The Design and Development of Information Products

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April 15, 1996

Published in MIT Sloan Management Review, Spring 1996 Issue
https://sloanreview.mit.edu/article/the-design-and-development-of-information-products/

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1 Introduction

This is not Snow White and the Seven Dwarfs [i.e., the Bell operating companies] here. Rather, it is a market of a thousand niches served by tens of thousands of firms, each offering dozens, if not hundreds, of different products.

— Andrew Campbell, president of Corptech

The information products industry, broadly defined to include products based on data, information, and knowledge, is intensely dynamic in terms of growth and the pace of new product introduction. The complexity in the variety of product offerings and the number of firms offering those products in this industry is shown by the fact that there are more than 36,000 information product suppliers in the United States; 90 percent of these have less than $1 million in annual sales.[1] Revenues for the information industry are large; for example, radio and TV accounted for $54 billion in domestic revenues in 1993; film and recorded music for $35 billion; newspapers, books, and magazines, $85 billion; and business information suppliers, another $26 billion.

Despite the economic importance and the rapid pace of innovation of this industry, no previous research has examined the design and development of information products. Research in the management of innovation and new product development has focused primarily on physical, assembled products such as automobiles, video-cassette recorders, portable cassette players, power tools, computers, and various types of production equipment.[2] This focus has been broadened by studies of innovation in non-assembled products such as ice and glass and of innovation in software products.[3] In this article, we focus on information products. We define information products broadly to include information provided in either electronic or printed form and sold to external markets as well as that provided by information systems departments within firms to internal "customers." Our research was guided by several basic questions: What can firms in information products industries learn from research on physical products? How are information products designed and manufactured, and how can information technology be used to support these processes? More fundamentally, what is the architecture of an information product and what are the strategic, organizational, and technical implications of the architecture for firms competing in this arena?

To answer these questions, we build on research and knowledge about the design of physical products. We first summarize that research and then extend it into the non-physical realm, proposing a framework for the architecture of information products. We then illustrate the architecture framework with data from two information product businesses. The first case, Corporate Technology Information Systems, Inc., demonstrates how a company can create competitive advantage through the information product platform. The second case, Individual Inc., focuses on the process platform and shows strategies for achieving advantage by refining information. We then conclude by considering how companies can manage the architecture of information products to achieve competitive advantage.

2 Lessons from Physical Products

product architecture: basis for product innovation, constraint on the variety of product versions

Other authors have stressed the importance of managing the evolution and renewal of product architecture for sustained competitive success.[4] The architecture of a product refers to its overall design concept. Different architectures result in different product functionality, cost, quality, and performance. Architectures are both a basis for product innovation and a constraint on the variety of product versions that a company can offer.

For example, Lehnerd described a classic example of product family and platform renewal that Black & Decker achieved in consumer power tools in the 1970s.[5] The "old" architecture in the company's major tool groups had little in common with other product groups or even within them. Traditionally, the company had redesigned its products one at a time. There were more than a hundred different motors, which were manufactured on different production lines involving substantial labor content and materials waste. Lehnerd and his colleagues decided to redesign the entire product portfolio, utilizing elements of common product architecture for all tools, whether a drill, sander, circular saw, or hedge trimmer. The "new" architecture featured a common universal motor with a fixed width but variable length, thereby producing power ranging from 65 watts to 650 watts. On a single, high-volume, highly automated production line, motors for hundreds of different power tool products could be produced at substantially lower per-unit costs.

rather than product architecture constraining product variety, ... common subsystems enabled variety, allowing engineers to focus on the other features

Black & Decker applied this approach to other key subsystems of the product architecture with a similar effect. The result was striking: a drill formerly marketed at $20 was replaced with a more durable, lighter drill profitably sold for less than $10. Rather than product architecture constraining product variety, Black & Decker's common subsystems enabled variety, allowing engineers to focus on the other features of their power tools, such as new types of bits, sanding surfaces, or blades. Product variety increased over time. The company's cost advantage drove dozens of competitors out of the business, and its market share in the consumer power tools industry grew from 20 percent to a dominant share during a five-year period.

well-designed platform enables a company to create new versions of product rapidly and efficiently

Every product has an architecture. That architecture has the potential to become a platform, as in Black & Decker's case, if it is explicitly managed and used to create a number of derivative products. For example, platforms have formed the basis for creating families of automobile products. Chrysler derived many successful versions of its basic automobile offering from its K-car platform. A well-designed platform enables a company to create new versions of its basic product rapidly and efficiently to respond to or anticipate changing market needs (see Figure 1).

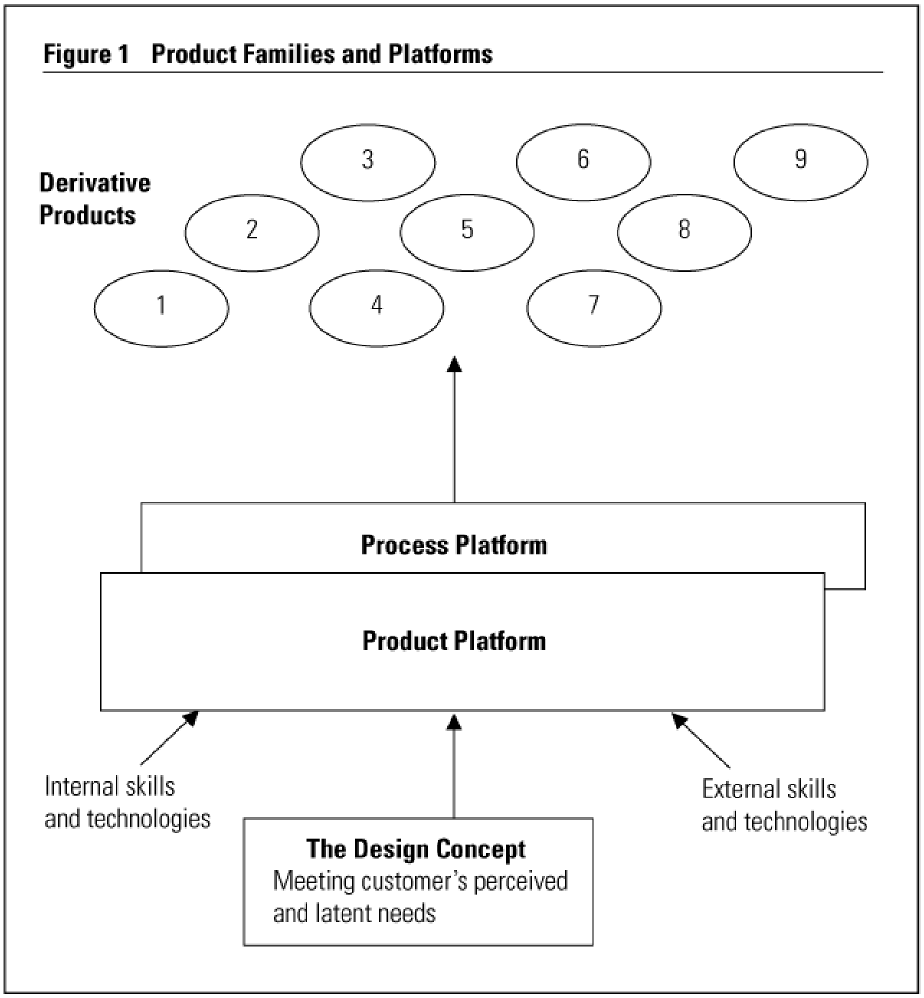

Figure 1: Product Families and Platforms

3 The Product Platform

In the arena of physical, assembled products, the effectiveness of a firm's new-product generation lies in its ability to create a continuous stream of successful new products during an extended time and in these products' attractiveness to the chosen markets.[6] Streams of related products are product families. For physical products, a family is a set of products that share common technology and address related market applications. The commonality of technologies and markets leads to efficiency and effectiveness in manufacturing, distribution, and service, enabling a firm to tailor each resource or capability more efficiently to specific market niches.

