Capitalizing on Emerging Technologies

A Path to Creating Opportunities in New Markets

A framework for identifying and developing technology-based business opportunities in new areas can help companies move into new markets.

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OVERVIEW: A critical innovation competency is the ability to recognize technologies that can best be exploited by a particular company and to drive investment in them. We have developed a framework for identifying and developing technology-based business opportunities in new areas for a company. The framework brings together many aspects of emerging business opportunity identification and deployment, and is centered on defining a critical set of capabilities needed to address evolving market challenges. Our approach is implemented through a parallel understanding of market and technology trends connected with the dynamics of the relevant value chains. A new external technology that has the potential to augment internal capabilities can be an enabler in the opportunity creation formula.

KEYWORDS: Emerging technologies, Emerging business opportunities, Technology scouting

Nearly all companies face the challenge of looking beyond their existing markets to capture growth opportunities in new, rapidly evolving areas. Exploiting opportunities in entirely new spaces is critical to achieving and sustaining growth. But identifying compelling business opportunities in these spaces is difficult, and it can be challenging to convince executives to make risky investments in high-uncertainty areas. As a result, delivering innovation in new-to-company spaces is challenging, with failure rates reaching 75 to 95 percent (Day 2007). Combatting these challenges requires the proper scaffolding to support breakthrough efforts; one way to provide this structure is to create a dedicated team that is

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Megatrends

Megatrends are forces that have the power to reshape society. They differ from normal trends in their durability, as they withstand economic downturns and other cyclic forces and build over 10 to 15 years, or longer. Megatrends frequently emerge from demographic changes, such as the influence of the aging baby boom generation, or technological developments, such as the increasing ubiquity of Internet connectivity.

Societal changes brought on by megatrends are often a breeding ground for new innovation and disruption. For this reason, IVG uses megatrends to guide discovery efforts, focusing on four key megatrends that inform strategy:

- *Cleantech*—Technologies and services that aim to protect or improve the environment by reducing waste and emissions
- *Emerging market growth*—Solutions addressing the challenges of rapid urbanization in Asia and other regions, along with products targeting the rising middle-class population in the BRIC and other growing economies
- *Demographic change*—Services and products to address twin demographic shifts: an aging population in developed economies and the rising tide of millennials entering the workforce
- *Digitization*—The confluence of inexpensive sensor technology, low-cost data storage, and faster processor speeds ushering in big data and the Internet of Things

Innovating outside the core involves much uncertainty. Focusing on defined megatrend areas offers a way to position the company in markets likely to see growth. For instance, the manufacturing industry in which Kennametal and its customers operate is facing the loss of a large number of experienced, knowledgeable workers. In response, we are developing knowledge automation tools to facilitate knowledge transfer and help the new generation of production employees do their jobs better. These digital tools, which are integrated into Kennametal's recently launched NOVO suite of manufacturing solutions, target two of our megatrends: digitization and demographic change.

allocated protected resources and receives high-level guidance and support.

Kennametal took this path with the founding of its Innovation Ventures Group (IVG) in 2009 with the mission to identify new areas of growth for the company. Positioned at the intersection of technology and marketing, IVG focuses on large platform opportunities (typically with revenue potential in the hundreds of millions of dollars) that are based on new technology and new business models. The group, which is made up of program leaders with business and technology experience heading cross-functional project teams, reports to a Governance Council that consists of top company executives from all key functions. The council's role is to ensure the programs pursued by IVG align with the business's goals; it also approves major investments as projects mature from the initial idea stage through development to new business creation.

Since its founding, IVG has shepherded a number of large projects into the market. In doing so, the group has developed a process for identifying attractive areas to pursue by identifying critical market challenges that can be addressed by exploiting key internal technology strengths in combination with emerging technologies. The group has also created a set of tools to address the other key challenge of pursuing innovation outside the core—convincing senior leaders and resource owners to make investments in higher-risk programs that often do not provide immediate bottom-line benefits. This framework and toolkit can help innovation teams seeking to move their organization toward new opportunities.

The Challenges of Innovation Outside the Core

Driving innovation outside a company's existing market is both challenging and risky. It can be difficult to identify truly compelling opportunities amid a large number of ideas, and even when a promising opportunity is identified, executives can be reluctant to authorize investment when uncertainties and risks remain high. Simply collecting a large number of ideas from various sources—even if they can be effectively captured—is not sufficient to provide breakthrough innovation opportunities, since the majority of ideas are not radical enough to lead the company into truly new markets. Those that do focus on new and emerging technologies often lack an essential market and business perspective, making them difficult for the organization to act on.

When a new opportunity does emerge, it can be difficult to drive investment decisions to support the development of the space. As with most companies, Kennametal's executives must manage two types of investment: those to defend the core and those in new opportunity growth. New opportunity growth usually entails greater levels of uncertainty, creating reticence to invest. To combat this reluctance, it is essential to define the new technology in the context of a business opportunity and provide a framework for making investment decisions that communicates both the upside and the potential risks of the opportunity in a somewhat quantitative way.

IVG has developed an alternative approach to new business and new technology development that addresses these primary challenges by combining knowledge and insights from various functions to essentially create a new business opportunity.

IVG's business creation framework focuses on megatrend areas where a market disruption is occurring (see "Megatrends," left) and on emerging technology trends, which can provide information about potential technological disruptions that may lead to new business opportunities. The approach is based on the view that Kennametal has essentially the same access to market and technology information as the competition. The ability to successfully deploy a new business thus depends on our ability to 1) generate insights

based on market and technology trends, 2) identify opportunities that align with the company's organizational structure and internal capabilities, and 3) deliver value within the context of the relevant value-chain dynamics.

