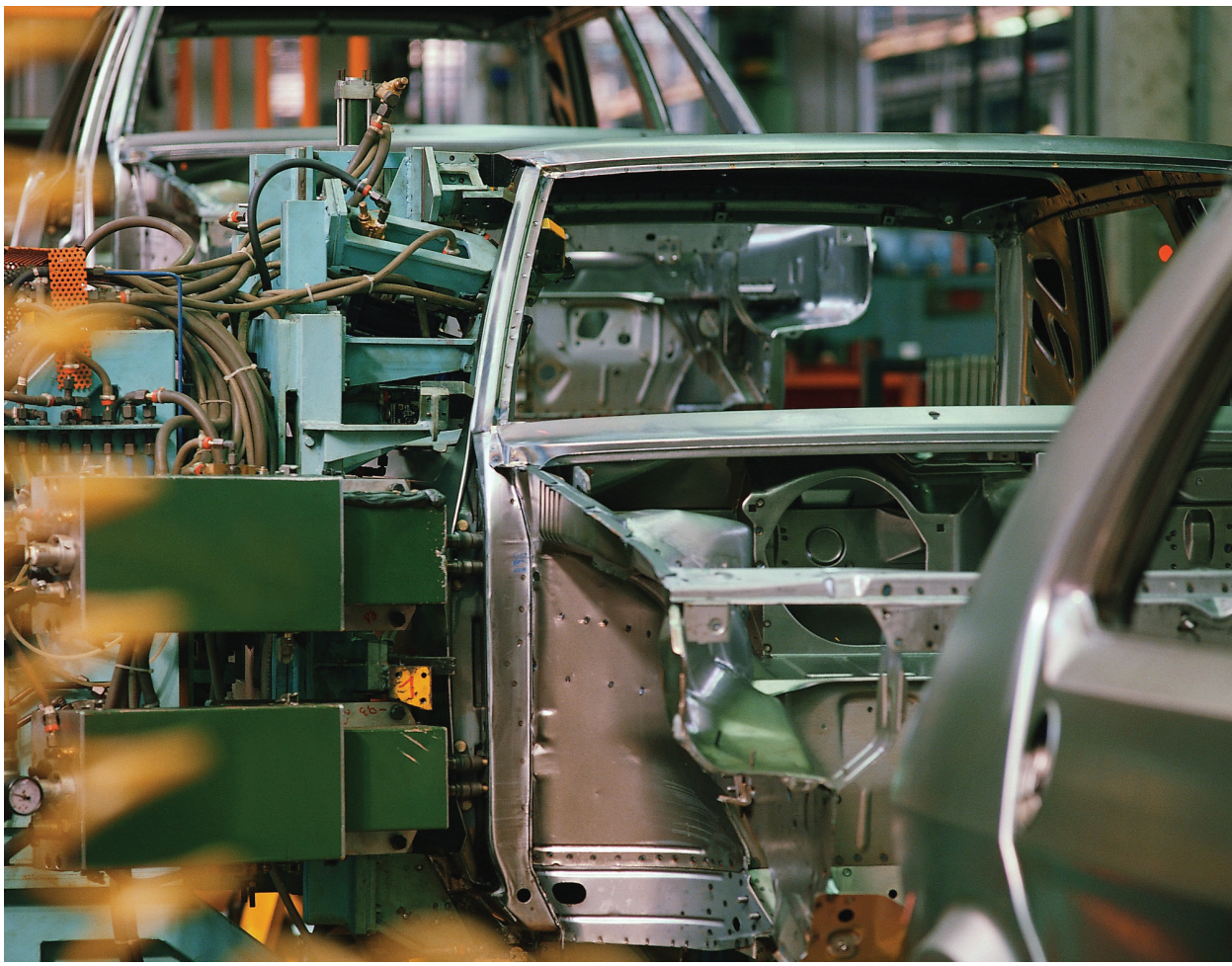
Metals companies can be great at innovation but they'll need to get better to keep up with future competition from within the sector - and beyond. In this report we review the industry's track record and look at how metals companies can improve their innovation efforts.

Pressing on the accelerator:
taking metals innovation to the next level



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Introduction

Innovation in metals is at the core of many of the changes that are shaping life today. New 'liquid metal' high tech alloys are set to make the next generation of phones lighter and stronger. Stronger, thinner and lighter metals are at the heart of modern car and engine design. And metals such as platinum and palladium are well known for their pollution-busting capabilities in catalytic converters.

It's not difficult to see that innovation in metals is core to much of modern progress and change. But innovation is not typically linked to metals. Instead, the industry is often wrongly characterised as little-changed from an older industrial era. That's not to say it isn't still grappling with the legacy of previous periods of development. Problems such as overcapacity, upstream integration and the high underlying operational cost structures that come from aging assets continue to cloud the sector.