The technological foundation of the product family is the product platform architecture or design. Platforms, their derivative products, and platform "extensions" or renewals have been described for vacuum cleaners, electronic imaging systems, portable cassette players, and power tools.[7] A product family evolves over time by incorporating new technologies into its designs and by targeting new customer requirements. Meyer et al. proposed a typology of platform evolution (see Figure 2).[8] A product platform is made up of common subsystems and interfaces for deriving related products. A new generation of an existing product platform occurs when the number and types of subsystems and interfaces remain constant but several undergo substantial enhancement. A new platform forms an entirely new architecture when subsystems and interfaces from prior generations are carried forward and combined with new subsystems and interfaces in a new design.

For an effective platform design, the interfaces between subsystems must be seamless and standardized

For an effective platform design, the interfaces between subsystems must be "seamless" and standardized. Subsystems can be thought of as bricks, and the interfaces the mortar that binds them together.[9] In an assembled product such as a camera, for example, subsystems include the shutter mechanism, lenses, various operator controls and focus mechanisms, flash, power source, and camera housing. The fittings and electronics for integrating these subsystems serve as the internal subsystem interfaces. The mechanisms for controlling shutter speed and aperture, for rewinding and changing film, or for using a flash are the user interfaces. Experience suggests the critical importance of specifying clear internal and external interfaces in new product design, standardized to the point where the interfaces may be assigned part numbers, similar to the components.

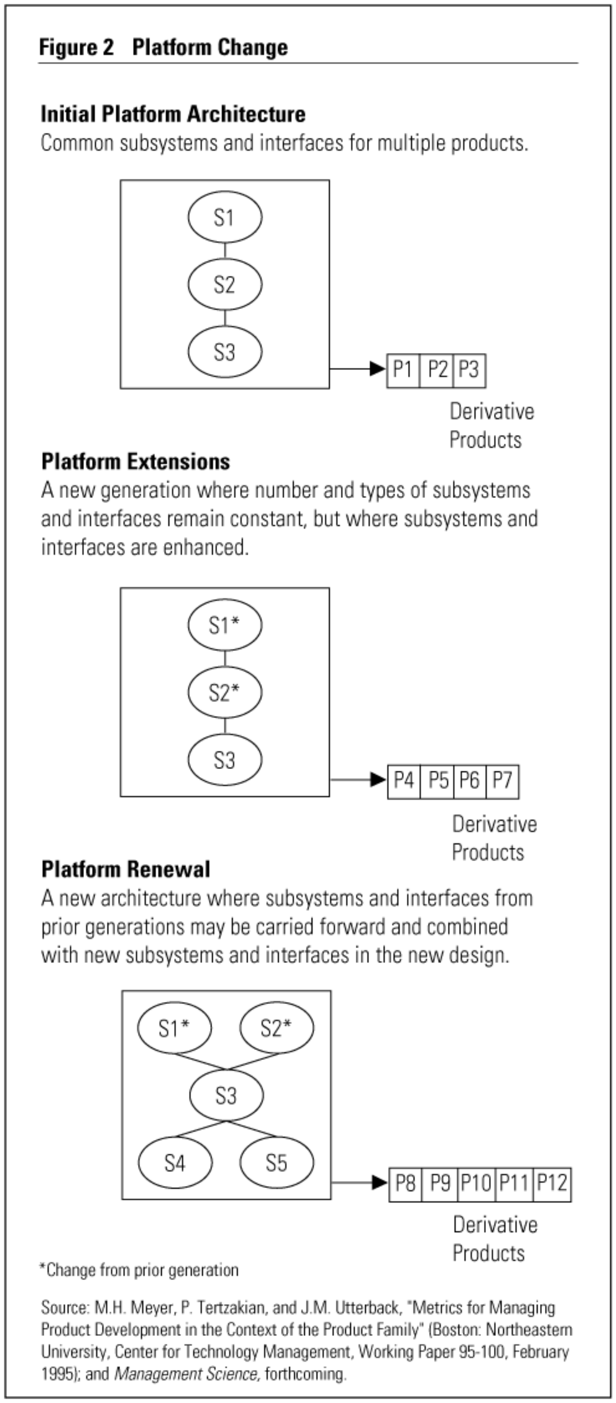

Figure 2: Platform Change

4 The Process Platform

sustained success requires creating and renewing process platforms

The process platform is composed of the technologies, facilities, and processes for manufacturing a firm's products. For an assembled product, such as a camera, the process platform encompasses the stages of producing or sourcing of components (with intermediate testing processes), assembly of the components, and final testing. For non-assembled products, such as materials and petrochemicals, sustained success requires creating and renewing process platforms.[10] (For a general representation of the process platform, see Figure 3.)

process platforms are also an opportunity for innovation

For both assembled and non-assembled products, the process platform evolves primarily by increasing volume or capacity. However, process platforms are also an opportunity for innovation to facilitate greater product variety during a product family's evolution. A lack of such innovation, in terms of the flexibility built into the production process, constrains the variety of product versions derived from the basic process. Abernathy and Hayes noted this in the stagnation of the Model T automobile caused by Ford's high-volume but inflexible mass production system.[11] A study of an industrial manufacturer also showed the problems encountered when management focuses on capacity expansion for its existing manufacturing processes at the expense of introducing new process capabilities.[12]

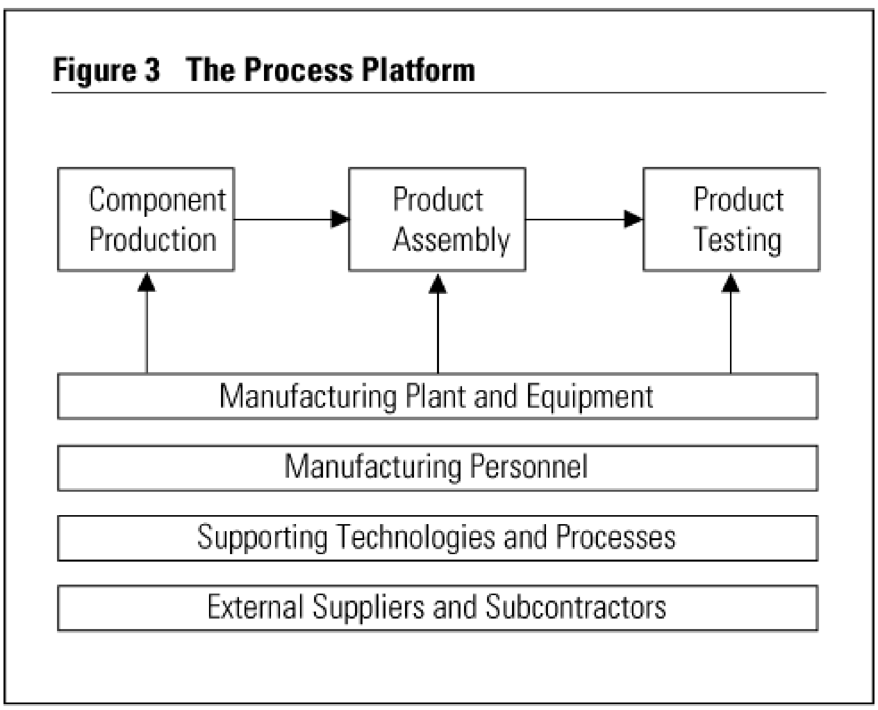

Figure 3: The Process Platform

5 Achieving Leverage: The Product Family

Well-designed product and process platforms enable product innovation and the generation of derivative products rapidly and at low incremental cost, creating leverage in a firm's R&D activities. Each of the two types of leverage that a firm can achieve in a well-managed product family - technological and market - has substantive financial implications.

engineering derivative products should cost substantially less than the development cost of the underlying product platform

Technological leverage is the extent to which investments in basic product and process platforms (either original developments or platforms extensions) serve as a foundation for efficiently developing derivative products. Thus engineering these derivative products should cost substantially less than the development costs incurred in making the underlying product platform.