The focus on megatrends lends itself to such techniques as technology forecasting and scenario planning (see, for example, Farrington, Henson, and Crews 2012 and Manyika et al. 2013); however, these tools offer little guidance for successfully adopting technologies that can serve as a foundation for new business outside the company's core. Other approaches that focus on analyzing the evolution of value chains driven by megatrends—for instance, the Magellan process (Mills and Siempelkamp 2012)—focus on internal technology capabilities and do not address external technologies or their integration into the firm. Therefore, IVG has established its own formula for identifying and developing opportunities in new spaces.

The process we have developed integrates various tools (some developed by Kennametal and some identified from the literature) into a coherent framework that we have found to be effective in managing programs with high levels of inherent uncertainty (Figure 1). The process comprises three steps:

1. *Define the opportunity space* in the context of unsolved challenges in relevant megatrend areas while identifying emerging technologies that are complementary to existing internal capabilities.
2. *Articulate the opportunity* based on a systematic analysis of Kennametal's position in the evolving value chain, describing 1) who the customers are and what their needs are, 2) how Kennametal will create value for customers in the opportunity space, and 3) what the company needs to do to deliver that value.
3. *Manage uncertainty and drive investment* via a spiral discovery process, using financial modeling tools to quantify and communicate economic risk.

When setting out to create new opportunities outside the core, the odds are not in your favor. However, we found that using a systematic process with specific tools to navigate external market uncertainties and internal organizational obstacles helps improve the chances for success. It all begins with deciding where to focus development activity.

Defining the Opportunity Space

To articulate a new business opportunity in the white space, we have found it helpful to adopt a central principle of effective corporate strategy, which requires clear answers to two questions: where to play and how to win. "Where to play" is the target market segment or customer application, and "how to win" is the set of capabilities that must be deployed to exploit the opportunity effectively (Lafley and Martin 2013).

Marketplace disruptions, which often create business opportunities, happen at the intersection of market needs and technology developments. For example, in the case of Apple's iPod, the need for portable, easily accessible music intersected with the emergence of lower-cost digital storage technologies. With this in mind, IVG has adopted a strategic approach for identifying new opportunity spaces that places equal importance on understanding both market and technology areas relevant to the company. We have found that building organization awareness in both areas makes cross-functional ideation of new growth opportunities more effective.

It is essential to define the new technology in the context of a business opportunity.

The process for identifying opportunities can be either *market back*—beginning with the marketing group identifying an emerging market need—or *technology forward*—building from an awareness and deep understanding of both internal and external emerging technologies. In both cases, we believe success depends on the ability to generate new value for customers via specific capabilities rooted in core competencies that can be augmented with complementary external technologies through open innovation. The best opportunities exist at the confluence of unmet customer needs and technologies that leverage existing capabilities (Figure 2).

The Market-Back Approach

A *market-back* opportunity is one that emerges directly from an end-user need. It begins with an examination of challenges customers are facing that we learn about through direct voice of the customer activity or through our participation in industry-backed consortia or government-funded research. Here, the focus on particular megatrends guides us to problems whose solutions provide better opportunities to penetrate the existing value chain, as megatrend developments may lead to the creation of entirely new market segments.

One example of a market-back opportunity space rooted in the cleantech area that Kennametal explored is electromobility, or the growth of electric and hybrid-electric vehicles resulting from rising energy costs and increasing fuel efficiency standards. The key to defining our opportunity space in this vast market was to focus on unsolved problems that align well with Kennametal's technology competencies. Through secondary market research—for instance, published reports from management consulting firms, government agencies, industry and trade associations, and media sources—and by analyzing specific performance objectives for battery quality (such as energy density) provided by the US Department of Energy (2014), the IVG identified critical application challenges in the powder-metal–based electrodes used in energy storage devices. Kennametal has strong internal competencies in the powder-metal area; therefore, this need aligned well with the company's internal capabilities.

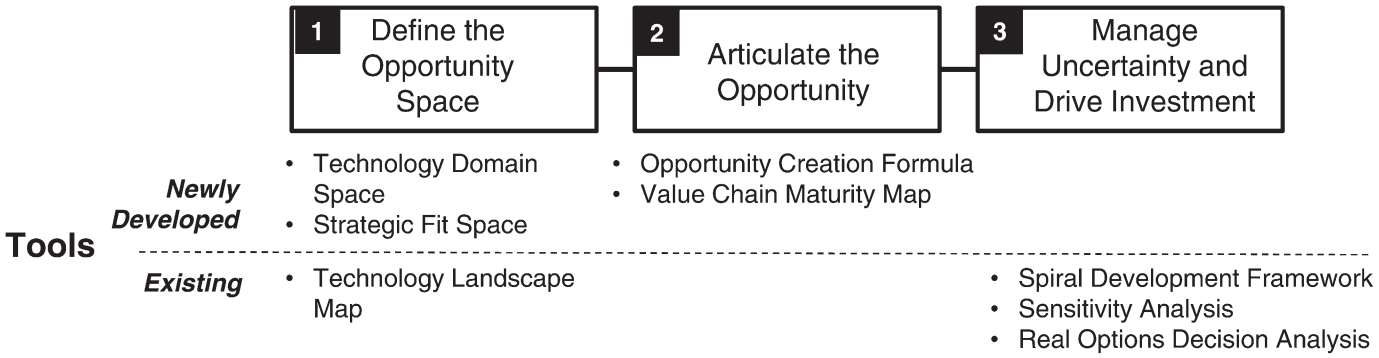

FIGURE 1. Kennametal's process for identifying and developing new business opportunities

The IVG then sought to understand how the company's internal capabilities could be complemented with specific external technologies to produce a compelling offering. External technology identification and selection was carried out through a systematic technology landscape mapping process (Spitsberg et al. 2013), which identified a promising porous material that offered a three-fold improvement in a critical performance dimension and that aligned well with Kennametal's internal technical competencies.

