Analog Devices, Inc—Case History

Gaining competitive advantage through the management of Process Knowledge

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Process Knowledge (PK) can give companies an edge. But PK must be incorporated into the fabric of the NPD process throughout the entire organization to be most efficient. In the first part of a two-part series, the authors explain how Analog Devices Inc. does this.

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Confronted with the accelerated rate of technology development, shortened product life cycles, and global competitive pressures to reduce costs, New Product Development (NPD) organizations are compelled to optimize every aspect of their process. Re-use of Process Knowledge is one way companies can gain a competitive advantage in their NPD efforts.

In this two-part series, we will explain how Analog Devices Inc. (ADI) has successfully leveraged its business and technical Process Knowledge (PK) as a critical business asset. In the first article, we will explain general principles and practices of knowledge management, but more specifically the focus on their role in helping the company accomplish business objectives. We will also give a real-life example. It is clear that by recognizing and incorporating knowledge activities—both high-tech and low-tech— into business processes, companies can optimize their productivity and gain higher return on their investments in people and technology.

Dollars and cents benefits

Let's look at a concrete example of how this works. Analog Devices recently released a product that we will call Product Y for an Asian manufacturer of IC testers. Customer priorities for Product Y were low cost and an aggressive schedule of no more than 14 months. An earlier project we handled for this customer had suffered from frequent changes and unsynchronized revisions that resulted in team members working off different versions of the specifications. Time zone lags between the team and the customer had produced delays in exchanging routine information and making decisions. Schedules slipped and costs accumulated, while ADI's reputation suffered. The new project was even more challenging and further complicated by the need to tap ADI technical expertise residing in different geographic sites to address unique customer requirements.

Communication was key

Early on, management realized that to succeed it needed to improve communication, increase accuracy of information, and access real-time data. We knew our solution would have to be appropriate for a globally dispersed team. It would also have to let the customer become a key contributor to the development effort throughout the process.

The solution we came up with had a number of elements including the creative use of the intranet provided team members with the most up-to-date product development results real-time, worldwide; accelerating the pace of data analysis and decision-making; and a website which included schematics, bill of materials, and even photographs for Product Y. The standardization of information provided by the website led to fewer product specification changes and revisions, helping to ensure a lower full factory cost. Exhibit 1 on this page shows the benefits of this information sharing. The result was a lower price point and release of the product one month ahead of schedule. These benefits enabled the customer to consider using the new part in other applications, thus solidifying ADI's position as their vendor of choice and substantially increasing volumes and forecast revenue.

Knowledge sharing

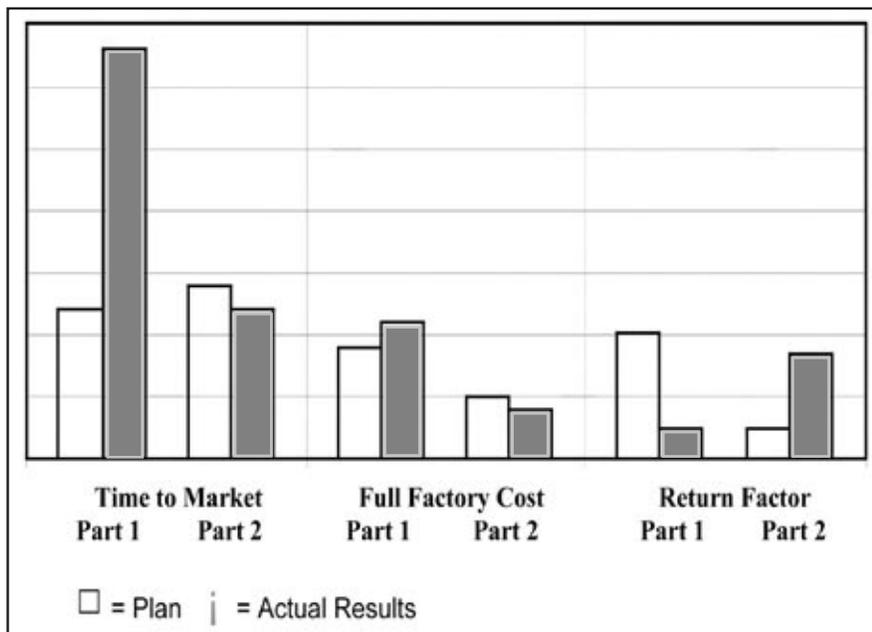Knowledge can be defined as "information in action." A key goal of effective use of inter-

Exhibit 1: Impact of Enhanced Information-Sharing Processes

Time to Market — Part 1 Part 2
Full Factory Cost — Part 1 Part 2
Return Factor — Part 1 Part 2

□ = Plan   ▌ = Actual Results

SOURCE: ADI internal report

nal Process Knowledge (PK) is creating and maintaining an environment that encourages knowledge to be created, stored, shared, and applied for the benefit of the organization and its customers.

