (e.g. Whole Foods).

Multidisciplinary Innovation Capability with Traditional Culture: More recently we have seen the trend where companies such as Sears or Walmart have hired technology executives from high-tech firms. While these firms aspire to develop multidisciplinary innovation capability, it is hard for them to overcome their cultures. Thus, the tech divisions of such firms may be spun-off, or these firms will eventually decline.

Uni-disciplinary Innovation Capability with Traditional Culture: Due to the complex emerging competitive dynamics, such firms will likely freeze and stay stagnant or die out.

The relationship between financial performance and strength of culture has been studied in both stable and dynamic environments (Bezrukova *et al.,* 2012; Chatman *et al.,* 2014; Sørensen, 2002). An extensive study that covered over 13,000 firms showed that "strategic renewal, innovation and corporate venturing positively influence overall, subjective and objective firm performance" (Bierwerth, Schwens, & Isidor, 2015). When companies have to innovate rapidly, traditional culture often clashes with the need to innovate (Deserti & Rizzo, 2014). A new identity may be desirable. Identity research is not new in business. Identity is considered as a sub-characteristic of culture (Jung *et al.,* 2003). Corporate culture is the greatest driver of innovation (Tellis *et al.,* 2009) and the factors driving innovation include future market orientation, willingness to cannibalize, and tolerance for risk. When it comes to identity, it is important to realize that the word has been associated with at least three manifestations in business literature. First, it is used in the context of organizational identity. Coined by Albert and Whetten, it generally referred to the question "Who are we as an organization?" (Albert & Whetten, 1985). This self-reflection question clarified the how to decipher organizational identity (Whetten, 2006). Second, identity is used in the context of social identity i.e. how people see themselves as part of a group. Third is corporate identity concept which comes from marketing and advertising. Within the corporate identity concept, five different variations were offered by (Balmer & Greyser, 2002). These include Actual, Conceived, Communicated, Desired, and Ideal. A concept that ties the three identities – social, corporate, and organizational – known as integrated identity has also been advanced (Cornelissen *et al.,* 2007). The relationship between strategy, innovation and identity was alsocaptured (Hoholm & Strønen, 2011).

7. Summary

A wicked problem was identified whereby a non-tech firm that traditionally relied upon tech firms to receive its technology and information assets may find it difficult to buy artificial intelligence technologies from them. The reason is simple: tech firms would rather keep such technologies for their own use and expand and encroach into the verticals dominated by non-tech firms. To stay competitive, non-tech firms will have no other choice but to either build or acquire these technologies and related capabilities. However, building or acquiring such capabilities would not be enough. These firms would need to architect a high-performance culture that welcomes change and innovation.

This paper identifies the wicked problem and provides a high-level model to understand what needs to get done. The model is derived from the intersection of two dimensions of Innovation Capability and Innovation Culture – and that specifically requires that companies need to develop multidisciplinary capabilities. An empirical model that tests and assigns various positions of firms on the grid will be a valuable addition to this paper. Additionally, breaking down the two dimensions into further micro elements can further enhance and clarify each dimension.

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