These challenges make innovation all the more important for metals companies. New mill construction will raise the bar even further for companies over-dependent on older manufacturing assets. In *'Pressing on the accelerator'* we show how, despite its stereotyped image, the metals sector already has a strong innovation track record. But because this is not so widely recognised, it faces a competitive disadvantage in competing for the skills and talent that will be important for future innovation. And metals companies will need to continue to step up their innovation to compete with the claims of rival materials for next generation design in sectors such as aviation.

We look at how metals companies are delivering innovation and how they can take it to the next level. We look at why radical and breakthrough innovation needs to go hand in hand with incremental innovation if companies are to meet the challenges of the next decade. And we consider the different paths that can be followed to make innovation happen and the role of senior managers in making sure it gets done.

Jim Forbes
Global Metals Leader

Metals innovation - myth and reality

Most people think of the metals industry as a dirty, labour-intensive, relatively low-tech industry. The metals industry isn't generally seen as a significant innovator. That matters. For example, negative perceptions of the sector have a profound impact on recruiting. In 2011, not one of the top 50 most attractive employers for engineers was a metals company.[1] Companies from the technology industry dominate the listings.

But not every company in the top 10 is a hip high tech player. Automaker BMW was number 4 on the list, and industrial conglomerates General Electric and Siemens both made the top 10. Strong reputations for innovation are one reason why these companies are so popular with job-seekers.

Why are other manufacturing sectors seen as innovative, while metals' image is stuck in the past? The answer may lie in part in metals' position in the value chain. As a raw material for many products, improvements in the strength and durability of metals just aren't visible to the general public. So when people think of metals they are still more likely to picture smokestacks rather than innovations such as advances in vehicle 'lightweighting' that are improving transportation fuel economy and reducing greenhouse gas emissions.

In reality the industry has made a whole range of significant breakthroughs over the past two decades. Production methods and product design have changed radically. Downstream, the industry's key customers need higher-performing metals to help improve products, while upstream the need to reduce the industry's environmental footprint, as well as secure reliable, low-cost energy sources, has driven a range of significant improvements in the production process.

We think that addressing the perception gap is a key task for metals executives. Some companies are already actively promoting their innovation activities (see '*Spreading the word*'), and industry organisations like worldsteel are doing their part as well. But there's still a very long way to go. Metals companies need to take their share of the credit for today's technological advances.

1 "Google is the world's most attractive employer," Universum (29 September 2011), http://www.universumglobal.com/IDEAL-Employer-Rankings/Global-Top-50

Spreading the word

Retail and consumer companies are aggressively using internet channels, including social media, to reach consumers. Does that approach make sense for a heavy industry like steel? It just might. Voestalpine AG is actively using social media to promote the company as an innovation leader. The company is present on Facebook, Youtube and Twitter, as well as Xing and LinkedIn.[2] They've also revamped the company website and maintain a blog, focused on innovation. The industry is taking note. Worldsteel presented the company with two 'steelies' in 2011: one for the best website, the other direct to CEO Wolfgang Eder as 'best steel communicator.' The bigger reward, though, is recognition in their local market. Austrian business magazine TopGewinn ranked voestalpine AG second in Austria in terms of the company's overall image with managers.[3]

2 Andreas Koster "Voestalpine AG zeigt best practices in social media," Online Investor Relations (5 September 2011), http://www.online-investorrelations.de/2011/09/05/voestalpine-ag-zeigt-best-practice-in-der-social-media-nutzung/

3 "Image ranking 2011: die beste Firmen Österreichs," Top-Gewinn (August 2011), http://saubermacher.at/web/at/aktuelles/2011/ImageRankingGewinn.pdf

Delivering today's innovation

It's nearly impossible to imagine modern life without the use of metals. Cars, trucks, airplanes, appliances, buildings, even cell phones and computers – they all rely on metal. Steel and aluminium are the most widely used, but lithium and copper are also important to many modern alloys and for use in electronics and batteries. Without advances in metallurgy, mobile phones and electric vehicles alike simply wouldn't be possible. Other precious and rare metals are vital commodities too.

Automakers have a much stronger reputation for innovation than metals companies do. But consider this: much of the 'lightweighting' of the automotive industry owes a major debt to improvements in material composition that are actually driven by the metals industry.

Innovative alloys

Take steel. In the past, parts for cars were only made using cold stamping. But hot forming special manganese-boron steels can create components that are much stronger – so parts can be made thinner and lighter and/or without additional reinforcements. That can translate into a weight reduction of up to 30%.

The technique initially could only be used to create parts with the same strength throughout. That limited its application, since some parts need to be able to absorb energy in a crash, for example. ThyssenKrupp has patented a 'tailored tempering' flexible heating process to get around the problem.[4] The finished steel piece can have different properties within one body panel.