A risk inherent in a discussion of Knowledge Management is the tendency to dismiss this as simply being the latest fad. It is interesting but soon replaced by another promising set of tools. At some companies Knowledge Management initiatives have been implemented as quick fixes, thereby justifying the "fad" label. At ADI, the approach to managing knowledge has solid roots in our organizational culture and business strategy. Ray Stata, Chairman of the Board of Analog Devices Inc., predicted in 1989 that "the only source of competitive advantage in knowledge-intensive industries would be the rate at which firms learn."

A key driver in this strategy is ensuring that our employees have easy access to the most pertinent knowledge when and where they need it. While technology may be an enabler of knowledge sharing, Stata recognized that people's willingness to share their knowledge is influenced by the culture of the organization. The importance of organizational culture as a Knowledge Management enabler has since become a common theme in the literature. [1, 2, 3, 4, 5]

Knowledge sharing in gated processes

Our gated NPD process shown in Exhibit 2 on page 13 illustrates the value of effectively sharing knowledge to achieve business objectives as a conceptual model and operational road map for moving a new-product project from idea to launch.

Wheelwright and Clark point out "…an excellent engineering design is one that not only achieves outstanding performance but also is manufacturable and comes to market rapidly."[6] Accordingly, our NPD process relies on effective communication and coordination among the diverse functional groups within the company, taping the latest technical and business knowledge.

> " Early on, management realized it needed to improve communication, increase accuracy of information, and access real-time data. "

We know that the ability to successfully leverage geographically dispersed organization knowledge can profoundly influence the quality of the decisions made and hence the outcome of the overall development effort—for example, tapping our diverse sales organizations to develop a competitive pricing proposal and avoiding selection of a given package due to problems experienced by another ADI team, which run counter to the vendor's claims in their data sheet.

Leveraging Process Knowledge

Each phase gate represents a critical learning opportunity. In accomplishment of the stage's specific tasks, successful teams leverage existing organizational knowledge. These information gathering activities reduce project risks and resulting cost overruns and time delays. Along the way, these very same teams may create new knowledge. When effectively shared within the organization, this information can provide a unique source of competitive advantage.

In a gated NPD process, decision-making events follow each stage. Product development teams complete a prescribed set of related cross-functional tasks in each stage prior to obtaining management approval to proceed to the next stage of product development. This approval corresponds to the opening or closing of the gate associated with that stage of the project. According to a Product Development & Management Association (PDMA) best-practices study, 68 percent of leading U.S. product developers use some type of "Stage-Gate™" process.

Analog Devices process

At ADI, we conduct a preliminary business and technical investigation before each project starts, during what we call a Product Concept Phase. The goal at this stage is to determine if the opportunity is sufficiently promising to warrant additional investment of time and money to conduct a more in-depth feasibility analysis. An emphasis at this point is on building the business case. The process is accelerated by our ability to tap organizational knowledge with respect to our competition as well as to the customer, the intended market, and the likelihood of success. This process involves utilizing sales and marketing databases, as well as contacting account managers and relevant sales and field application engineers.

We sometimes hold Technology Summits within the company to bring together diverse product lines, supporting common markets such as displays and automotive. Key goals of these events have been developing an infrastructure to effectively share customer information and ADI core technologies in order to expand market share by developing integrative solutions.

Feasibility Stage

During the Feasibility Stage we conduct a more in-depth assessment of both business and technical issues. Exhibit 3 on page 14 shows that it is here in the Front End of

the project that management involvement has the greatest potential impact on the project. Research shows that up to 75 percent of the total cost of a new product is determined by the time the product is defined and serious design work is started. Robert Cooper went so far as to say, "…the steps that precede the actual design and development of the product—screening, market studies, technical feasibility, and building the business case—are key factors separating winners from losers."

