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# Environmental Knowledge Management

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Advances in the emerging field of knowledge management, the intelligent processing and distribution of information, hold out the possibility of integrating industrial ecology into standard business practices. As network computing has evolved to routinely provide users with universal access to data and applications, the problem has become sifting through the huge volume of information rather than having access. Knowledge management (KM) has the goal of providing the right information to the right person at the right time. "Knowledge" here means information placed in context and goes beyond electronic artifacts to include the knowledge that resides in people's heads. The integration of industrial ecology objectives with KM tools could give rise to environmental knowledge management (EKM) systems that use knowledge to improve corporate environmental performance by lowering the information barrier that prevents organizations from realizing environmental opportunities.

Will EKM systems align industrial ecology with market forces? Will market actors respond to the new knowledge? Will they bother to integrate it and act? The challenge of replacing enterprise business applications with ones that fully integrate environmental performance concerns remains formidable. Experience in North America suggests that success occurs primarily in cases where environmental initiatives are consistent with innovative, but already accepted, business applications. Identifying the areas where EKM

can integrate with existing enterprise business systems should guide EKM development and eventually lead to their broader integration in the future. For instance, companies already using activity-based cost accounting methods can leverage their existing platform for sophisticated environmental cost accounting. Those firms using metric-based management can extend this strategy to encompass resource productivity and waste generation.

In the context of a commercial enterprise, EKM systems can embed management-level decisions into standard business practice to realize some practical industrial ecology innovations. EKM systems can greatly reduce the search costs involved in finding environmental regulatory, technical, and market information, for example, by integrating procurement systems with the capability for federated searches of environmentally benign sub-

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stitutes. As entire supply chains become digitized (see the discussion of product tags by Saar and Thomas, this volume), EKM components can be integrated with supply-chain management systems to monitor supplier environmental performance ratings, as well as the material composition of product components. For capital-intensive environmental initiatives, such as upgrading a facility's energy supply, EKM systems can consolidate the electronic libraries and analytic applications necessary for evaluating the benefits and costs of alternative paths.

Inevitably, industrial ecology relies on effective communication within and between organizations, be they buyers and sellers of industrial wastes or product design and marketing teams to implement design for environment (DfE) initia-

tives. Establishing the right knowledge networks is essential to making an EKM system work. More generally, KM offers experience in establishing “communities of practice,” that is, self-organizing groups of individuals that cut across traditional boundaries of expertise to coalesce around a shared interest. Industrial ecology communities can be enabled using the same technologies that facilitate intra- and intercorporate communication ranging from instant messaging over secure networks to dynamic shared workspaces accessed through an extranet.

To make the information reaching an individual relevant and useful, KM systems generally include a capability to filter information. To standardize the processing, these systems typically rely on a controlled vocabulary of useful and familiar terms to build a taxonomy that organizes enterprise information. By applying descriptive “tags” to units of information, the taxonomy establishes relationships between information stored in libraries, databases, and in people’s heads. Leveraging the taxonomy, experts can devise rules for relating the units of information to turn the information into knowledge. Although human expertise is essential to devising the rules, further processing can be largely automated, taking advantage of recent advances in concept-based categorization and content management software and the emergence of standard extensible markup languages (e.g., XML).

Designing a system to connect data, analysis, and people presents an unprecedented opportunity to formalize industrial ecology in a business setting. The framework provided by materials flow analysis (MFA) and life-cycle assessment (LCA) identifies the *stocks* and *flows* of physical resources as two core information taxonomies to embed within EKM systems. Using business rules to relate stocks and flows lets users evaluate alternatives to existing resource-consuming activities and identify their financial, managerial, and market relevance to stated business goals.

The development of EKM systems must be informed by broader market trends. Undoubtedly, information technology supports efforts to establish communities of practice and maintain specialized information taxonomies. Corporate experience over the last decade, however, shows that investment in networks and software alone

does not provide a panacea for effectively sharing knowledge. Time has shown that the utility of knowledge-sharing networks rests heavily on active participation and continued maintenance. In fact, the thrust of most KM consulting today focuses on organizational learning, not technology, with effort going to encouraging, if not coercing, participation in knowledge networks. Experience with industrial ecology itself consistently shows that management support and teamwork are key to successful initiatives. As such, future EKM systems need to accommodate the dynamics of human cooperation to succeed in generating demand for environmental knowledge. On the cost side, contrary to expectations of vanishing infrastructure costs, past practice shows that costly human expertise is needed to configure and maintain information systems and to manage content. Because industrial ecology draws on such an eclectic domain of information, the task of maintaining relevant content and analytic applications cannot be underestimated.

Arguably, EKM systems can intelligently filter environmental knowledge and deliver it to key market actors. These systems also offer a structure to formalize business rules that reveal opportunities to reduce waste and prevent pollution. The question that remains is, If we build them, will they come? Will managers and employees embrace the knowledge once it is there for the asking? To encourage knowledge demand, EKM needs to draw on the affinity of industrial ecology with many of the business innovations of the last decades, particularly those stressing metrics of efficiency and productivity. The experience in the United States shows that although companies may demonstrate a willingness to join in public environmental initiatives with marquee (i.e., marketing) value, they are reluctant to restructure established accounting systems and design processes to accommodate initiatives.

Internationally, the large majority of commercial software packages represent stand-alone applications that operate separately from corporate systems and focus on processes such as LCA (e.g., SimaPro 5 [www.pre.nl], Gabi [www.pe-product.de]), green building design (e.g., Athena<sup>®</sup> [www.athenasmi.ca]), and emissions accounting (e.g., Greenware [www.greenware

.com]). These software packages are produced primarily in Europe and Canada, and judging by the spotty response in the U.S. market, they seem better targeted to those audiences. In the United States, government and nonprofits have made attempts to use networks and intelligent processing to ease the integration of environmental performance into business. The U.S. Environmental Protection Agency's Energy Star software ([www.energystar.gov](http://www.energystar.gov)) offers businesses the means to quantify, benchmark, and communicate improved energy performance. The MERGE tool developed by the Alliance for Environmental Innovation and Environmental Defense ([www.environmentaldefense.org/alliance/merge/merge.htm](http://www.environmentaldefense.org/alliance/merge/merge.htm)) assists companies in profiling product formulation and packaging. For commercial ventures, however, the need to generate revenue frequently pushes them to meet the requirements of existing environmental, health, and safety business units and largely ignore enterprise-wide applications. As enterprise busi-

ness applications mature, industrial ecologists need to identify the key points for integrating industrial ecology knowledge into business systems. Once implemented, EKM systems will lower information barriers to environmental opportunity and raise questions about the next group of limiting factors to improved environmental performance.

### **About the Author**

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