

ARCHITECTURAL CYCLES IN THE R&D PROCESS

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ABSTRACT

Over the last year, George Richardson and I have participated in a consulting project involving a large high technology company. The project focused on the problem of rising product development times in the firm's research and development group. In order to analyze the causes of rising product development times, George and I constructed a detailed model of the firm's research and development policies. The model included many of the factors which influence product development times. A more complete discussion of the problem and the model is included in George's abstract, tentatively titled "Managing R&D in a High-Growth Company: The Significance of Coordinating the Flows of People and Products."

My paper focuses on an extension of the basic R&D model. The basic model uses the concept of an average product which the firm develops and eventually sells. The extended model used in my paper disaggregates products into products and architectures. In the extended model, products are developed and sold just as they are in the basic model. An "architecture" is a basic engineering development

which, when completed, enables the firm to develop a large number of products. An investment of resources in architectural development is necessary before marketable products can be created.

The first purpose of my paper is to demonstrate how the distinction between products and architectures leads to cycles in the R&D process. Following the completion of an architecture, the firm can develop many products at low additional development costs. The new architecture allows the firm to jump ahead of the competition in terms of product quality and to earn large profits. As the architecture ages, it becomes more and more difficult to develop a marketable product. Development costs begin to rise and the competition eventually catches up to the firm's technology. The firm must now invest a substantial fraction of its resources in the production of a new architecture. Once the new architecture is completed, the cycle begins again.

The second purpose of this paper is to analyze policies which affect the cyclical process described above. Certain traditional responses to declining profitability may be counter-productive when analyzed from the cyclical perspective. For example, as the architecture ages, there will eventually be downward pressure on profits. One response to lower profits is budget cutting in order to hold down current expenses. If the R&D budget is also cut, the development of the architecture will be delayed, putting extra downward pressure on profits. My paper will analyze several policies in the context of R&D cycles.