Meyer et al. proposed as a metric of technological leverage the average engineering cost of product derivatives divided by the engineering cost of underlying platforms.[13] They found that this measure of platform "efficiency" for creating derivative products for successful families of industrial measurement systems was in the range of $.10 for every dollar of investment in creating the underlying product platform. They also proposed a corollary measure of platform efficiency focusing on time cycles. While product platforms tended to take three to five years of elapsed time to develop, derivative products were created in three months to one year. Robust product platforms therefore enable a firm to develop new derivative products and bring them to market in a fraction of the time and cost required to create the underlying product platform. Recent research at a large consumer products company also showed that successful process platforms allow new products to be introduced into manufacturing without excessive ramp-up and retooling costs.

The market leverage from a product platform is the return provided on product development investment. Meyer et al. proposed a measure of platform "effectiveness," similar to measures of platform efficiency, as the accrued sales for a set of derivative products divided by the total engineering costs of those products.[14] For the industrial measurement system families in that study, sales of successful product families were from thirty to fifty times engineering costs. Ratios of market leverage vary from industry to industry. For example, data gathered from a printer manufacturer showed rates of market leverage across its most successful product platforms to be more than 100 times engineering costs. Market leverage can also be considered as the extent to which product and process platforms enable a firm to diversify from initial target market applications into others that are related by virtue of common customer requirements. A robust platform facilitates the type of "expeditionary marketing" that Hamel and Prahalad describe.[15]

market applications that are related by virtue of common customer requirements

We have discussed the concepts of product and process platforms as the bases of the evolving product family. We have also described measures of efficiency and effectiveness that apply to the development of physical products. In the remaining sections, we extend these concepts to information products.

6 The Architecture of Information Products

The architecture of information products is not as readily apparent as that for physical products. If we were studying the telephone on our desk, for example, we could identify the key subsystems as the telephone box, voice and dialing electronics, push buttons, handset, cord, and so forth. The internal interfaces are how these parts fit together; the external interfaces are the standardized telephone wire plug and the design and use of the handset and push buttons. The architecture for an information product such as an electronic news service requires rethinking the concepts we have presented. These concepts are critically important because managing the architecture of an information product is as essential to design quality and to a firm's survival as managing the architecture of a telephone.

"telephone on our desk"??? sounds like the story from medieval ages... And yet while technology examples are archaic, the analysis and ideas in this article are profound and timeless.

in the end it is all about interfaces...

Information products exhibit characteristics of assembled and nonassembled products: there are product families, product and process platforms, and derivative products. Therefore, the architecture of an information product reflects an integration of the product and process platforms to generate individual products within the information product family (see Figure 4 for a framework).

the architecture of an information product reflects an integration of the product and process platforms to generate individual products within the information product family

Figure 4 The Architecture of Information Products

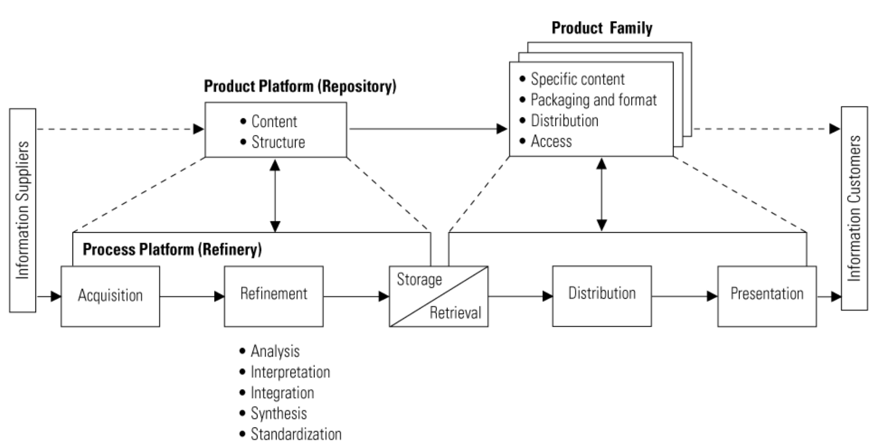

Figure 4: The Architecture of Information Products

7 The Information Product Platform: The Repository

We posit that the product platform of an information products business is best viewed as a repository comprising information content and structure. Information content is the data held in the repository that ultimately forms the substance of the information products. The type of business will, of course, be reflected in the unique content of the repository. For example, life insurance companies, when underwriting new business, may access computerized third-party repositories containing data on physicians' examinations, blood and urine laboratory results, and motor vehicle records. The insurance company, in turn, may integrate these data into its own internal proprietary repository used to provide products and services to its in-house underwriting, claims, and research units.

Beyond the information in the repository, the overall structure and arrangement by which the content is stored, manipulated, and retrieved is a key design element. The basic structural dimension of the repository is the information unit, a formally defined atom of information to be stored, retrieved, and manipulated. For example, a relational database defines data elements (attributes) as the basic information unit, while a more document-oriented repository might define various elements (e.g., subtitled text segments, graphic elements, title, and byline) as basic information units.

Different businesses tend to employ uniquely meaningful information units. For example, in Mead Data System's Nexis, a repository of financial statements, the footnotes are defined as an information unit. A user can then select particular financial statements for analysis based on key attributes of the footnotes.

The structure of the repository further includes schemes for labeling, indexing, linking, and cross-referencing the information units comprising the repository content. Structure can range in degree from a little (e.g., a random collection of expense slips on a desk) to a lot (e.g., structured transaction data in a general ledger accounting system). For example, consider a reference catalog listing firms and their products. Printed fact sheets might be stored in binders with tables of contents and indexes for locating information by product or firm. The repository's structure is closely related to its storage, access, and retrieval capabilities. In this case, the user looks for the appropriate binder and finds the answer to a particular query. In automated form, these data might be in a relational database on a computer system. The user queries by company name, industry affiliation, or product set to find specific information. These search keys are the referencing structure of the repository. In another example, an electronic newspaper links the text of a story to its headline, byline, and graphic elements. It may even link the story to a related one in hypertext fashion. Each link, element definition, and label reflects the structure of the repository.

The repository becomes the foundation from which a firm creates its families of information products. The greater the scope, depth, and complexity of the platform structure, the greater the flexibility for deriving products and thus the greater the potential variety within the product family derived from that product platform. The greater the complexity of the platform structure, however, the greater the cost and effort to maintain the repository. A well-designed repository will enable a firm to mine the most value from the content for a given maintenance cost.

The levels of complexity and granularity and the associated scheme for structuring the repository can constrain basic product design. The more ways a firm can slice and dice its repository, the greater the potential for rapidly and efficiently creating products for new market niches. Then success becomes a matter of market development to create brand and niche dominance. For example, while some book publishers have converted hard copy to electronic media by storing text blocks by subject and others have stored text by chapter, some have stored by entire book, which offers little flexibility in creating new versions of the basic product. The flexibility in product design from being able to combine subject-oriented text blocks far exceeds that of combining chapters. Yet the flexibility to respond rapidly to customers' product requirements carries a high cost of infrastructure development with respect to creating and sustaining the repository structure.

8 The Information Process Platform: The Refinery

We also posit a generalized process platform for information products. The "manufacture" of information products resembles a refining process, composed of five information processing stages: acquisition, refinement, storage/ retrieval, distribution, and presentation or use.[16] These processes are not necessarily executed purely sequentially, as there may be feedback loops between them.

- *Acquisition* of data or information addresses the issues regarding sources of "raw materials," including quality, scope, breadth, depth, credibility, accuracy, timeliness, relevance, cost, control, exclusivity, and so on. The adage "garbage in, garbage out" is a guiding principle. Source data must be of high quality so as not to compromise the downstream integrity of the process and ultimate products created from the repository.

issues with sources of data: quality, scope, breadth, depth, credibility, accuracy, timeliness, relevance, cost, control, exclusivity

The adage "garbage in, garbage out" is a guiding principle.