In Austria, voestalpine AG has also been ramping up innovation efforts using hot-forming. The company recently announced a new line of press-hardened steel that will also help automakers reduce vehicle weight; interest is so great that the company expects to double its turnover in the automotive sector over the next few years.[5]

These are just two of the many examples of how steelmakers are reducing the weight of automotive components. The world's largest steelmaker, ArcelorMittal, has summarised the benefits of a number of these strategies in its 'S-in motion' project. The company estimates that by using advanced high strength steels, hot stamping technology, laser welded blanks and tubular products, auto-makers can reduce the weight of a modern five-door C-segment vehicle 'body-in-white' and chassis by up to 19%.[6] That should help the sector fight off challenges from lightweight materials like carbon fibre composites.

4 Research in Germany website, "ThyssenKrupp Steel Europe: Breakthrough for tailored tempering," (28 June 2010), http://www.research-in-germany.de/news-archive-2010/news-archive-june-2010/48838/2010-06-28-thyssenkrupp-steel-europe-breakthrough-for-tailored-tempering,sourcePageId=65560.html

5 "Voestalpine on the fast track with future oriented phs-ultraform product," (1 March 2012), http://www.voestalpine.com/group/en/press/press-releases/2012-03-02-voestalpine-on-the-fast-track-with-future-oriented-phs-ultraform-product.html

6 ArcelorMittal company website, "Lighter, stronger steel," http://www.arcelormittal.com/corp/news-and-media/our-stories/s102-automotive-sinmotion

30%

Estimated weight savings in steel automotive parts made using hot-forming processes

In the aerospace sector, where weight plays an even greater role, aluminium makers faced a major blow when the new generation of widebody aircraft vastly increased the use of composites in the airframe. That spurred them to ramp up efforts to capture a larger share of the airframe in the next generation of single body planes. The advances are impressive. In 2011 Alcoa introduced their third generation of aluminium-lithium alloys. According to the company, the new materials offer a 10% weight savings over composite-intensive airframes and also reduce skin friction drag.[7] That means significant fuel savings – and maintenance costs are lower too.

New ways to use raw materials

Production technology is also much more efficient than it was ten or twenty years ago. Raw materials are one area of emphasis. In the US, Carbonyx has developed a new carbon alloy to substitute for coke in the steelmaking process. The new material is more environmentally friendly to produce and steelmakers like US Steel are licensing the process.

On the other side of the globe, Korea's POSCO has developed the FINEX® iron-making process, together with Siemens VAI. Already in commercial use, the system produces direct reduced iron (DRI) directly from iron ore fines (powdered ore which is cheaper than other forms) and non-coking coal (a less expensive grade). Because the method eliminates one stage of raw material processing, plants are cheaper to build. Using less expensive raw materials saves on ongoing production costs, and the FINEX® process also reduces emissions.[8]

Making the best of lower-quality raw material is an issue for Indian steelmakers too. Many are also processing steel using DRI; according to worldsteel around 37% of the world's DRI is produced there.[9]

DRI is one area where innovation coming out of another sector has the potential to radically change the metals landscape. New techniques for mining natural gas (especially hydraulic fracturing or 'fracking') have opened up vast new shale gas reserves in the US, although some groups have raised environmental concerns. Other regions are taking note.

In April 2012 the UK approved the resumption of shale gas exploration in northern England.[10] And Poland's government is funding shale gas exploration in the hopes of reducing dependence on expensive natural gas from Russia.[11] If the process proves environmentally sustainable, there's huge potential to ramp up the use of DRI in a number of steel-producing countries. Of course, steelmaking isn't the only energy intensive industry, so natural gas rich countries will still need to balance the needs of a variety of sectors.

7 Jon Ostrower, "Alcoa unveils 3rd generation of lithium alloys," Flight Global (10 June 2011), http://www.flightglobal.com/news/articles/alcoa-unveils-3rd-generation-aluminium-lithium-alloys-and-357829/

8 Posco company website, "Finex Technology," http://www.posco.com/homepage/docs/eng2/html/company/product/s91c5010010c.jsp and Siemens VAI website, "Environmentally safe ironmaking," http://www.industry.siemens.com/industrysolutions/metals-mining/en/metals/ironmaking/finex/Pages/home.aspx

9 "World steel in figures 2012" worldsteel.org, http://worldsteel.org/dms/internetDocumentList/bookshop/WSIF_2012/document/World%20Steel%20in%20Figures%202012.pdf

10 "Fracking Europe," Wall Street Journal Europe (19 April 2012), http://online.wsj.com/article/SB10001424052702304432704577349953765053154.html