To reduce risk, time-to-market, and cost, during the Feasibility Stage a key area for discussion is identifying intellectual property from previous projects, that can be reused effectively with the new product. For example, ADI's expertise in the areas of Analog and Digital IC design is one of our core competences. Accordingly, our ability to effectively share the latest knowledge and tools with our designers is a source of competitive advantage.

To accomplish that goal we have developed two easy-to-use IP exchange databases where reusable designs can be catalogued and distributed across the company. They are:

- A library of robust and supported reusable cores available for download, obtained from both internal and external sources
- An IP catalog designed to provide enough information to let the user determine the suitability of the IP for their project.

Use of partnerships

In parallel to this web-based approach, one of our Computer Aided Design (CAD) groups has been championing the usage of partnerships with design teams based on the theory that the most effective way to transfer technical know-how is person to person. It is definitely true that from a short-term perspective a strategy of partnering CAD staff with design teams may not be the most effective use of limited support resources. Our experience, however, has shown that as we roll out existing methodologies and develop new ones, the need for CAD support declines over time as the design teams learn to use the new tools. Additionally, the partnerships prompt further improvements in our design methodologies.

In the case of the first partnership between CAD and a design team using a new set of tools, the iteration time was reduced by an order of magnitude. On the next NPD effort, using the new tools, the team with a CAD partner reduced iteration time by another order of magnitude. At the end of the day, use of a person-to-person approach significantly reduced time-to-market, as well as costs associated with rework.
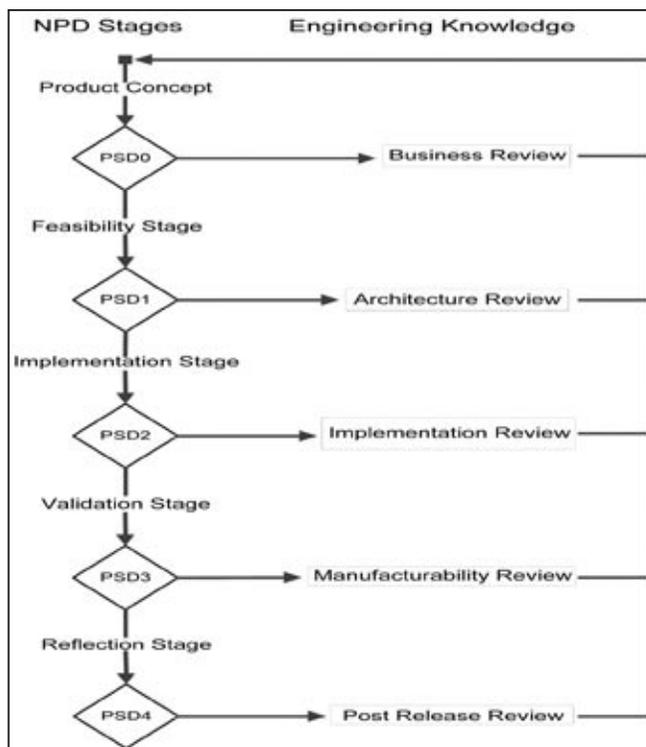
People-to-people sharing

ADI's culture also encourages people-to-people information-sharing opportunities throughout the development process. Functional representatives of the team are required to present their plans and findings at "technical reviews." While these meetings were primarily instituted to mitigate risk and explore faster, less expensive solutions, they also serve as an effective forum for real-time learning. Over the last three years, the percentage of new breakthrough products that have undergone this review process has increased steadily from 30 percent to greater than 90 percent.

In accomplishing a stage's specific tasks, teams not only leverage existing knowledge, but also may create new knowledge which, when effectively shared within the organization, can provide a unique source of competitive advantage. During the "Implementation Phase" a team using new membrane probe technology conducted an After Action Review (AAR), focusing on schedule slips. By sharing their AAR learnings ADI was able to enhance emerging technologies in real time, allowing future teams to avoid similar pitfalls. Similarly, a team encountering puzzling yield problems conducted a brown-bag session to brainstorm their experience with their colleagues.