- *Refining* is the primary source of value added. Refinement can be physical (e.g., conversion of data from one medium to another) or logical (e.g., labeling, indexing, integrating, or restructuring relationships among data). Refining may also include cleaning or standardizing data. Meta-analyses on repositories may also be performed, for example, using statistical packages or neural network software, to glean further meaning from the combination of individual elements. Refining adds value to the repository not only by creating usable information but also by enabling information to be stored flexibly to enable efficient generation of various products. Creating flexibility may require converting the acquired data from its native structure to more meaningful or useful information units.

- *Storage and retrieval* form a bridge between the upstream acquisition and refinement stages that feed the repository (product platform) and the downstream stages of product generation. Storage may be as simple as placing sheets of printed information in labeled binders. However, it usually means computerized storage using database or knowledge management software.

- *Distribution* represents the form in which the product is delivered to the end user, such as print, fax, CD-ROM, e-mail, and radio or television transmission. Distribution encompasses not only the medium of delivery but its timing and frequency as well. Medium and content are related; for example, audio data must have a way to deliver audio signals.

- *Presentation* is the final stage of the process platform. A fundamental characteristic of information products is that the value of information and, therefore, the value added in producing information products are pervasively influenced by the context of their use. Ensuring ease of use and sufficient functionality is part and parcel of the information product itself. Many information products companies have found that delivering a file of information on a CD-ROM, for example, is not nearly as valuable as giving a consumer an easy-to-use interface to navigate through and interact with the information. In fact, many information products companies compete as much on the quality of the interface, i.e., their information ergonomics, as on the information content behind it.

the value of information is pervasively influenced by the context of its use

process knowledge repository contains the rules by which the information product repository is itself created

The process platform may be supported by a process knowledge repository containing the rules by which the information product repository is itself created. These rules are part of the process platform, not the product platform. One type of process rule in an information refinery is "front-end" knowledge. Such rules may include methods to identify source information, acquire it, refine it, and subsequently add it to the firm's information repository. For example, Lincoln National Reinsurance Company has developed a sophisticated expert system that builds the information repository needed to underwrite life insurance policies. The system electronically determines the information needed by the underwriter and where to get it, accesses the appropriate information vendors' computers, evaluates the information received, integrates it within the repository, and evaluates the need to acquire additional related information based on what was "learned." The back end of the process platform - that is, the distribution and presentation of information as products - may also be rule based. For example, in subscription-driven markets, such as industry analysis, rule-based limits guide users as they access on-line publications. Other rules may restrict their access to other products.

9 Achieving Leverage in Information Product Families

information technology infrastructure is the information product firm's core manufacturing capability

The two platform elements - the repository and the refinery - combine to enable the generation of specific products (see Figure 4). Supporting these respective platforms are the firm's core capabilities in computer hardware, software, and telecommunications, its internal knowledge about its business and external knowledge about its current and emerging markets, and how it organizes and manages itself. The design of the information technology infrastructure is especially important; it is the information product firm's core manufacturing capability and how it administers business.

Similar to physical products, information product platforms should be the source of considerable technological and market leverage. For an information product, technical leverage refers to a firm's ability to rapidly and efficiently engineer new products based on the existing common repository. There are several ways in which products can vary: by actual content; by packaging, formatting, and presentation; by distribution; and by degree of interactivity. The combination of different variations can lead to a range of distinct products within the product family, all derived from the same information repository.

For example, consider the export information databases sold on a CD-ROM by a number of firms. These data are acquired from governmental and commercial sources, filtered and categorized, and stored in a computer database. Products are created from the database. One product could be a printed volume of information for a particular country, including import regulations, sources of trade financing, and sales agents. Another product could be similar information provided on-line through an Internet server. Another product may be an aggregation of individual country information into continental regions, printed or placed on-line. Or the firm might record its entire repository on a CD-ROM and package it with software to enable customized searches using a PC.

levels of interactivity between the user and information products: raw data, preprocessed units of information, finished reports and analyses

Different on-line products provide varying levels of interactivity between the user and information products. Interactivity is the user's ability to dynamically select, manipulate, integrate, and format the information to suit particular and changing needs. It is similar to baking a cake: some customers want to start from scratch (access to raw data), others prefer a cake mix (access to preprocessed cells or units of information), while others choose to purchase a ready-made cake from a bakery (access to finished reports and analyses). Providing users direct control over the packaging and content of the product itself can be a highly desirable product feature. As information products become more dynamic (e.g., interactive TV, magazines, and information services), mechanisms to allow individualized, useful, and relevant feedback to the information supplier will produce even greater product variation.

The flexibility to create numerous product derivatives from the repository becomes the basis of a firm's ability to realize market leverage from its information assets. Like any other producer, the information products firm must identify new market niches that need the firm's assets, in part or in whole. Products may then be packaged from its repository and sold.

A combination of characteristics makes the information products industry distinct in technical and market leverage. First, the pace of market identification and exploitation is often rapid, with consequences for the style and process of market R&D. A firm that plods along in its market research may never get its product to market, while a more agile competitor creates a franchise in a new market niche. Second, a flexible repository combined with a highly automated refinery can make the incremental cost of creating new products unusually low compared to physical products. A new product, for example, may simply be a matter of performing a different type of sorting function or statistical analysis on the computer. Third, information products supported by a computer-based refinery are more easily and dynamically decomposed to create new products. For example, textbook publishers can sell chapters of books rather than entire volumes once text is stored and distributed electronically. Fourth, ease of product decomposition also enables ease of reintegration to create composite products. In the textbook example, new books can be custom designed for particular customers or uses by recombining selected chapters from many books into a new book. Fifth, one-time purchases seem to be the exception for information products. Once customers perceive information as valuable, they are more likely to provide revenue to the supplier through an ongoing subscription.

make simple and robust POCs, release them fast and early

pluggable modular inference algorithms can be easily recombined to support new data products

An information products company entrepreneur described his industry and the opportunities for leverage in it:

> Consumers of information are not as intelligent about the information they are buying as they might be for a car, a sound system, or a power tool. In the information business, the company that recognizes a market need first, and delivers a product soon thereafter, can establish a franchise that dominates the niche.
>
> Since information gets old, customers will tend to continuously repurchase information from the franchise holder. The pace of action is so fast that there is rarely sufficient time to perform thorough market research for new products. A company just has to go for it, all the time seeking to take its information assets into the new uses. Once you have the information, the marginal cost of adding another customer or creating a new product can be very, very small. The opportunities for leverage are indeed substantial.[17]

information products companies must always plan for the renewal of their repository and refinery platforms

To sustain product leverage and avoid product obsolescence over the long term, we believe that information products companies must also plan for the renewal of their repository and refinery platforms, just as a physical products company must renew its product designs and manufacturing processes. Renewing the information product platform requires rethinking the basic content and structure of the information repository to enable more efficient creation of newer versions of existing products or, more important, introduction of radically new products such as the "composites" we described earlier. The opportunities include establishing greater depth and detail of information content, greater scope of content integration, more sophisticated and complex linking structures to facilitate integration, and greater standardization in the definition of information units.

greater standardization in the definition of information units

Renewing a process platform requires rethinking the technologies underlying the five process stages to exploit the latest capabilities and functionality. For example, a number of information products companies are presently adopting Lotus Notes as a way to electronically distribute and present their information products. Many others are creating World Wide Web servers on the Internet. Such efforts are focused at the back end of the refinery. We believe that great opportunities lie in renewing the front-end acquisition and refinement stages of the refinery. Here, the application of information technology has lagged in many of the firms we have studied. Finally, firms seeking to improve their information refineries must also strive to improve and standardize the interfaces between each process stage to achieve a seamless pipeline of information processing within the firm, as well as between it and its suppliers and customers.