The Technology-Forward Approach

The electrode solution is one example of how an opportunity can be defined by tracing back from a megatrend area. Emerging technologies are a critical element in defining how to win and how to position the company to access opportunities that might otherwise be out of reach. The opportunity identification process can also begin with promising emerging technologies, moving from how to win to where to play. This *technology-forward* approach, which focuses on the new business potential of emerging technologies, can be as effective as the market-back process in identifying opportunities.

The key is identifying technologies that are relevant for the company. While information about emerging technologies is relatively accessible—for example, see publications and presentations such as Kumara (2014) and Shukla (2014)—it can be difficult to decipher what a particular technology may mean for the company. At Kennametal, IVG developed a two-step approach to identify the few critical technologies that could make a difference for the business.

In the first step, the company's *technology space* is defined in a manner that creates a framework for relating seemingly distant emerging technologies to core competencies. A company's technology space comprises all the technologies it uses to create products in a given domain and provide them to customers. It can be defined in such a way that it captures both current and developing technology capabilities. We use a broad definition of the space that allows us to capture

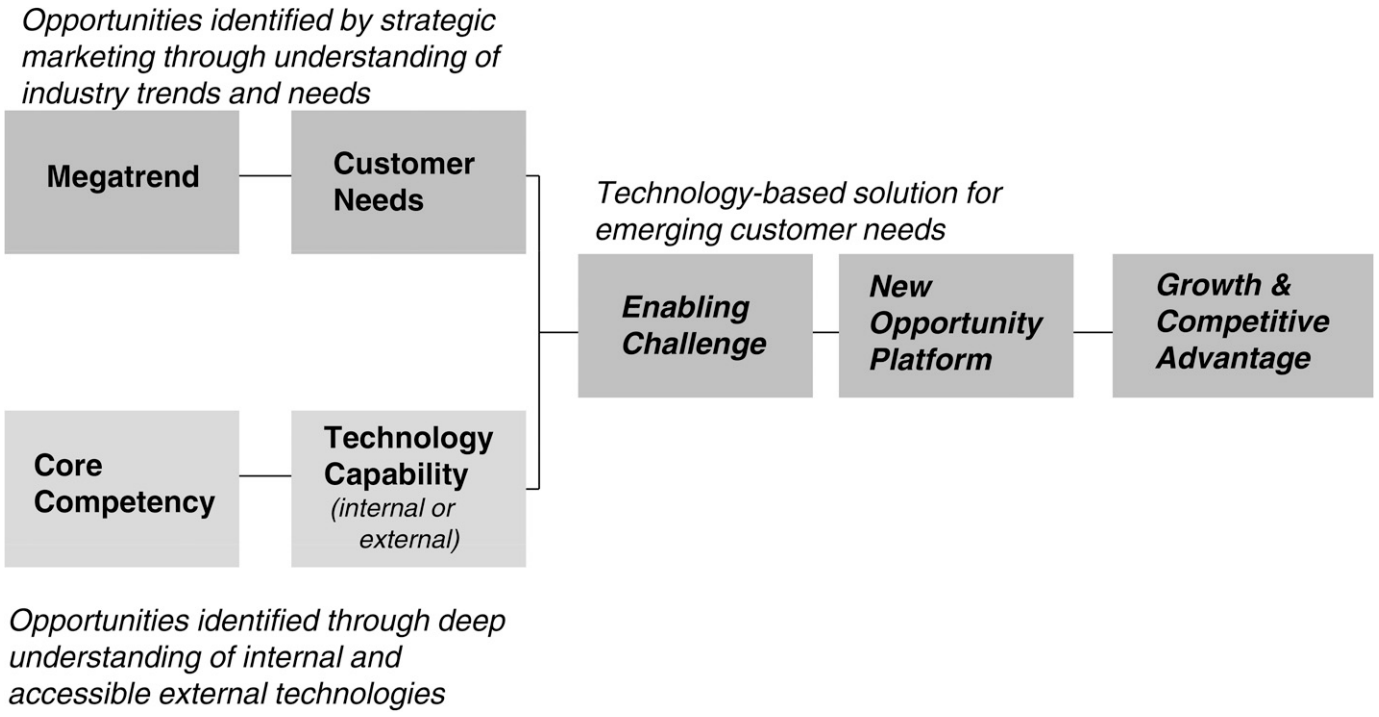

FIGURE 2. Identifying opportunities at the confluence of customer needs and technology development

current capabilities within a domain along with external technologies that are related to the core capabilities and that can be exploited to enter new markets.

For instance, Kennametal's material science–related technology space can be mapped across seven domains (Figure 3). Within each domain, the inner ring includes core areas in which the company has deep expertise, and the outer ring includes technology areas that are outside the core but share some key attributes with core competencies, such as commonality in manufacturing processes or technical expertise. These commonalities would lead us to expect that the company could likely exploit those technology areas either through an open innovation approach or through targeted internal development. If the inner ring were the only technology areas being explored for new opportunities, options would likely be limited. The expanded definition of the technology space makes identification of a promising opportunity much more likely.

For example, consider Kennametal's ceramics technology domain. If only the core technologies are considered, the opportunity search would be focused solely on new opportunities in wear applications. However, the expanded domain includes such technologies as porous or functional ceramics, which are a good fit for many cleantech applications—a market with many potential opportunities. Thus, the definition of the technology space is critical in identifying emerging technologies with high potential for innovation.

Once the technology space is defined, the next step is to identify emerging areas within each domain and select promising technologies. We begin this process by engaging a team of external and internal experts and asking them to identify trending technology areas. (Note that a technology area may comprise several specific technologies.)

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This process usually results in a substantial list of candidate technology areas that may be relevant to the business. It does not, however, provide enough detail to allow a final selection.