11 "Polish fracking well shows no harm to the environment," Reuters (2 March 2012), http://www.reuters.com/article/2012/03/02/us-poland-shale-idUSTRE8210KX20120302

Using waste heat and byproduct gases

What comes out of the steelmaking process is just as important to overall environmental impact as what goes in. That's why areas like waste heat recovery and byproduct gas recovery are so critical. Steelmakers in Japan have made particularly impressive advances. In 2008 the Japanese steel industry ranked first in the world for energy efficiency. Just one example: Nippon Steel now recovers 100% of byproduct gases and also captures most of the waste heat from the steelmaking process.[12] The company generates 89% of their electricity needs in-house – about 83% of the in-house generation comes from their byproduct gas and waste heat recovery effort.[13] Research in Japan continues, with much of it under the 'COURSE 50' banner of the Japan Iron and Steel Federation, a collective project to reduce the industry's CO2 emissions through the development of innovative technology.

Waste heat recovery isn't only relevant for the steel industry. The aluminium industry is working on the technology too. It's not easy, though. Waste heat lost during the aluminium smelting process is of high temperature. Heat in exhaust gases is easiest to access, but the high temperatures create increased thermal stresses on heat exchange materials.[14] There's more chemical activity and corrosion in the emissions too, which can seriously damage equipment.

One solution is to install heat exchangers at a relatively late point in the process, when exhaust gas has already been partially cleaned, and is lower in temperature. In fact, Norwegian local communities around the Hydro smelters in Høyanger and Sunndaløra have been benefiting from this approach.[15] The recovered heat is then used in space and district heating schemes.

12 "Nippon Steel Sustainability Report 2011," http://www.nsc.co.jp/en/eco/report/pdf/english_2011.pdf

13 Ibid.

14 "Waste Heat Recovery: Technology and Opportunities in U.S. Industry," U.S. Department of Energy/BCS Incorporated (March 2008), http://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/waste_heat_recovery.pdf

15 Martin Fleer, "Heat recovery from the exhaust gas of alumium reduction cells," Master's thesis, Reykjavík Energy Graduate School of Sustainable Systems (January 2010), http://en.ru.is/media/reyst/Martin_Fleer.pdf

Working together

For both steel and aluminium companies, collaboration is a must. Industry-wide research projects are important, but so is working together across industry sectors. Some metals companies are partnering with chemical companies to develop sophisticated surface treatments and paints that improve durability or water resistance.

Metals companies are also working closely together with customers. Both steel and aluminium companies have long had close relationships with companies in a number of industries, including the automotive and aerospace sectors. Today that means intensive co-development efforts.

One well-known example is the collaboration between Audi and Alcoa around the automaker's A8 series. The Audi A8 spaceframe, the first mass-market aluminium car chassis, was jointly developed by Audi and Alcoa back in the late 90's. It employed 40 new patents, a number of new alloys, and several new design and production techniques.[16] Alcoa even built a new plant in Soest, Germany, to produce the new spaceframes for Audi. The cooperation has continued with updates to the series.

Alcoa is also working closely with the aerospace industry, for example developing specific fasteners for the Boeing 787 and the Airbus 350 aircraft to integrate the function of lightning strike management with the structural fastening of the airframe.[17] The company is going further, looking at other fastener innovations, like fasteners that can detect cracks in composites.[18]

Steel, aluminium and newer composites are often used together, but their different properties create engineering challenges. In February 2012, Rio Tinto Alcan announced a new research partnership aimed at developing innovative solutions and technologies in the field of aluminium joining and multi-material combinations.[19] The project will help give small and medium-sized companies access to the technologies needed to work with new material mixes.

Steelmakers are continuing efforts to work together with automotive customers too. As we've noted, new advanced high strength steels can cut the structural weight of a vehicle up to 25%.[20] Often that means working directly with an automotive customer to develop exactly the right steel for a particular component. Demand is booming. In the US, Severstal has commissioned a new plant to produce advanced high strength steel, based on expectations for soaring local demand.[21]

83%

of in-house power generation at Nippon Steel comes from byproduct gas and waste heat recovery efforts

16 "Aluminum-intensive Audi A8 Team Honored as European Inventors of the Year," http://www.alcoa.com/car_truck/en/news/releases/audi_a8.asp

17 Alcoa Annual Report 2011, http://www.alcoa.com/global/en/investment/pdfs/2011_Annual_Report.pdf

18 Doug Smock, "New fastener doubles as crack sensor," Design News blog, (30 March 2011), http://www.designnews.com/author.asp?section_id=1386&doc_id=230340&dfpPParams=ind_183,aid_230340&dfpLayout=blog