10 Applications of the Framework

We now apply these architecture concepts to two specific companies. The first case, of Corporate Technology Information Systems (CorpTech), focuses on the product platform – that is, the information repository – and how products may be derived from that platform. The second case, of Individual, Inc., focuses on the process platform, especially the role of information technology in providing the appropriate processing infrastructure for creating and delivering products to meet market needs.

11 Leveraging the Repository Product Platform: CorpTech

Founded in 1985, CorpTech, located in Woburn, Massachusetts, provides business, management, product, and employment information on 40,000 U.S. companies operating in technology-intensive industries. The process platform is simple. A team of trained telephone surveyors regularly contacts existing information providers to verify or update company names, executives' names, product descriptions, sales levels, employment levels, and projected growth rates. The data are stored in a computerized relational database that forms the information repository. The database employs a simple physical structure of indexed sequential records, accessed through a set of proprietary CorpTech programs. From this repository, the company creates a variety of products using internally developed software for searching, formatting, and distributing the information. Each product has a subscription orientation, whereby customers license the right to use the data and receive timely updates with new information. As our framework suggests, each product can be differentiated by its content, distribution, and presentation.

The primary product contains the full database. A subscriber's sales force might use it to generate leads, or university placement offices and employment agencies looking for leads might access information about companies in specific regions and industries. For customers requiring a search and browse capability, CorpTech distributes the database via mail on a CD-ROM. Search and presentation of the data is supported by CorpTech's proprietary data access software provided as part of the product. Subscribers can use the CD-ROM with a PC to perform ad hoc queries. CorpTech also sells a printed version of the product, with a national and several regional versions for those without PC support or the need to browse the database interactively. In another derivative product, CorpTech generates information for subscribers based on various criteria through a data-on-demand service. These data may be shipped on floppy diskettes or in printed form. Names and addresses may also be shipped on preprinted mailing labels.

Management continually considers ways to process the basic repository data to add new, higher value-added products to the family. For example, CorpTech recently introduced a newsletter, the "Technology Industry Growth Forecaster," that presents sales and employment growth trends by region and industry and information on companies that are growth leaders in their respective fields. While all these products are packaged and priced differently, the company creates all from the same information repository. The repository has grown from 8,000 technology-based firms to approximately 40,000 firms. (For CorpTech's product family map, see Figure 5.) There are two major platform versions: (1) computer databases and applications of software to search these databases, and (2) databases printed in various hard-copy formats. (Figure 6 shows CorpTech's information repository and refinery process underlying its product family.)

The technical leverage achieved in the form of derivative products is clear. CorpTech has generated a variety of computer-based and printed products by segmenting and analyzing the underlying information repository. The market leverage achieved from these products is shown by cumulative economic benefit: sustained increases in sales accompanied by a healthy level of corporate profitability.

We might expect CorpTech to have many competitors because the information it gathers and the process for gathering it is quite simple. Yet CorpTech has used its repository to create a defensible competitive advantage. The sheer size of the repository and labor cost for continual maintenance represents a formidable barrier to entry. Most of the companies in the repository are not public. Therefore, information about these companies has not been "free" and could not be electronically acquired from a government database. Rather, CorpTech has had to generate leads and solicit firms through individualized telephone calls and mailed surveys. Once it reaches firms, it focuses on specific characteristics of the companies' products. As a result, CorpTech has created a front-end "franchise" with its information suppliers. For their efforts, suppliers know that their information will be distributed accurately and professionally.

CorpTech's management has viewed the development and maintenance of its repository as a distinct investment area. Since a major focus of data gathering consists of product details, CorpTech invested in the development of a proprietary technology classification system early on. This system is an index of product types that are industry and technology specific. The index is based on approximately 15,000 generic product descriptors that, combined, form about 3,000 unique product codes. These product codes are then organized in a hierarchical system that contains 17 specific industries and 255 product areas within these industries. The 3,000 product codes are then applied at the finest level to all the products of a firm participating in the CorpTech research. The careful application of these codes to the products of all the 40,000 firms in the repository creates CorpTech's commercial strength and serves as an effective barrier to entry to potential competitors. For example, Digital Equipment Corporation's products alone are assigned more than 200 unique product codes to allow a granularity of information reporting that can be exceptionally useful.

As the repository evolves, CorpTech also benefits from network externalities. That is, as CorpTech's repository of companies and customers grows, its position in the middle of this information exchange network becomes ever more valuable to all stakeholders. There is a disincentive for provider companies to withdraw from CorpTech's listing because CorpTech holds the de facto franchise in the target market. There is less incentive for a user to purchase a competitor's list because of its potentially lower coverage. Both forces feed on themselves in a reinforcing spiral, providing CorpTech with a competitive advantage. CorpTech has been quite successful in building reputation and franchise rapidly to attain a defensible critical mass.