The second step seeks to narrow the selection by mapping candidate technologies to a *strategic fit space*. We begin this process by sorting the technologies on the list along two dimensions: alignment with the megatrends of interest and fit with the company's strategic mission and technology competencies. Each technology is assessed in each dimension according to several weighted factors, and the output is plotted onto a Strategic Fit Map (Figure 4). The Strategic Fit Map is divided into three zones. The outer zone—the right side of the map—includes those technologies likely to be of highest importance to the company. Technologies in the upper right corner fit best with both megatrends and internal company capabilities and therefore should be explored for potential business opportunities, and technologies in the bottom right corner may present opportunities or disruption for the core business and thus may be important to the business even though they do not fit particularly well with megatrends. Technologies falling into the middle zone show only moderate fit with the trends and

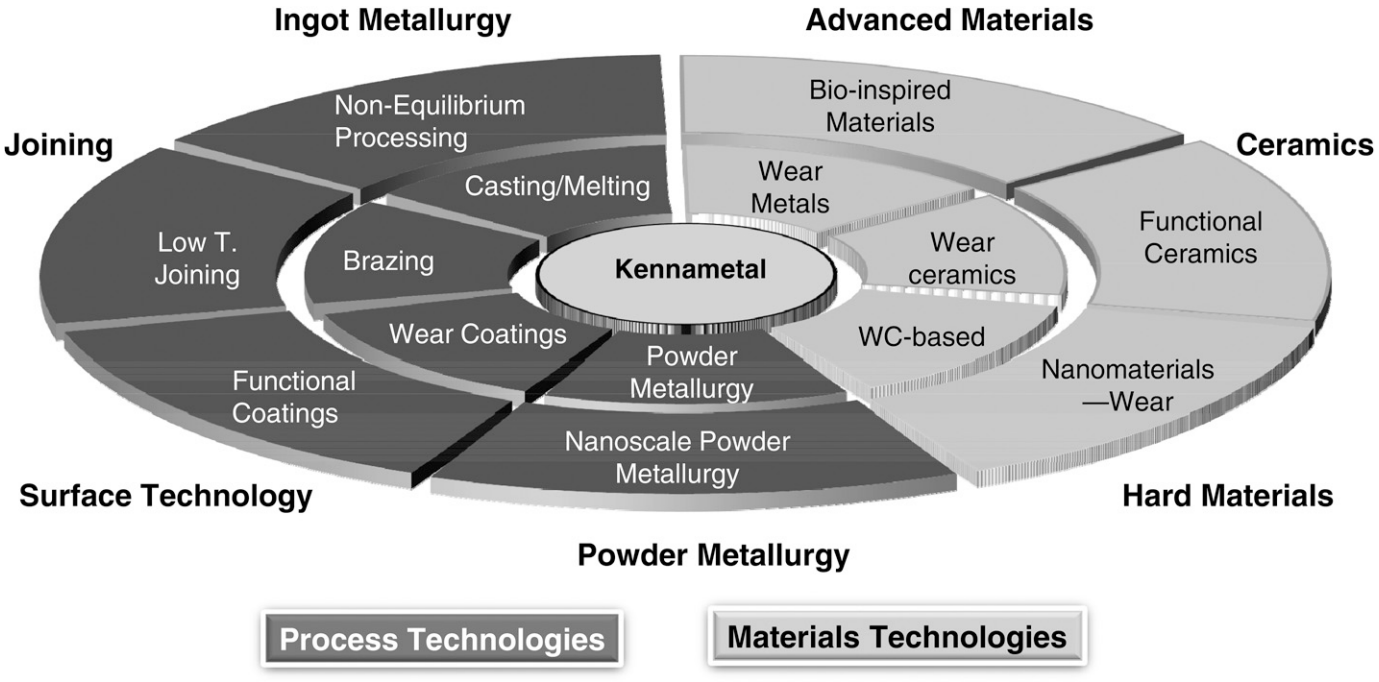

FIGURE 3. The technology space for Kennametal's materials science–related domains

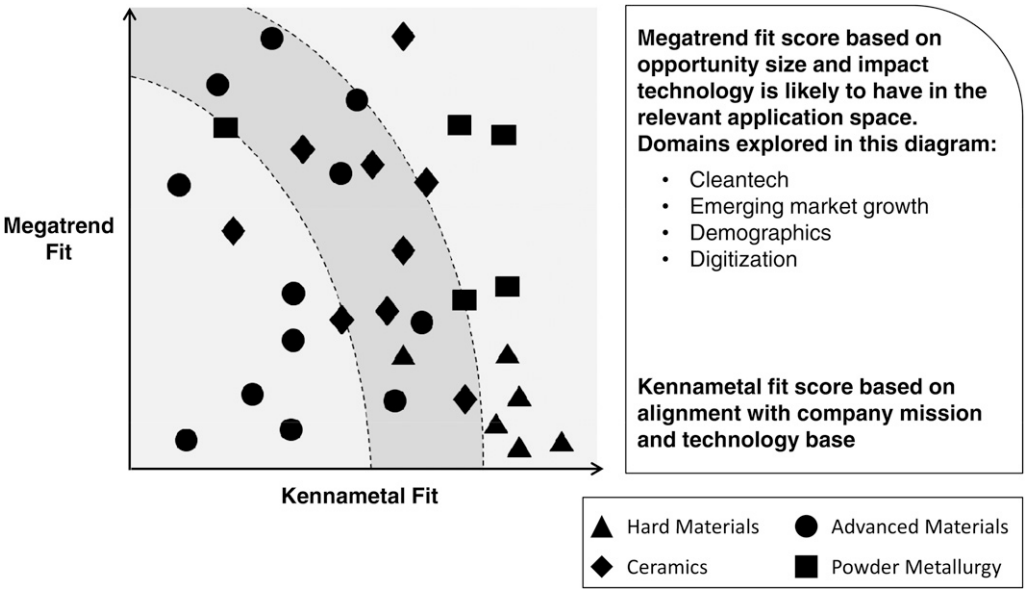

FIGURE 4. Strategic Fit Map for four materials science domains

Kennametal's competencies and goals; these may be addressed at a lower priority. The inner zone of the map captures technology areas with low fit on both scales; these warrant monitoring for peripheral awareness, but probably should not be developed. In this way, the Strategic Fit Map clearly visualizes how the identified technologies fit along the two dimensions of importance to the company and provide a rationale for selecting technology areas to pursue.