19 "Rio Tinto Alcan establishing Consortium de recherche et d'innovation en assemblage léger to stimulate Quebec's aluminium transformation industry," (17. February 2012), http://www.newswire.ca/en/story/923451/rio-tinto-alcan-establishing-consortium-de-recherche-et-d-innovation-en-assemblage-leger-to-stimulate-quebec-s-aluminium-transformation-industry

20 Jonathan Katz, "Steel Industry Faces Weighty Ultimatum," Industry Week (14 September 2011), http://www.industryweek.com/articles/steel_industry_faces_weighty_ultimatum_25532.aspx?Page=1

21 J. Patrick Pepper, "Severstal forges future steel at Dearnborn plant," Press & Guide (10 January 2012), http://www.pressandguide.com/articles/2012/01/10//news/doc4f0c91a7ddf3e287394294.txt?viewmode=default

Stepping up the emphasis on innovation

Innovation will continue to be critical to maintaining competitiveness for metals companies and their customers alike. Products will have to get better. Metals CEOs are mindful of the need to continue to improve processes and ramp up current innovation efforts. In 2012, nearly three out of four metals CEOs told us they plan to change their company's R&D and innovation capacity, and 23% intend to make 'major' changes. They're putting the most emphasis on increasing their efforts around process improvement (see Figure 1).

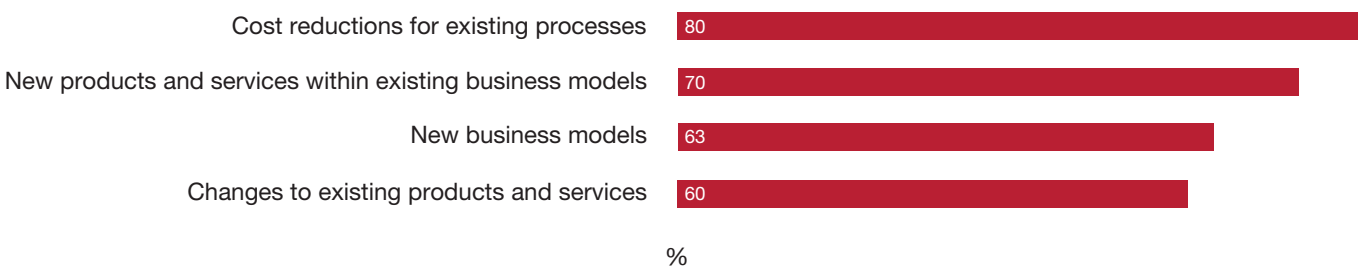
This focus on innovation is seen as highly important for industry success. In 2011, more than three-quarters of metals CEOs said they expected revenues to increase based on innovation, and even more – 86% – anticipated increases in efficiency.[22] Their customers expect them to lead such efforts – 71% of automotive CEOs and 55% of engineering & construction CEOs in the same survey said that businesses will look more to their suppliers for process innovation.

So metals CEOs will need to work together with customers not only to develop the next generation of products, but also to find more efficient ways to manufacture them.

While somewhat fewer metals CEOs placed their focus on new business models or improving existing products, in our view both areas will need increased attention too. In fact, the current emphasis on improving processes may lend itself particularly well to developing business models based on marketing these types of innovation, independently or together with development partners such as equipment manufacturers. We believe that truly radical change happens when technology breakthroughs are combined with business model innovation.

Figure 1: Metals CEOs are ramping up innovation efforts

Q: To what degree are you changing the emphasis of your company's overall innovation portfolio in the following areas?



Base: All metals respondents (40)
Source: PwC 15th Annual Global CEO Survey
Note: Respondents who stated the emphasis increased 'somewhat' or 'significantly'

22 PwC, 14th Annual Global CEO Survey, 2011

Making tomorrow's innovation happen

How can metals companies make sure they are up to the task of delivering the next generation of advances? Can innovation be disciplined without killing it? We believe the answer is yes, if companies implement innovation as an end-to-end, 'idea-to-cash' process using an idea management system and systematise support for problem solving.[23]

Edison's light bulb and Google Search–many people would describe these hallmark inventions as examples of rare talent in action or the products of uniquely innovative companies. But is rare insight only the domain of the extremely brilliant? Is radical innovation conceived in a single, stunning act of invention and delivered as an entirely new offering? No. Innovation is a process. It is a process that taps into genius, but it need not be the accidental province of the madly brilliant, as these hallmark inventions illustrate.

Even some of the most celebrated inventions don't quite fit the eureka moment stereotype. For example, a disciplined problem solving process in materials science led to the light bulb. And applying a ranking principle from one domain to another led to more satisfactory web search results.