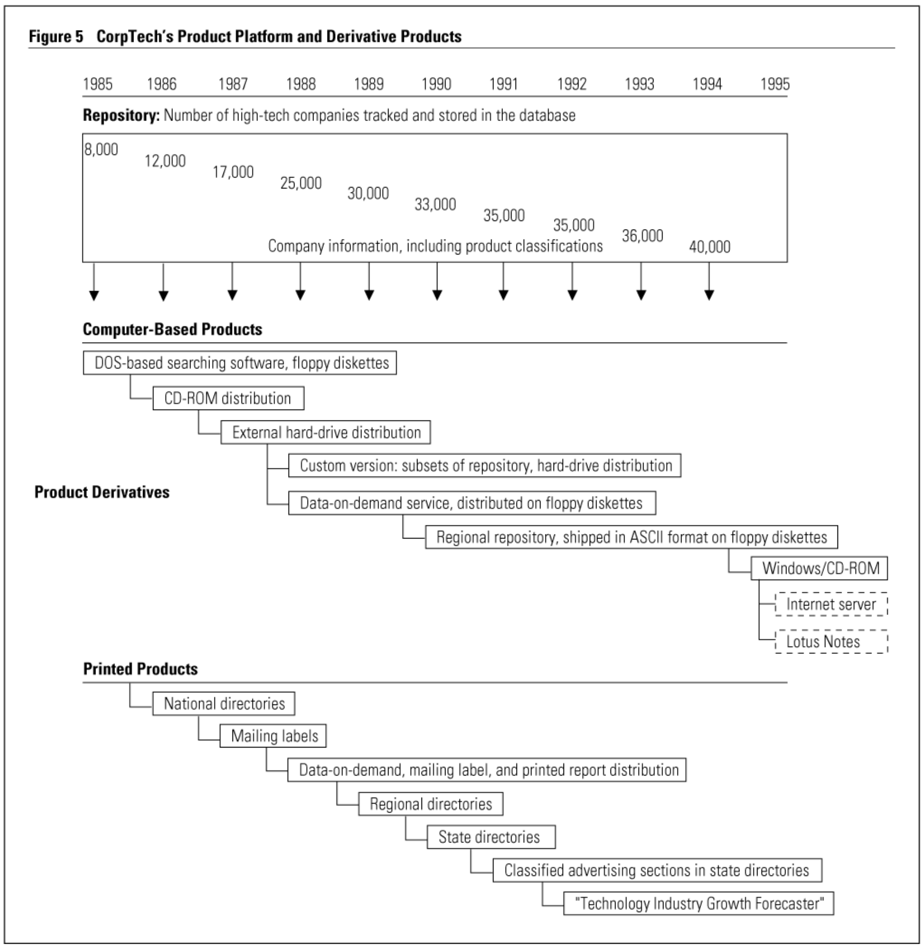

Figure 5: CorpTech's Product Platform and Derivative Product

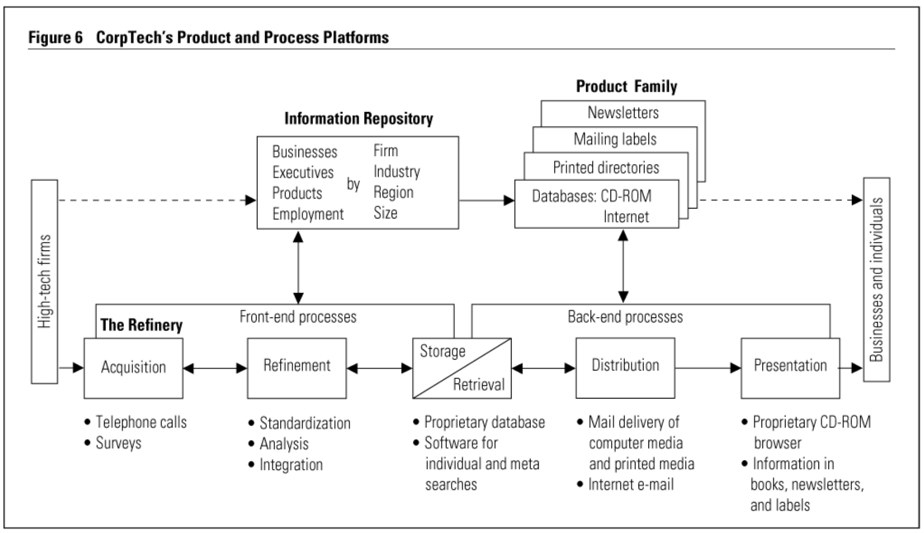

Figure 6: CorpTech's Product and Process Platform

12 Leveraging the Refinery Process Platform: Individual Inc.

Founded in 1989, Individual Inc., in Burlington, Massachusetts, is a repackager of news information. The firm creates a customized set of news stories for each of thousands of customers, based on their unique preferences and needs. It provides the stories through various electronic media. Since its founding, the company's sales have doubled annually based on the proposition that "less information – as long as it is the right information – is more." (For Individual's platforms and product family, see Figure 7.)

On any given day, Individual's information repository is fed with about 20,000 news stories indexed and stored in a computerized database. The repository becomes distinctive and valuable because of the company's refining process platform. The firm acquires news stories (the raw material) electronically from about 600 suppliers through computer and telecommunications networks. It then reformats this raw content into a common structure for further processing. Next, it matches story content to customers' reading interest profiles stored as keywords in a database separate from, but complementary to, the information repository. Using a software search program called SMART, the refinery matches the customer profiles to streams of incoming stories, prioritizing the matches, and identifying those with the highest probability of reader interest. Individual has made sufficient modifications and enhancements to SMART so that the matching engine has become a proprietary strategic asset.

The company has further enhanced its refining process by creating predefined keyword filters or templates by industry and market. Each template contains terminology and company names deemed useful for finding stories relevant to readers interested in a particular industry. Templates currently exist for electronics, computers, health care, biotechnology, telecommunications, finance, energy, and government, among others. The company employs editorial managers who create and improve industry templates as well as identify additional sources of news information. Customers complete questionnaires to specify industry affiliation and specific interests. Then, as they receive information, they provide feedback on the news stories' usefulness. Editorial managers use the feedback to continually improve the industry templates.

After extracting appropriate stories from the repository, Individual formats the selected news stories into one of four product designs and distributes them. Users can receive Individual's news by fax, by e-mail, through the World Wide Web, or through Lotus Notes. The primary product, called "First!," provides the full text of the selected articles via an on-line browser. "HeadsUp!" contains only story summaries. However, through interactive, on demand ordering software, readers can order the full text for any particular news summary. The third product is "iNews," an even simpler news-flash service. Last, the company supplies a direct feed of its entire repository to a number of large corporations. They may then use their own database software or integrate Individual's repository into their own information. As with CorpTech, these products are all priced differently, and licensing arrangements are structured on a subscription basis. Individual also has a new product called NewsPage, which is a Web home page providing access to all of the company's stories at the broad level of headlines and abstracts. Users can then subscribe to full story contents.

The design of Individual's supporting information technology infrastructure resembles a human organization with different functions allocated to groups operating under a hierarchical control structure (see Figure 8). At the front end of the process, work is allocated to PCs based on volume and type of source input, such as file transfer, e-mail, telephone lines, or satellite. Dozens of PCs gather these data; more can be added as the number of information suppliers increases. Next, workstations filter news stories. Here too, the company can add workstations to handle increased volume. Last, for the back-end process of product distribution, clusters of PCs are organized around the firm's products and delivery mechanisms. Thus there are clusters that focus solely on "First!," other clusters for "HeadsUp!," and others for "iNews." A separate server is maintained for NewsPage. Each cluster has a master computer that assigns and tracks news delivery. Attached are dedicated PCs for the respective fax, e-mail, Notes, and direct-feed product variations. As the business grows, more clusters can be added. This clustered, client/server architecture has allowed Individual to address the great challenge facing any information products company once it has created a winning product design: scaling up production to achieve large-scale volume.

Individual Inc. has achieved considerable technical leverage in its products and services. The firm has used technology to create leverage in the form of product variety. Each of the four basic product designs is tailored for every customer, based on desired information content. These customers may be individuals at various levels in different industries, professional work groups needing to share a common subset of the daily news, or companies that receive a large portion of the repository and integrate it into their own information. Individual has achieved leverage through a sophisticated, automated, and proprietary process platform, an "intelligent" refinery that automatically acquires information and filters it for customers with an artificial intelligence tool. The refinery then automatically performs the distribution of customized products with the flexibility to employ the continuous advances in telecommunications technologies. In market leverage, the firm is also successful. Sales have continued to double every year.

Given that any company may contract for electronic news feeds, purchase an intelligent text-based search engine, or build a network of PCs and workstations, where does Individual's advantage lie? Like CorpTech, it deals with a number of information sources, many not easily located. Second, like CorpTech, it has created a franchise in the marketplace. In addition, Individual enjoys economies of scale because it can amortize the cost of its news feeds across many customers and products. But its competitive advantage lies mostly in its information refinery. The refinery provides a unique level of service and functionality, not only by working directly with customers to create a valuable profile, but in gaining knowledge over time of how best to create profiles in general so that they add the most value for given readers. Individual Inc. continues to learn via customer feedback and, more important, to capture that learning.