Once technology areas are prioritized, the next step is to conduct an in-depth assessment of the most promising areas to understand the explicit market needs they may address and the specific technologies best suited to meet those needs. This assessment is conducted using Technology Landscape Mapping (Spitsberg et al. 2013). This process starts by identifying key technology developments in a given domain; those developments are then systematically projected onto broad market drivers that they can address. By identifying specific technologies with potential to address particular (and often newly identified) application segments, the team can connect technologies to markets and define tangible opportunities suited for the company. The outcome of this process is a Technology Landscape Map that depicts key technology drivers and the related application segments, with specific technologies and their readiness level connecting the two (Figure 5). The Technology Landscape Mapping process therefore allows us to systematically identify and select specific technologies and application areas to pursue. Once these are identified, the opportunity space starts to become clear.

Articulating the Business Opportunity

The next step involves bringing the various pieces of the puzzle together to articulate the business opportunity. While the growth opportunity is at this stage fairly well defined, capturing both where to play (the specific user segment and application) and how to win (the set of capabilities needed to deliver value), it is critical to consider whether there is a reasonable chance of commercial success associated with it. Indeed, at Kennametal, having screened a large number of new growth opportunities that leverage the company's current competencies in advanced materials and processes, we have found that the "how to win" element of the strategy must include not only technology-related capabilities but also business-related competencies.

In fact, business competencies—including such elements as channel access, brand equity, strategic alignment, and business infrastructure—often contribute more to the future commercial success than technology capabilities; thus, they should be carefully considered early in the discovery process, and given every bit as much attention as the technical capabilities that are typically the focus of front-end innovation efforts. In this light, the winning formula for a new business opportunity can be presented as:

Technical Capabilities (TC) + Business Competencies (BC) = New Business Opportunity

To provide the competitive differentiation needed to turn a technology-based opportunity into a commercial success, we have found there must be a critical mass of capabilities in each of the two categories. Typically, a differentiated technology capability arises from the combination of two or more of critical elements, such as material, process, and application knowledge. In the case of product development in the core, the company will mostly have a critical mass of these capabilities internally. However, a company entering a new space often does not have the needed technology competency factors; in this case, external technologies, accessed via licensing or acquisition, are needed to augment core strengths and achieve a critical mass of technology capability. With this in mind, the formula can be modified to include the effects of external technology leverage (ETL):

[Internal Technology Capabilities + ETL] + BC = New Business Opportunity

This formula highlights the role of external technologies as important enablers in the business opportunity formula. However, any external technology must be considered in the context of the other organizational competencies. If there is not enough overall critical mass—a combination of internal technical and business capabilities—the external technology will not likely lead to commercial success.