Problem-solving: core to how innovation happens

A substantial body of research explores how intuitive innovators think and how their thinking patterns can be incorporated in the problem-solving steps that lead to innovation.[24,25] The literature usually refers to this approach as 'structured problem solving.' Two broad themes emerge:

- Problem-solving is core to innovation. Problems are what inspire innovators to look for answers. Problems often surface as tensions–loss of market share, decline in profitability, dissatisfied customers, and others. Natural innovators are good at defining the problems; they often see problems that others do not.
- Almost all innovation involves the application of a known solution to a problem or part of a problem from one domain to a new problem in a different domain.

TRIZ, developed by a Soviet inventor and his colleagues in the 40's, is one such approach. Usually translated in English as 'the theory of inventive problem-solving,' TRIZ emerged from a deep analysis of patents. Identifying and understanding technical contradictions is a core part of the process. Once the contradiction is described, TRIZ practitioners, sometimes aided by sophisticated software, use math and science algorithms to look for creative solutions in other industries.

23 For more information on the 'ideas-to-cash' process, see "Can innovation be disciplined without killing it?" *PwC Technology Forecast 2011, Issue 2 – Uncoding Innovation's DNA*.

24 Robert W. Weisberg, *Creativity: Understanding Innovation in Problem Solving, Science, Invention, and the Arts* (John Wiley & Sons, 2006).

25 Kathleen L. Mosier and Ute M. Fischer, eds., *Informed by Knowledge: Expert Performance in Complex Situations*, (Psychology Press, 2010).

It's an approach already used by some of the metals industry's customers and at least one major steelmaker (see *Using TRIZ at POSCO*).

Just solving problems isn't enough, though. Innovation is an end-to-end process, not an isolated activity. Moving from an idea to cash poses challenges at every stage, and each problem faced is an opportunity to invent a solution that moves the process forward. Discovering and incubating great new ideas are only the first steps. Accelerating and scaling new approaches into cash benefits can take even more resources.

Idea management systems are one tool to help manage the process. They track innovation ideas from discovery, incubation and acceleration through to scaling the idea into commercial use. That helps provide structure and discipline to the innovation process. It also lets companies track metrics to better understand the flow and outcome of their investments.

These kinds of systems can also help drive innovation through all levels of the organisation. We've seen that when employees are involved and have ways to offer constructive suggestions, it can increase innovation happening outside of the R&D function.

Taking the next step

Even if metals companies get much more efficient at incremental innovation, small steps forward won't be enough to meet ambitious goals for energy efficiency and emissions reductions – the industry will have to make more radical breakthroughs. Indeed, in a March 2011 report the US Department of Energy argued that "the US steel industry has almost fully achieved the energy efficiency and carbon emission reductions that can be obtained using today's best available technologies. Additional breakthrough steelmaking technologies and processes will be needed to achieve proposed domestic and global policy goals for energy efficiency and carbon emission reductions."[26]

The industry's already deeply involved a number of projects all around the world. For example, the World Steel Association's CO2 Breakthrough project includes research taking place in the EU, US, Canada, South America, Japan, Korea, China and Taipei and Australia. It's looking to radically alter the steel production process on a number of fronts.

Truly break-through innovations are needed for the aluminium sector too. Aluminium companies are already working on developing a groundbreaking new smelting technique that uses inert anodes instead of coal. When perfected, the process would emit only oxygen. And since the anodes would not need to be replaced as frequently as the coal anodes currently used, it would save the industry money too. In Russia, Rusal is already piloting a version of the technology and aiming to bring it into commercial use by 2015.[27]

Other possibilities are on the horizon. For example, nearly half of the heat lost in the aluminium-making process is actually loss via the sidewalls of the 'cells' where the reaction takes place. Currently, most waste heat recovery efforts are focused on heat lost through exhaust gases, which is easier to access. 'Non-traditional' areas for heat recovery may offer the next frontier.[28]

Incremental innovation won't be enough to meet the metals sector's energy reduction goals. Radical breakthroughs in process engineering will be mandatory over the next decade.

26 "DOE report confirms US Steel Industry Is a World Leader in Energy Efficiency," (22 March 2011) American Iron and Steel Institute, http://www.steel.org/en/sitecore/content/Global/Document%20Types/News/2011/DOE%20Report%20Confirms%20the%20US%20Steel%20Industry%20World%20Leader%20In%20Energy%20Efficiency%20and%20Emissions%20Reductions.aspx

27 Rusal company website "Inert anode technology," http://www.rusal.ru/en/development/innovations/inert_anode.aspx

28 "Waste Heat Recovery: Technology and Opportunities in U.S. Industry," U.S. Department of Energy/BCS Incorporated (March 2008), http://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/waste_heat_recovery.pdf

Using TRIZ at POSCO

POSCO is one of the leading users of TRIZ in Asia. The company's chairman, Joonyan Chung, gave the keynote address at the 2011 Global TRIZ Conference, held in Korea. Chung called TRIZ a "tool that helps you to leap forward to become a true global leader."[29] POSCO's in-house version, PRIZM, is being used in both product development and cost reduction in the production process. To spread the word, POSCO has founded a TRIZ University. When Chung spoke in March 2011, 1800 employees (10%) had completed the course. The technique has already had a major impact. Patents were up more than twofold, while costs were down an estimated $7 million.

