**Indian Software and Pharmaceutical Industries:**

**A Systems Thinking Perspective to Firm Evolution**

**Abstract**

The Indian software industry is knowledge based and export oriented. It has grown indigenously by taking advantage of policy changes and developing alternative business models to drive its growth. Cost arbitrage has been amongst the major strategies used by firms in this industry. Another Indian in­dustry that shares some of these characteristics is the Indian pharmaceutical industry. More im­portantly, both the Indian IT and pharmaceutical industries have focused on US and Europe as the main markets. Offerings from both these industries are dominantly positioned at the lower end of the value chain, and have made their mark on the global stage. Firms from these two industries have unique evolutionary trajectories distinct from those of the developed country multination­als, and hence their sustained global success has been of interest to researchers.

However, of late, Indian software services firms seem to be facing increasing challenges with respect to growth, and the sustenance of their linear model of growth has been brought into question. They seem to respond to these challenges through increased focus on service enhancement and product development. Similar threats were faced by the Indian pharmaceutical firms’ reverse engineering based model. Recognizing that reliance on generics might not be the best strategy for the industry in the long run and also incentivized by the possibility of greater returns, some Indian pharmaceutical firms ventured into drug discovery. Except for a few initial successes in new drug development by way of out-licensing, these forays into drug discovery were not completely fruitful, and these firms scaled back their drug discovery efforts, and have continued to rely on reverse engineering.

Using the systems thinking perspective, I provide a structural explanation for this behavior. Systems thinking is an approach to understanding the behavior of complex systems that evolve over time. Philosophically, the approach builds on the premise that (system) structure determines behavior. The structure in this case refers to the feedback loops formed by a series of cause-effect links and the delays that separate the cause and effect. Each cause-effect link is an explanation for how the interconnections among system performance guide policies and actions by system operatives, and thereby determine the evolution of a system through time. Presence of delays in these interactions contributes to system inertia which is manifested as persistent patterns observed in the path of change. Visualization of firms’ evolution in terms of such causal loops leads to the identification of mechanisms that played an important role during different stages of the firm’s history. Systems thinking approach thus allows the development of an endogenous explanation for the evolutionary trajectories of firms in terms of dominant causal loops, that is, loops that determine the pattern in a certain span of time in the trajectory. I try to link such dominance to the strategic choices of the firms, and understand how these choices may have in turn shaped their trajectories.

Towards this, I have undertaken detailed case studies of three Indian firms, each of which has faced the strategic choice of adopting a new business model in response to environmental changes. The details of the three cases are as follows. The first case studied for this dissertation is that of a software services firm that has a limited but continued presence in software products. Regulatory changes provided this firm with an opportunity to develop a domain specific software product. While the firm has implemented this software product successfully for clients in close to a hundred countries so far, its product business is still relegated to a small proportion of its overall revenues. More recent paradigmatic technology shifts, combined with pressures to its current business model, seem to motivate the firm to strengthen its product presence.

The second case studied for this dissertation is that of an Indian pharmaceutical firm which began its journey with reverse engineering and subsequently pioneered drug development efforts in India. The firm attempted to overcome the numerous challenges in drug discovery by building alliances, setting up subsidiaries and even investing in drug discovery capabilities outside the country. However, it subsequently rolled back its drug discovery program due to limited success. Instead, it is cautiously approaching mid-level value products such as biosimilars while continuing its dominant focus on generics.

The third case studied for this dissertation is that of a software product firm that attempted to penetrate the enterprise systems market. The product had attracted media attention as one that held the promise of an indigenously developed potentially successful product. However, the lopsided market of enterprise systems continued to be dominated by a couple of well-entrenched products, motivating the firm to explore new opportunities in the evolving technological environment. Recent technological disruption, by way of cloud computing, altered industry dynamics and created a window of opportunity for new business models, consequently offering the firm the possibility of creating a niche for itself.

Primary data for this dissertation was collected through field visits to the three firms. Secondary data on the evo­lution of the firms, product strategies, etc. was collated from annual reports and other publicly available documents. These were analyzed qualitatively, and duly substantiated and supported by key financial and other firm performance measures, along with industry level metrics. The analysis led to the development of causal loop diagrams that represent mechanisms that contributed to the growth of the firm. Interpretation of these causal loops in terms of their dynamics helped present explanations of their evolutionary trajectories and strategic choices, especially with respect to their R&D investment decisions. In line with expectation, ‘*reinforcing*’ loops were found to be a significant growth mechanism.

A more in-depth analysis revealed interesting dynamics. It was noted that typically, R&D investment in service improvement yielded faster returns (e.g. revenues) on account of shorter delays. Therefore, if an organization allocates R&D investment to different activities by considering the impact of the investment on its revenues, then it is likely that service improvement would increasingly receive R&D investment and become the dominant mechanism of growth. By extending this logic, we could say that when growth by product development and growth by service enhancement compete for a limited amount of resources, the balance may tilt in favor of the loop of quicker returns, if the firm’s R&D allocation depends primarily on how quickly the investment turns into revenues. In such a situation, decision makers may lose sight of the magnitude of change. On the other hand, there could be cases where the strategy of the firm lays higher stress on the path of longer delay (of capability building and product innovation), where the returns are delayed, but the payoffs are also greater. In this case, by way of the firm’s strategic choice to invest in such activities, the slower loop could become dominant and over time define the dexterity of the firm.

In all three cases, I observed the presence of the ‘*success to the successful*’ archetypal structure. The two reinforcing loops that made up the systems structure were ‘explorative’ loop and the ‘exploitative’ loop. The explorative loop brought in growth through investment in capability for exploration of new opportunities (e.g. cloud computing, drug discovery). The exploitative loop, in contrast, fostered growth by way of doing the same thing better (e.g. enhancing features of an existing product, improving service efficiency, or enhancing economies of scope). Both loops required different capabilities and the R&D investment to acquire them. The embedded delays also differed between the two loops. Each firm made its choice about the loop(s) it would like to strengthen, that were influenced by its current trajectory, and would, in turn, shape its future trajectory.

Based on a cross-case analysis of all three firms using the exploitation-exploration lens in tandem with the success to the successful archetype, I propose the twin concepts of *dominant and dormant dexterities* as against extant literature’s emphasis on ambidexterity as the most likely means of achieving the tight-rope balance between exploitation and exploration.

The central contributions of the thesis are in three directions. First, it extends the current academic thought on the growth and evolution of firms in two major industries in India, namely, software and pharmaceutical, both export-oriented, knowledge intensive and offering significant growth potential. Second, the use of the systems thinking approach, to present possible alternative explanations to phenomena in the language of causal loop diagrams, is a novel approach to understanding firm growth and evolution. Third, the thesis adds to the theoretical narratives on exploration-exploitation, often seen as a strategic tradeoff, but found here to be a conscious strategic choice through the pursuit of dominant and dormant dexterities. This dissertation also presents opportunities for research extensions. The current study is restricted to technological and regulatory changes. Further work is necessary to extend the models to include a greater number of macro-economic changes, both specific to the two industries as well as those generic to the economic environment. Moreover, to draw more generalizable insights, it would be useful to conduct similar studies with firms in other industries.