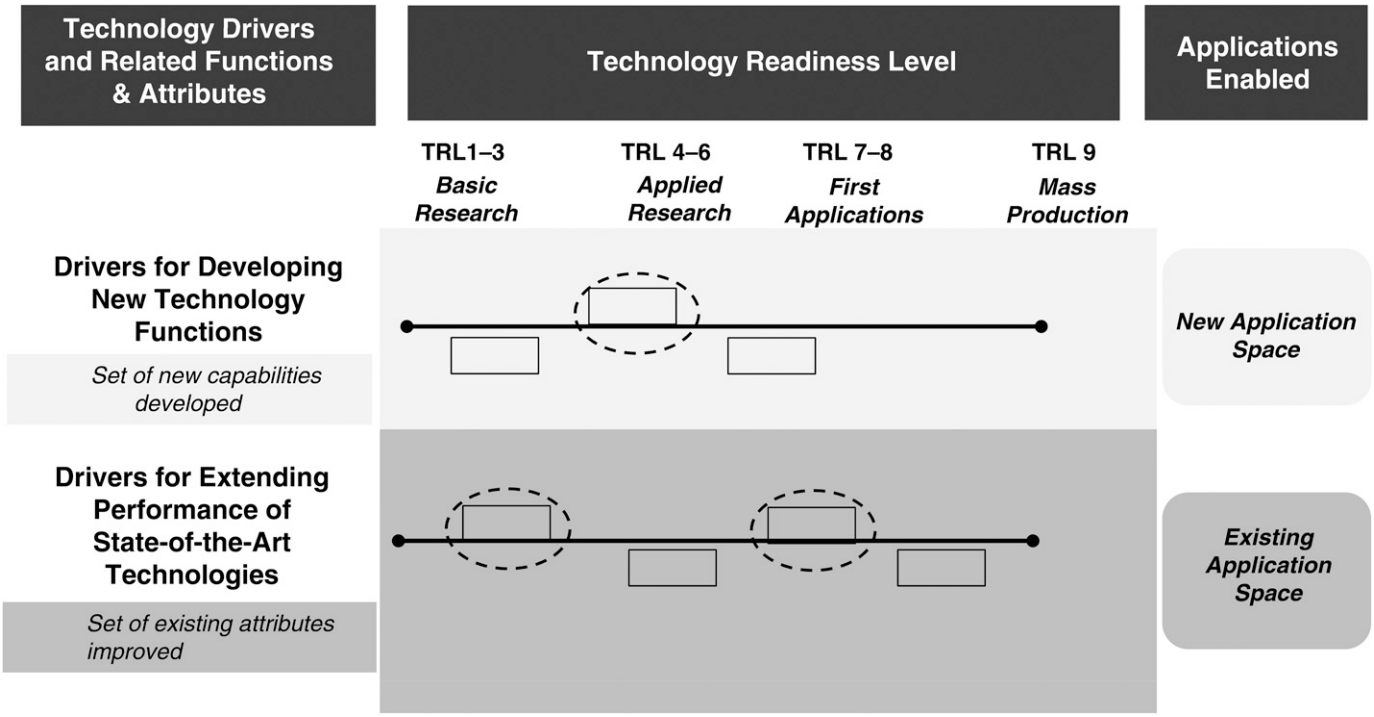

FIGURE 5. The Technology Landscape Map

The final consideration when analyzing the business case for a new opportunity is to understand the dynamics of the value chain. Once a potential solution is identified, it's important to see how it maps onto the existing or evolving value chain. For instance, we have found that technology components are often highly integrated at the system level, leaving limited space for new entrants. Developing an understanding of these limitations early in the process saves valuable time and resources from going down a development path or adopting a technology that cannot be turned into a business opportunity because of limitations or incompatibility in the value chain. Alternatively, a detailed understanding of value chain dynamics can help guide the development program toward defining what partnerships are essential for commercial success.

An illustration of this point may be found in the earlier example of the energy storage opportunity for hybrid and electric vehicles. We saw in this market space a well-defined need to improve the energy density of batteries to improve vehicle range. Analysis of the opportunity through the lens of the new opportunity formula showed that the company had enough technical and business pieces—existing powder metallurgy technical competency, brand equity as a powder metal solution provider, and existing processing infrastructure—to suggest the existence of a reasonable new business opportunity. Through the technology mapping process, the team was able to identify a promising electrode material that addressed the energy density challenge in a significant way, and that external material technology matched with Kennametal's internal processing capability, resulting in a specific solution. However, when we examined the value chain for the energy storage device market, we observed that production of the electrode subsystem and the battery system were most often integrated into the same process. It was unlikely that Kennametal could enter the market with only a subsystem solution. Therefore, the best commercialization path for the electrode material solution was to create a proprietary powder product that could be supplied to system manufacturers.

One other important insight here is that the chance that a technology-based business opportunity will succeed is largely dependent on the maturity of the value chain. It is useful to think of value-chain maturity in four phases, from technology development through commercial scale-up, cost reduction, and incremental improvement. We have found that there is a greater likelihood of penetrating new market segments with promising emerging technologies in value chains that are transitioning from technology development to commercial scale-up. Markets and opportunities beyond the scale-up phase generally show high levels of component and system integration and the supply chain networks are typically well established. On the other hand, markets and applications in the early stages of technology development

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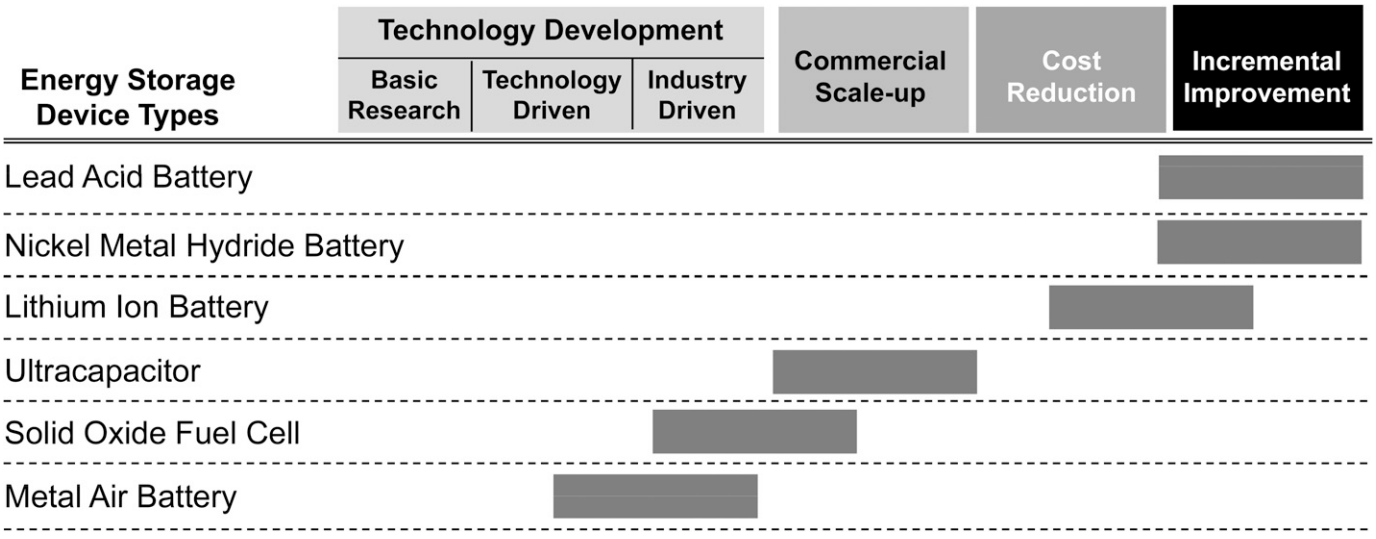

FIGURE 6. Value chain maturity in the energy storage device market space

possess high levels of uncertainty, and selecting emerging technologies involves significant risk. By contrast, in value chains in the late part of the technology development phase, the potential for creating value by integrating a few technology capabilities to enable commercial scale-up is high.