Throughout the development process ADI

Exhibit 2: ADI's Gated NPD Process and Design Knowledge

SOURCE: ADI Internal Process Guidelines

also makes extensive use of its intranet, as a readily accessible virtual warehouse of pertinent data. Our web-based tools provide a useful mechanism for standardizing practices necessary for ISO certification, and also serve as the engine to drive automated workflow tools connecting our worldwide manufacturing organization with the product lines.

Post-launch sharing

Learning activities and acting on this information does not stop with the release of the product. Upon initial release of the product, many Product Lines require teams to conduct an After Action Review, assessing the team's performance against metrics set at project start, such as TTM, development costs, number of design iterations, etc. The goal of this activity is not to judge the team's performance, but rather to learn from the team's experience and then share these learnings with future and current teams. During the AAR, teams are encouraged to identify successful practices to replicate and problems to avoid. These learnings are then posted on a website called "The Learning Board" and in some cases result in changes to policies and procedures.

Six quarters after release, a PSD4 meeting is held, where the project is assessed against financial metrics established at PSD3. Once again the goal is not judgment, but learning and continuous improvement. In addition to ensuring that lessons learned are applied to future projects, Product Line management is encouraged to identify actions that can be taken to assist poorly performing projects.

Sharing knowledge across NPD teams

An ongoing challenge to our KM efforts is that knowledge is sometimes shared successfully within business units, but the process breaks down at the business unit's organizational boundaries. Knowledge was sometimes not flowing from unit to unit and so knowledge

> ❝Our NPD process relies on effective communication and coordination among diverse functional groups.❞

re-use was being precluded. Several different initiatives have been launched addressing this challenge. Common to all of them is that the driving motivator is accomplishment of business objectives. KM is seen as a helpful means of achieving a business objective, but not an end in and of itself.

Conclusion

At Analog Devices knowledge sharing is not a slogan, or a banner, or an end in-and-of-itself, but rather one of the methods used to achieve the end goals of profitability and market leadership. ADI has resisted the temptation to launch discrete KM initiatives, that extract Knowledge Management from day-to-day activity. Such an approach—to set up an organizational entity responsible for KM that would initiate projects outside the NPD process—might lead to a situation where KM is perceived to be the responsibility of a small cadre of people whose charter is to deliver Knowledge Management for the organization. If this scenario were to emerge, where the initiative was somewhat disconnected from the general ADI community, it would likely experience the slow death associated with other fads. ◆

Part II of this article will describe additional elements in the use of Process Knowledge in the development of a variety of new products.

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Exhibit 3: Timing and Impact of Management Attention and Influence
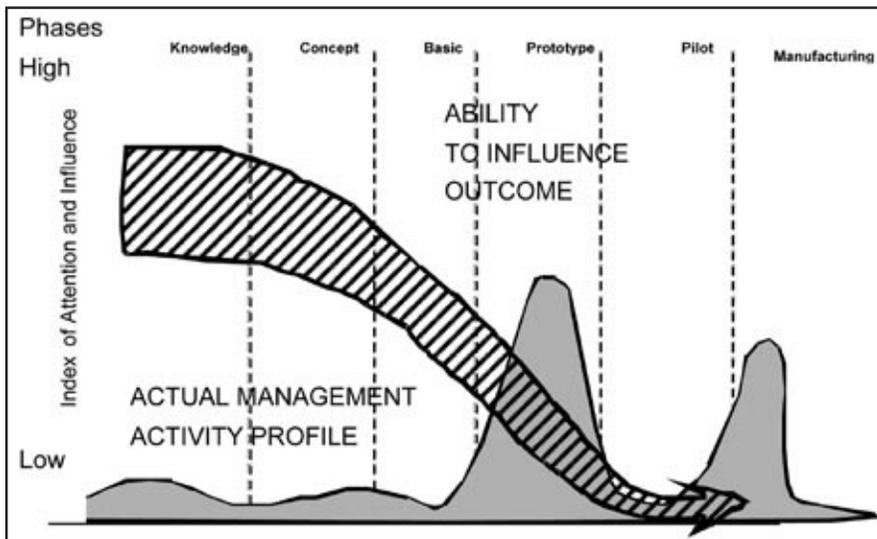
SOURCE: S. C. Wheelwright and K. B. Clark, Revolutionizing Product Development, p.33. New York, The Free Press (1992)