INDIAN INSTITUTE OF MANAGEMENT INDORE

DOCTORAL THESIS

Decision-making in high-tech industry using predictive technology and services

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A thesis submitted in fulfillment of the requirements
for the degree of Executive Fellow Program in Management
in the
Operations Management & Quantitative Techniques Area

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Abstract

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Digital technologies are transforming physical products into intelligent, connected products. Capabilities enabled by intelligence and connectivity drive significant improvements in the service productivity of OEMs selling products with service. The particular capability of digital technologies to predict specific product failure modes in advance allow us to christen service-oriented digital technology as predictive technology. Improvements in service productivity due to predictive technology and the benefits of recurring revenues over the product lifetime are making service business models increasingly attractive for OEMs. Further, service business models and predictive technology also enable an overall enhancement in the performance of the products sold. In the current thesis, we critically analyze the impact of predictive technology on the market decisions of two types of OEMs.

1. OEMs currently selling only products, but intending to offer service business models on such products
2. OEMs already offering product service competing with fringe firms in the market for service

In the first part of our thesis, we study the market segmentation of products offered with service contracts and predictive technology using an adverse selection model that incorporates:

1. The cost of product development and operation
2. The OEM's share of the failure opportunity cost driven by the product failure rate and the product quality
3. The cost of incorporating predictive technology which reduces the two cost components

We postulate two product offerings from the OEM, a primary offering and a premium offering targeted at their respective customer types while incorporating the customer's share of the failure opportunity cost. We find that service contracts hinder an OEM's ability to segment markets with the high segment product's long-term failure opportunity cost being a key driver. The adoption of predictive technology, however, enables segmentation and high-quality products.

In the second part of our thesis, we study the competition for the service of products between the original equipment manufacturer (OEM) and a fringe firm. We consider two scenarios,

1. When the two firms compete
2. When the firms jointly maximize the total profit

The OEM utilizes predictive technology to reduce the product failure rate, and the fringe firm provides efficient service at a reasonable price. Because of market remoteness, the OEM is incapable of matching the local fringe firm's service quality. The price of service offered by the two players, the effective failure rate of the product when serviced by the OEM, and the fringe firm's service quality drive the number of products in the service market. Further, the captive market segment for OEM service and the products' failure rate as seen by each player drive that player's service demand. When the two firms compete, predictive technology reduces the effective failure rate of the products serviced by it. With the OEM equipping all the products in the market with predictive technology, every product's failure rate is reduced when the two firms maximize the total profit. We find that the two firms, when competing, can co-exist with Pareto improvements in profits and prices because of predictive technology at higher product failure rates. The OEM, however, finds it unprofitable to enter the service market at product failure rates greater than a certain threshold. In such remote markets, the OEM also finds that it can dominate the fringe firm with higher prices only when its captive market segment is larger than a particular threshold, which is independent of the level of predictive technology. Further, in markets with larger OEM captive market segments, the OEM finds it more profitable to equip all the products with predictive technology while maximizing the total profit with the fringe firm. This phenomenon seems to be especially true at higher failure rates.

In the last part of our thesis, we look at the managerial implications of the work done in the previous two parts of this thesis by applying the decision-making frameworks to few products operating in the real world. We also suggest a product-targeting framework to help OEM decision-makers identify products in their portfolio to introduce predictive technology and shared-service contracts.

Our thesis is targeted at OEMs hoping to use predictive technology in their journey towards incorporating service contracts in their portfolio of offerings while enhancing profit from pre-existing service offerings.

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