For instance, when we analyzed the energy storage device market to identify the best application and path to market for proprietary powder solution, we mapped various energy storage technologies to their maturity in the value chain (Figure 6). When considering opportunities in the energy storage market, our initial inclination was to go after the lithium-ion battery market due to its size and potential for growth. However, lithium-ion batteries are a well-established technology with well-entrenched players, and the opportunities for technologies in these maturity stages tend to be for high-volume suppliers competing on cost. This value-chain maturity analysis made it clear that our ability to penetrate that market with new technology was limited. Instead, we shifted our focus to ultracapacitors and fuel cells. In some cases, even the ultracapacitor value chain was becoming too established and device makers were prioritizing cost improvements over performance improvement, making it difficult to commercialize performance-improving technologies.

FIGURE 7. The spiral development process

Managing Uncertainty and Driving Investment

One of the main challenges in developing opportunities in areas with high levels of technology and business uncertainty is securing program investment. It is critical to provide a framework that allows key decision makers to prioritize these investments in context of the company's overall opportunity portfolio. In crafting such a framework, we again adopted a main principle of corporate strategy—not to eliminate risk but to increase the odds of success (Martin 2014). To do that, our process 1) focuses on understanding sources of uncertainty and relating the program's progress to the reduction of key risk drivers, 2) quantitatively

TABLE 1. Learning plans for Kennametal's spiral development process

Dimension		Description
User/Market		
Market Assessment	*Market Size*	Estimate the total size of the opportunity space.
	Growth Rate	Estimate the rate of growth of the industry.
	Industry Landscape	Identify customers, competitors, complementors, and other players in the defined market space.
Segmentation		Divide the market into distinct groups defined by distinct needs and target an addressable market space.
Strategic Fit		Define the degree to which the company's resources and capabilities match the opportunity and can be developed to provide a competitive advantage.
Customer Needs		Develop understanding of the functional requirements to meet customer needs.
Technology		
Technology Mapping		Identify technology attributes that correlate with customer needs; define technology solutions that can fulfill customer requirements.
Functional Evaluation		Conduct initial screening of potential technology solutions to determine feasibility.
Model/Prototyping		Build prototype models and test in application environment or simulated test set-up.
Partnering Strategy		Identify and engage with potential external partners, especially owners of critical technology components that could be integrated into the solution.
Commercialization/Go-To-Market Strategy		
Value Proposition		Create statement expressing why a customer would want to buy the product or service, including definition of the job to be done.
Business Model		Define how company would make money, including example list of potential customers and demonstration of how offering can be priced to generate profitable return.
Supply Chain		Identify manufacturing and supply routes to produce proposed solution.
Go-to-Market		Describe how company will bring the solution to the customer.
Organization		
Receiving Business—Transition Plan		Plan for market development, manufacturing capability demonstration, sales force training, and other infrastructure to support new business.
IP Strategy		Consider intellectual property options and issues, including patentability and trade secrets.
Resource Commitment		Describe resource requirements and assets that can be leveraged across the organization to develop and commercialize the proposed solution.
Internal/External Barriers		Identify internal and external commercialization risks.

describes the risk drivers and provides an analytical investment-decision framework, and 3) provides the ability to stage the investment decision.

To focus attention on reducing sources of uncertainty, we have adapted a spiral development model proposed by Gallagher, George, and Kadakia (2006). The model illustrates a process for developing an innovation opportunity that begins with a description of the compelling unmet needs addressed by the opportunity and proceeds along a spiraling, iterative path of interconnected, interdependent technology and business development cycles. At each stage, represented by one revolution along the spiral, learning plans are formulated to address the largest uncertainties in each of four main areas—organization, user/market, commercialization/go-to-market strategy, and technology. We refined the specific categories of uncertainties in each of these areas, creating definitions we found useful for program planning and communication (Figure 7), and developed detailed learning plans in each area (Table 1). As opposed to the linear Stage-Gate processes (Cooper 1990) frequently used to manage core programs, the spiral approach focuses on defining and addressing key uncertainties and allows for course adjustments based on market feedback or other factors identified in the learning plans.

To provide a quantitative view of program value before it is possible to develop a solid business case, we have adopted a future P&L modeling approach that quantifies the key risk drivers and models total variability in the expected net present value (NPV) of the program at each stage using Monte-Carlo simulations or similar methods. The key assumptions