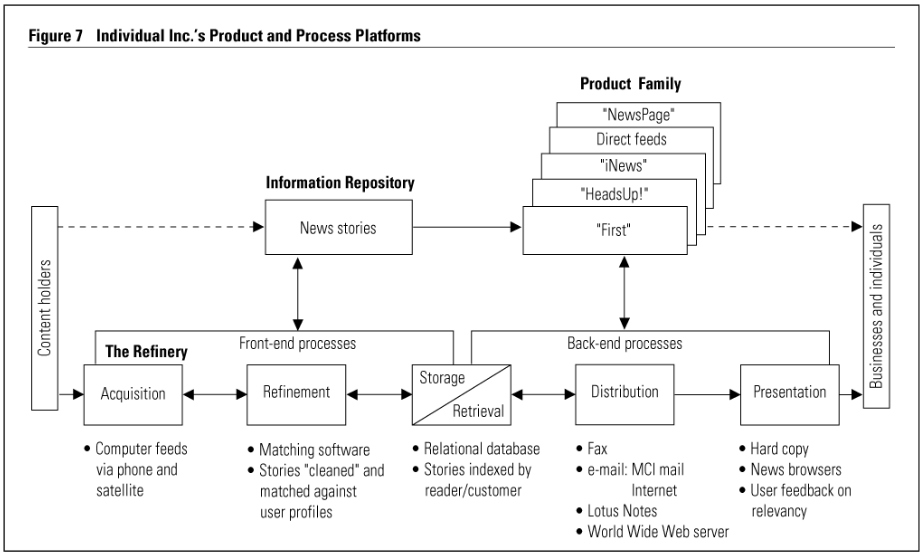

Figure 7: Individual Inc.'s Product and Process Platforms

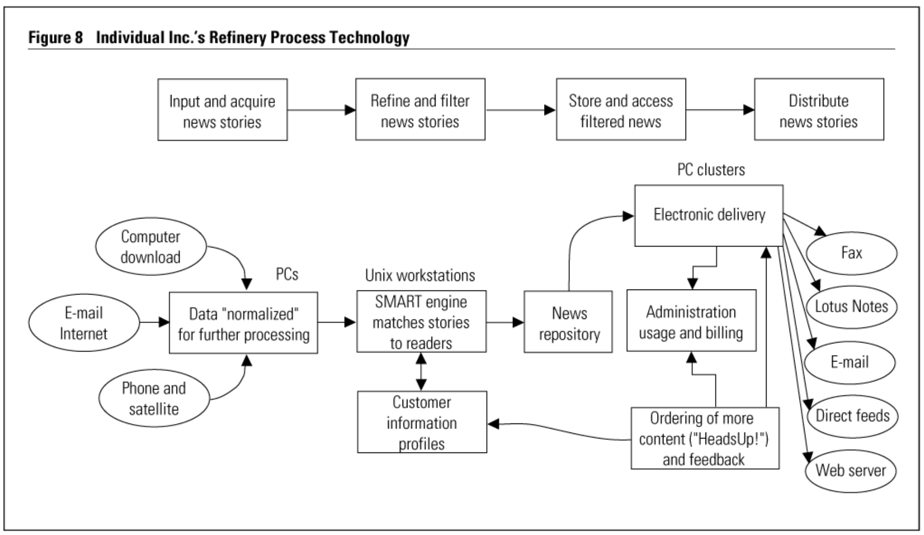

Figure 8: Individual Inc.'s Refinery Process Technology

13 Managing the Architecture to Gain Competitive Advantage

importance of acquiring and tailoring information to specific customers' needs in rapid, increasingly efficient ways

The information architecture concepts we have presented are a major aspect of competitive advantage in information products companies. Both CorpTech and Individual are small, fast-growing firms. Robust repositories and refineries have given each the capability to respond quickly and profitably to new market opportunities. This is also clearly evident in large, established companies. For example, Equifax, with more than a billion dollars in annual revenue, traditionally provided credit information to lending institutions. It then expanded its offerings by leveraging its existing product and process platforms to provide risk management information to life and property insurers. Such successes are driven by a combination of entrepreneurial management and strong market focus. They also exemplify senior management's awareness of the importance of acquiring and tailoring information to specific customers' needs in rapid, increasingly efficient ways.

14 Managing the Information Repository to Enhance Flexibility

The information repository is something to be managed aggressively for flexibility through modularity and standardization. The repository consists of both information content and the structure by which that information is accessed, maintained, and enhanced. Thus an information products organization, whether it publishes periodicals or provides on-line services, must first define its own repository. This requires thinking more deeply, both within and across particular products and markets.

The basic idea is to redesign the architecture underlying the product family or portfolio en masse, rather than to create new versions of individual publications, hard copy or otherwise, on a single product-by-product basis. We suggest that an information products company address these questions:

- What are the basic and deepest level chunks of underlying information (information units) across all the products in the portfolio?
- Of these information units, which ones are common and which are specific to particular product offerings?
- What level of granularity or fineness for these information units can reasonably facilitate a strategy of flexibly mixing and matching different elements together into rapidly created and more fine-tuned, customized products? The implications for employing standards in structuring a repository are far-reaching. A tightly defined structure can facilitate flexibility in creating customized products. However, different product-line managers might simply ignore a structure that is too elaborate.

An information products company can apply the repository structure laterally across different products to create product variety for customers, as shown in Figure 9. Common information units are at the left of the figure, with noncommon information units at the bottom. Across the top are the various product lines in the company's portfolio. The inventory of content within these products is done by information unit and indexed accordingly. The typical publisher currently distributes the "standardized" versions of each product to customers as hard copy. Increasingly, through electronic search and distribution mechanisms, new customers will create their own customized publications by accessing the information unit inventory and selecting what they wish to receive. Many publishers are creating new subscription and advertising revenues by turning to this electronic on-line form of customized publication that leverages content from existing magazines.

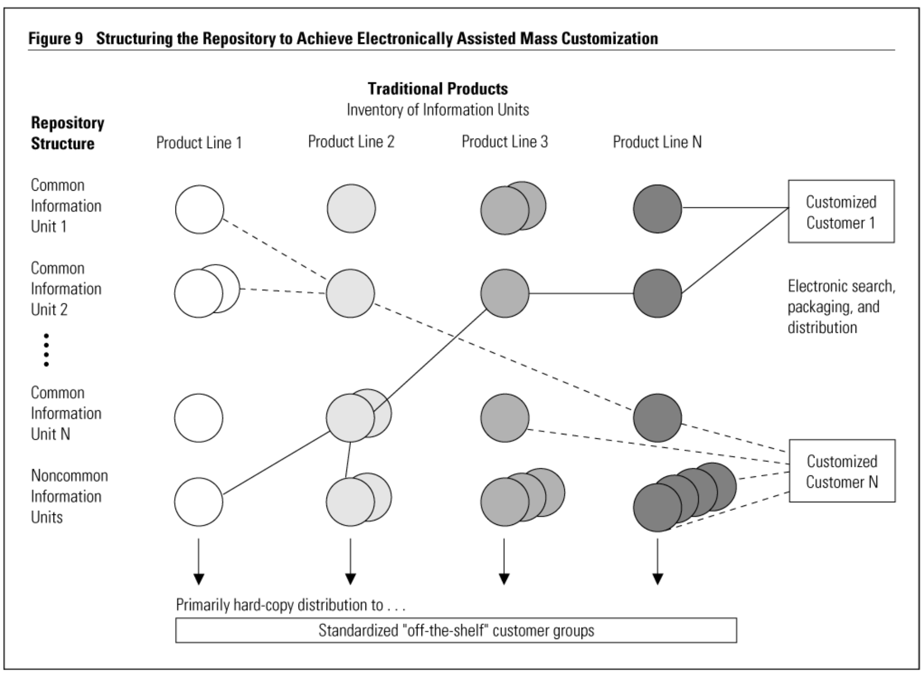

Figure 9: Structuring the Repository to Achieve Electronically Assisted Mass Customization

Ziff-Davis Interactive in Cambridge, Massachusetts, the on-line division of Ziff-Davis, is a classic example. It has taken the content of its computer-related magazines and placed them on-line with many of the leading on-line service providers (such as America Online and the Microsoft Network). Ziff-Davis Interactive has also added new, exciting content to draw both readers and advertisers to its sites. For example, it has recently introduced a three-dimensional interactive "world" called "Terminal Reality," a mock-up of LaGuardia Airport's main terminal that was developed with software from InterVista Software in San Francisco. Users visiting this site on the Internet can walk around, browse the virtual magazines at a newsstand, and in the future, we suspect, board airplanes to visit such places as virtual "trade shows."

As we prepared our business courses, we accessed an Internet site developed by a division of McGraw-Hill called PRIMIS. It has gathered a wealth of publications, such as articles, cases, and textbook chapters, for a host of subject areas that professors can peruse, select, and customize into a textbook. These customized textbooks are then assembled, printed, and delivered to college or university bookstores. In another example, International Data Corporation gathers information on market growth trends and vendor participation rates in a host of computer-related market segments and packages these data into fifty different reports that are distributed as hard copy and electronically through Lotus Notes. IDC's ability to mix and match the information contained in its various industry-focused repositories enables it to rapidly create new composite reports for emerging markets.

Once a company defines the structure of its repository and makes an inventory of information units within that structure, it must then carefully consider the standard mechanisms by which it or its customers may integrate or combine information units. For PRIMIS, the integration problem is simple: individual items are simply assembled into a customized text and sent to the professor for final approval. However, in other situations, integration may be complex and require additional resources. For example, IDC develops market forecasts for various market segments in the computer industry. A customer requesting an aggregate report containing information on multiple market segments will demand that individual forecasts be reconciled into a reasonable whole. In other words, one plus one must equal two.