More than one path to innovation

Many projects focused on break-through research are broad collaborations across the industry in conjunction with academic institutions and government. And while that may well be the only way to tackle some of the industry's challenges, we believe there is still more potential to foster radical innovation within individual companies.

When does it make sense to ramp up radical innovation in-house? That's always a judgment call. If there is significant potential to patent a truly revolutionary product, that may be one good reason to try and 'go it alone."

It won't be easy. Traditional management techniques lend themselves better to incremental innovation, which is easier to measure and where return on investment is more predictable. So in some cases completely new approaches are necessary. These might include creating a separate organisation to pursue some types of innovation, as Kennametal is doing (see *Ramping up innovation downstream,* next page).

29 "TRIZ is the core tool to realise POSCO 3.0," (18 March 2011), http://www.posco.co.kr/homepage/docs/eng2/jsp/prcenter/news/s91c1010025v.jsp?idx=1688

Ramping up innovation downstream

In 2011 Kennametal was named Corporate Innovator of the Year by the Product Development & Management Association (PDMA). Kennametal's business is split between metal-working solutions and advanced materials. In the early 2000's, Kennametal made a decision to aim for 40% of annual revenues from new products each year.[30] The company's structured approach divides innovation into three types: improvements to the core business, scaling of growth business, and emerging opportunities. Executive involvement happens early in their 'stage gate' process and continues through the post-launch review. Kennametal also believe one size does not fit all. The company's 'Innovation Ventures Group' specifically targets emerging business opportunities. The more flexible structure of the IVG enables a 'Probe & Learn' approach.

30 George W. Coulston, "Kennametal's Innovation Journey," (17 November 2011) http://www.pdma.org/uploaded_images/chapters/Cincinnati/George%20Coulston%20Kennametal%20Innovation%20Journey.pdf

For many companies, the best option may be to develop an incubator.[31] Today's incubators function as integral units of the parent company, rather than as independent think tanks. As such, they focus on developing product concepts and business models considered core to corporate strategic goals. They also have full access to corporate assets and competencies.

And while their primary goal needs to be significant profitable revenue growth, they do require some organisational freedom. It's important to isolate them from bureaucracy and quarterly profit and loss concerns. At the same time, contact with the rest of the business is important, to make sure that concepts are truly commercially viable.

We think it makes sense to design incubators to deliver breakthrough change in both technology and business models, to increase the potential for robust growth. Companies should also consider making incubators responsible for commercialising winning concepts and generating the initial revenues. That helps keeps them focused and accountable.

In our view, executives who want both incremental and radical innovation should consider creating two innovation processes to realise the potential of both. Radical breakthroughs may evolve incrementally but are more likely if they are a goal in their own right. At the least, companies need a clear way of identifying ideas and products that have the potential to disrupt an entire industry and ensure they are prioritised.

Management's role in making it happen

The tension between radical and incremental innovation is just one of several tensions innovation generates. That's good, for tension is the energy that powers the innovation process. But that energy needs to be harnessed by a process that applies the right type of discipline and the right type of measures.

Company culture will be important too. Many metals companies are now global, and the innovation process will need to be managed globally. It's also important to build room in the organisation for open mindedness, creativity and questioning. If that's in place, companies will be able to tolerate, manage and even encourage risk-taking, which will inevitably lead to fast, frequent, frugal failures that accelerate learning and innovation.

The onus is on the CEO and the leadership team to lead from the front by integrating innovation in the strategic goals of the business and to hold the members of the senior teams accountable for results both individually and collectively. This will create a culture that instills innovation into the organisation and its employees.

CEOs set the tone by creating a work environment that is more open to innovation and systematic in its approach. Since good ideas come from many places within the firm's network of relationships, CEOs also need to create the partnerships and alliances that will foster them.

Perhaps the biggest task for metals executives, though, will be overcoming the perception gap and showcasing their companies as innovators. That means using new ways to spread the word about their innovation success. And it means looking to make the innovation process even better.

In the end, the best talent will migrate to those firms that have inspiring goals, along with process, culture, incentives and investment that seeks out exciting innovation-driven growth opportunities. Those firms that attract that talent into a superior innovation culture will win in the global marketplace.

Metals executives need to showcase their companies as innovators, spread the word about their successes, and keep the focus on making the innovation process even better.

31 For more detailed information on incuabators, see our publication "Incubating greater growth," listed under related reading.