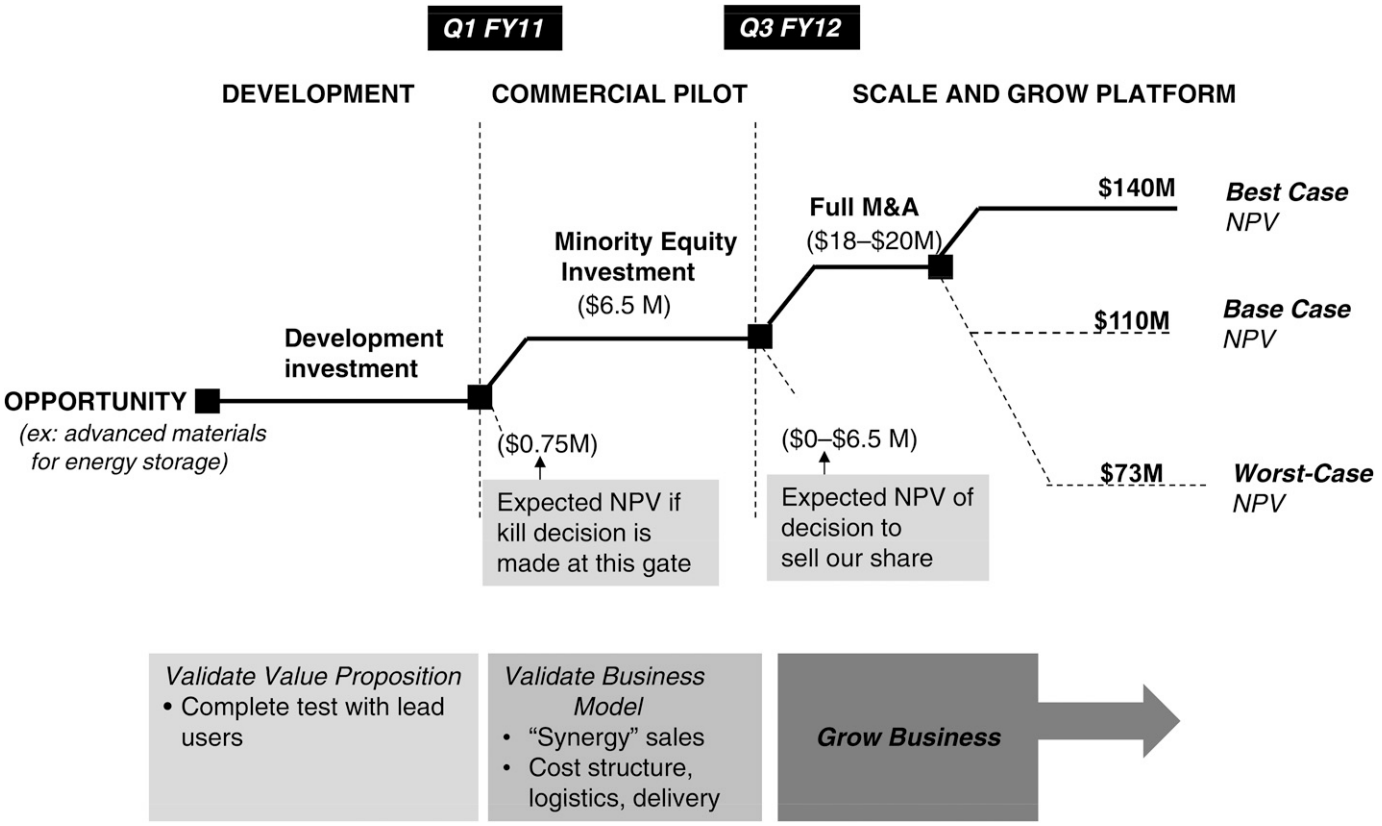

FIGURE 8. Real options decision tree

in the model (such as market size, penetration rate, manufacturing cost, and sales price, as well as capital expenditure and operational expenses) are directly tied to the uncertainties identified in the learning plans, and the output shows the sensitivity of the NPV to the key variables.

In presenting these analyses, we make it clear that the forecasts are based only on what we know at the time—and valid only within the bounds of that knowledge—and that they will be refined and adjusted as new information is gathered. This structure helps us communicate program risks in a quantitative way and relates them meaningfully to the probability of commercial success. We have found that this approach drives focus on the relationship between program activities and business case inputs.

The idea of asymmetric risk—where upside and downside are far mismatched—is another useful concept in making investment recommendations. Considered in parallel with optionality, which provides the ability to stage investment decisions, the idea of asymmetric risk can significantly reduce organizational barriers to approving high-uncertainty investments. To integrate this concept into our financial models, we have adopted a real options framework. Real options is a financial term for alternatives or choices that become available with an investment opportunity based on business conditions that arise during life of the investment. This approach is based on the idea that an investment in a new technology or business opportunity is not a single-stage decision, but rather a sequential investment in real options (Bowman and Hurry 1993; Sanchez 1993; Dixit and Pindyck 1994; Mitchell and Hamilton 2007; Mathews 2010; Mathews 2011). An initial investment is typically required to enable the opportunity to be further explored, thus creating a real option.

As the development program unfolds, additional investments can be made in the original concept, or new knowledge may lead to alternative opportunities, or the program can be stopped if it appears the opportunity will not yield the desired returns. The choices at each decision point can be presented as a two-dimensional, three-factor decision tree that depicts the investment required for the next stage, the potential the investment can lead to, and the loss that will occur should the program stop after the next stage (Figure 8). This approach provides structure in decision making and helps frame the uncertainty and risk in a more constructive way—as something to be exploited rather than avoided.

Conclusion

The IVG at Kennametal, although relatively young, has successfully transitioned several programs from conceptualization to commercialization in areas as diverse as digital intelligence, advanced materials, and emerging manufacturing technologies. Investment in these new initiatives has increased substantially, with a few major platforms advancing into the early commercial stage. These new-to-the-company programs offer 20–100 times the revenue potential of typical new product development projects in the core. The total value of IVG's pipeline has been built over the last six years to about one-third of the total R&D pipeline in the core. One other significant outcome is the establishment of

Kennametal's Innovation Lab, a 2,800-square-foot space housing pilot-scale equipment to develop and mature strategic external technologies identified through IVG's opportunity identification process.

The IVG approach to opportunity creation relies on the integration of emerging technology with a company's inherent capabilities. We believe this merging of emerging external technology and internal competencies to address critical market needs produces differentiated offerings. Whether the process of discovery begins with market needs or technology, what's important is to develop a systematic and parallel understanding of market and technology trends connected to an analysis of the value-chain dynamics to pinpoint opportunity areas that can be addressed by the company's specific capabilities, augmented by strategic technology partnerships.

Securing internal investment in promising technologies requires that the technology be articulated as a business opportunity; a decision-making framework that shifts the focus from risk to opportunity can help stakeholders see the value of the opportunity. An oversight structure with senior leadership that provides expertise and decision-making authority to support these high-uncertainty, longer-term investments is also critical.

Innovating outside the core is a challenging proposition. Established companies can take advantage of their knowledge depth and technology infrastructure to penetrate evolving market areas and compete successfully against more agile startup companies. We found that success requires a broad set of technology and business skills from dedicated cross-functional teams employing the right set of tools. We believe that the application of our approach will help other innovation professionals improve their odds of success outside the core by creating a structure for considering new- and adjacent-space initiatives.

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