15 Managing the Information Refinery to Improve Quality and Cycle Times

Companies tend to think about how information is refined, integrated, and published in technological ways. However, the improvement of the information refinery is essentially a redefinition of how the business works.

We have yet to visit an information products company that is not looking at the World Wide Web and tools such as Lotus Notes and HTML home-page development kits for electronic distribution of its products. Many have placed their publications on-line in part or in whole by creating Web servers. This focus is at the back end of the refinery model.

The greatest potential for redefining the information refinery comes from more careful application and integration of both human and technological capital to the front end of the process, i.e., the acquisition, refining, and synthesis of raw

front end of the process: acquisition, refining, and synthesis of raw information

information. In redefining its information refinery, a firm might ask three key questions:

1. What does the current refinery look like? The company should map its current process onto the refinery model we presented earlier.

2. How is each stage or step of the refinery managed? Are there any metrics for assessing the effectiveness and value added at each stage?

3. How are the functional stages of the refinery being integrated? Are there any individuals responsible for the complete flow of information, from its raw form to delivered products? What mechanisms support feedback between stages, particularly those at the front end of the refinery process?

From the answers, managers can begin to think about how better to structure their organization's information refinery, applying both management and technology to improve work with functional stages and integration between them.

A peer-reviewed academic journal provides an example. Typically, authors write an article on a word processor and add bibliographic references from their computer database of authors and publications. To submit the article to the journal, they print several copies and mail them to the journal editor. The editor reads the printed material, likes it, calls potential referees, and mails the anonymous article to several referees for blind review. The referees then draw on related articles in their own file systems, type their criticisms into their word processors, and print and mail them to the editor. The editor assesses them, packages them with an accompanying letter, and mails the lot back to the authors. They make revisions and mail several more copies back to the editor, along with a copy of the article on a floppy disk. Once the article is accepted for publication, the editorial staff people transfer files from the floppy disk to their own computers, do line editing, and prepare graphics. By the time the final product is scheduled for publication, typically within a year of acceptance, the thrill of publication has passed.

A new refinery for the journal might use technology to help authors, editors, reviewers, and readers get on with their respective activities faster and more effectively. The journal could create a Web site on the Internet through which authors could submit new articles and where editors and reviewers could pick up time-stamped versions and attach their criticisms and editorial revisions. The journal could maintain previously published articles, indexed by subject matter and author, on the Web site, so that authors and reviewers could quickly access specific managerial frameworks, data, or bibliographic references to help them write, critique, and respond. The editorial staff could also identify Internet links to other repositories of articles and data and build these into the journal's home page for the authors' and reviewers' convenience. Once an article was accepted by the editorial board, the staff could edit and prepare graphics directly on text and graphic files on the server, with more direct communication to authors. These would all be improvements to the front end of the journal's refinery.

actually the faster and easier exchange of pre-publication papers among physicists was one of the immediate goals of the creation of http, html and www

For the back end, the new refinery could facilitate faster access to accepted articles through customized ordering of articles. The journal would still produce its printed products for subscribers, including complete issues and reprints. At the same time, readers could peruse abstracts of forthcoming articles and order a complete copy of articles through the server.

A multitude of academic, industry, and mass market publications are implementing the scenario we have painted. That implementation is becoming increasingly systematic and predictable. Home-page development tools and developers are getting better and less expensive. Most academics have e-mail addresses and access to the Internet, which now handles multimedia objects as readily as text. An area that remains problematic, but that we expect to be remedied soon, is the security of financial transactions on the World Wide Web. The greatest challenge, of course, lies beyond the technology: journal managers, their staff, academics, and readers have to learn to communicate and work in new ways.

information units instead of subsystems, a repository instead of a product platform, and an information refinery instead of an assembled or nonassembled production process

If we were discussing physical products such as power tools or automobiles, we would identify the subsystems and interfaces of a common product platform. As managers, we would seek to continually improve the platform at both the subsystem and interface levels, introducing new component technologies and industry standards to these elements. But since we are talking about intangible information products, a different terminology is more appropriate: information units instead of subsystems, a repository instead of a product platform, and an information refinery instead of an assembled or nonassembled production process. However, the meaning and application of the basic product and process platform concepts are indeed very similar between both classes of products, i.e., the physical and the intangible.

16 Designing the Information Products and Services of the Future

Repositories and refineries exist merely to serve the needs of the products that the firm wishes to create. In turn, these products exist solely to serve the needs of customers. Thus, as with any physical product, customer needs must drive the design of information products.

Two categories of customer needs shape product development. First are those that users themselves know and can express. Market research departments are adept at identifying these known needs by studying competitors' products and administering surveys. However, learning what customers explicitly know only takes a firm farther down the path of incremental innovation.

those needs that users have but cannot clearly express

What is far more difficult, but more rewarding and exciting, is to uncover those needs that users have but cannot clearly express, i.e., "latent, unperceived needs." We believe that such needs lie at the heart of new platform design. If the architecture can satisfy these needs, an enterprise can bring new excitement to an industry and generate additional levels of demand, even in traditional, mature businesses.

For example, how many of us could clearly express the need for an inexpensive color ink-jet printer? But once Hewlett-Packard introduced its color Desk-Jet line, vast numbers of people said, "That's exactly what I need." HP found itself riding a tidal wave of newly created demand for non-laser printers. The new platform made something possible that was not possible before: users could print in color on a reliable unit costing about $500.[18]

The same idea holds true for intangible products. The managers of an information products company must charge its best new-product thinkers to identify latent customer needs. Only then can they define the design of the company's information repository and refinery so that they can deliver what people need in a pleasurable, convenient manner. This is especially important for information products, such as those appearing fresh on the Internet almost daily, in which customers often have relatively little purchasing experience relative to most physical products.

Let us consider the Sears Catalog as an example. It changed America, bringing products formerly constrained by the physical proximity of manufacturers and retailers right to the doorstep of rural America. Before mail-order distribution, most users could not conceive of not going into a store to buy something. But once mail-order catalogs became fully featured, they were exactly what vast numbers of consumers realized they needed. Similarly, before on-line shopping on the Internet became available, if you asked consumers how they preferred to buy goods, most would answer "in a store" or "through a catalog." Yet, now that there is on-line shopping, on either TV or the computer, there are significant growth opportunities for a broad variety of firms.

What will be the next wave of demand based on a need that consumers have but have not yet clearly expressed? Take two friends, for example, one living in Massachusetts and the other in California, who want to go on a camping trip in the Caribbean. Each logs onto the Internet, and together they go to a particular World Wide Web server that has descriptions, pictures, and reservation facilities for campgrounds on the islands. They browse through the portfolio together, discuss ideas through the computer, make a decision, and reserve a site. Then they call up another Web server that contains a "virtual shopping mall" and walk together into a "virtual store" of camping supplies. They browse through the equipment together and discuss via computer those items necessary for the upcoming trip. One of them then orders the products through the computer with an electronic funds transfer.

Our two friends, if asked today, might consider this scenario preposterous (unless, of course, they work for a software company or an on-line services provider). The repositories of most travel and retail concerns do not currently have the logical and physical structure to support this type of complex, distributed, and interactive activity. However, many firms are working hard to change this, using new technologies such as three-dimensional Internet browsers to create and sustain electronic "communities," teams, and individual liaisons. Once Internet shopping becomes reality, the two friends just might give it a try. It would clearly make it possible for them to go shopping together even though they live far apart.

timing will always be critically important for information products companies

Because timing will always be critically important for information products companies, firms that first identify emerging markets get a step ahead. A modular, flexible repository backed by an efficient refinery will help firms to quickly establish market franchises by rapidly offering new products targeted to their customers' specific interests and needs.

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