Last thoughts

A look at some of the key considerations for metals companies to step up their innovation strategies:

Think about whether you have the right foundation in place. That means making sure innovation is connected to your markets.

Do you have strong processes for identifying and defining problems in your customers' markets and using that as the basis for problem solving and innovation?

Don't let innovation stop at technological development. Innovation in the business model, in customer and supply chain processes and in communication all have potential for maximising impact.

Can you develop a technological breakthrough into a radical new business model?

Look at ways of intensifying co-development efforts. Work together with customers, supply chain partners, companies from other industry sectors.

Are there areas that were previously thought of as off-limits that could now be fruitful?

Participate in cross-industry research projects, but look at your in-house capabilities too. There are a lot of areas where pooling efforts is critical, but sometimes your own research team may be on the right track.

Do you know when it makes sense to 'go it alone' rather than collaborate?

Don't be afraid to push your organisation to deliver breakthrough innovation. But make sure you have the systems in place to support it.

Are you identifying the projects that require a different type of organisational model rather than traditional in-house management techniques?

Manage innovation all the way through the pipeline. Remember, rolling out a new breakthrough can take as much effort as developing it.

Do you have the right ideas management or other systems to accelerate and track ideas through scale-up to commercial use?

Make innovation an integral part of the company culture. It's important to strike a balance between structure and creativity, and to learn from set-backs as well as successes.

Are you creating room in the organisation for open mindedness, creativity and questioning?

Set the tone from the top. Start with the entire C-Suite – but don't stop there. Innovation needs to be part of the whole organisation, not just happening in an R&D silo.

Is the leadership team taking the lead and integrating innovation into strategic goals and processes?

Make sure your innovation track record and ambitions are well recognised. A strong reputation for innovation is important in attracting tomorrow's talent as well as today's orders.

Are you looking at new channels like social media?

How PwC can help

We have deep experience in helping companies innovate better. That means developing the right products or services, or improving key processes, at the right time, cost and quality, underpinned by the right systems and methodologies.

Innovation Strategy

Your vision and how to get there

For every business, the path to success starts with the business strategy and goals–the vision of where the company wants to go and how it will get there. The business strategy and goals define the role innovation will play and set the context for the innovation strategy and its execution. Increasingly, companies are looking to hone their innovation strategies to ensure they drive profitable growth.

Innovation strategy answers three key questions:

How much innovation do you need? Define how much innovation needs to be delivered–and when–in order to achieve the business objectives.

Where do you focus your innovation efforts? Specify the focus areas and relative investments in innovation types–incremental, breakthrough, and radical.

What type of innovation do you need? Communicate to everyone in the organisation what is in bounds to keep efforts focused where they bring the most value.

We help you devise the right innovation strategy to signal to the organisation the importance of innovation, the way it should be managed, and the expected outcomes. That includes balancing different types of innovation and refining organisational structures as needed.

Operational models

Designing and organising the growth engine

The operational model–which includes resources, assets, governance, culture, and partnership approach–is pivotal for translating strategy into execution. The more complex the technologies and business models under development, the more robust the required innovation operational model.

We can help you develop an innovative culture, from defining your vision through enabling change. That includes making sure change is 'leader-led' and that roles, responsibilities, metrics and incentives are clear and constructive.

Metals companies are increasingly global and need to operate accordingly. As the R&D and innovation footprint extends across countries, continents, and enterprises, the complexity of operations often overwhelms traditional management systems, resulting in slower time to market and lost revenues. We can help you manage internal and external product and service development resources so you can deliver successful offerings again and again.

We can also help you tap into customer-centric design and development, or design business incubators to rev up breakthrough innovation.

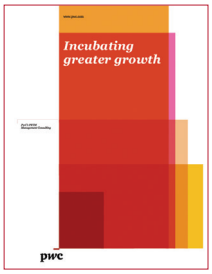
Execution

Making it happen

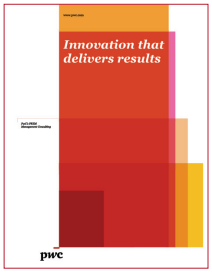
Now that you've got the strategy and operational structures in place, you need to get the most out of them. We can help you increase the productivity and efficiency of your R&D process, with idea management, technology management and project excellence tools. We can help you get new products to market quicker and manage your resources and portfolio. We'll work with you on product lifecycle management to get the most out of innovations over the long term. Our product innovation maturity model can help you benchmark where you are, and plan how to get to the next level.

And because partnering is critical, we can help with ecosystem and partner management too.

Related reading



Incubating greater growth



Innovation that delivers results

Demystifying innovation:
Take down the barriers to new growth

View
"Striking the innovation balance:
Seeking value in a radically changing world"
June 2011

Technology Forecast:
Decoding Innovation's DNA
Spring 2011

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Innovation

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