

The Management of Creativity & Innovation

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The Management of Creativity & Innovation

Abstract

Industry has made some significant improvements in the management of creativity and innovation over the last decade but there are problems in the overall process that still persist. We might assume that on investigation we could expose either a single factor or a small number of key processes which will allow us to resolve this problem, but there are a great many factors and many are sector specific.

In this paper we focus on the area of Information and Communication Technology (ICT), however we have also identified 'generic factors' which can be applied to all business sectors.

We have come to believe that a truly multidisciplinary approach will greatly enhance the way in which creative and innovative teams work and that the adoption of 'open innovation' can both enhance creativity and reduce costs. We also advocate a stronger coupling between research teams and product and service development people as a way to reduce lost opportunities and make better use of business resources.

We have learnt that the way in which an industry player interacts with its academic partners will be key to its success in harnessing creativity, and we have seen that maximum value can be gained from these relationships if it is understood that new knowledge and information are often the most important outputs and that these will result from mutually beneficial areas of research and collaboration.

Collaboration has become increasingly important and we would argue that in the knowledge based industries, with complexity increasing every day, it is now almost impossible to work in isolation.

People are absolutely key to this whole process, how we support them, their motivation and their management cannot be underestimated as it is central to the success of the whole ecosystem.

Communication plays an essential role in the successful execution of these processes; these are complex tasks that involve all parts of an organisation. The language used must be considered, as although it can appear that all in a business or collaboration speak the same 'language', the words used by marketing may well have a different meaning to those used in research.

This paper highlights the issues, drivers and systems which will enable the harnessing of creativity and innovation in a business.

Introduction

'It is nothing short of a miracle that the modern methods of instruction have not yet entirely strangled the holy curiosity of inquiry; for this delicate little plant, aside from stimulation, stands mainly in need of freedom; without this it goes to wreck and ruin without fail. It is a very grave mistake to think that the enjoyment of seeing and searching can be promoted by means of coercion and a sense of duty'

Einstein, 1949

Even back in the middle of the 20th century Einstein worried about creativity and innovation; now as we move into the 21st century we still have major concerns about how we manage these in our industries. This is particularly relevant in today's highly competitive market place where the role of creativity is becoming even more important and in many cases provides a competitive edge in a sector. Many companies are attempting to encourage innovation in their businesses, however they are finding that to do this they must continually increase the skills of their managers of creativity and innovation in order to maintain a market edge. Companies investing in these skills seek to answer questions such as:

- How can we release the creative talent of our people?
- How can we move ideas through our organisations efficiently and bring them to the market place quickly?

In order to answer these questions in industry a first step is to realise that creativity and innovation are not just about developing great new ideas, they are about turning those great ideas into great new products or services that people really need.

It is also important to understand that the management of creativity and innovation are two different skills and successfully linking these two areas requires not only a process but an understanding of the areas. To do this it is essential that marketing, product development, technology foresight, knowledge exchange, project execution, and talent management are all managed in a coherent way.

It has been said that the 'management of creativity and innovation' is an oxymoron, but as this paper demonstrates it is essential that appropriate management techniques be employed.

It is believed that the successful management of all these areas will allow industry to:

- Survive fierce competition by generating breakthrough ideas
- Make the most of innovations
- Manage business within shorter product life cycles
- Deliver greater customer satisfaction
- Integrate product development, process development, and value chain strategy
- Link technology decisions with business strategy

This paper examines the key issues in the management of both creativity and innovation. It looks at the environment within a business and how this can either enhance or constrain creativity. It also explores the role of research in a business and how this, if well managed, can drive both creativity and innovation.

Creativity and Innovation

Creativity

The definition of Creativity from The Oxford English Dictionary is "inventive, imaginative".

Creativity is often said to be 'thinking outside the box'. This assumes breaking out of a traditional way of thinking and taking a completely different view, a process termed 'lateral thinking'. But creativity is more than this; it often involves quite a radical approach supported by prior thought and experience, although depth of experience is not always necessary and too much legacy thinking can constrain really new thinking. Really creative thinkers are often those who ignore criticism and the comment of their peers and forge on regardless, following their idea to its conclusion. The environment surrounding and supporting the creative person or team can have a major impact on the effectiveness of this.

We can best understand the mechanism of creative thought by dividing it into two types:

Visual thinking: the intellectual ability to visualise a totally new situation. Einstein claimed that he had his initial insight into the theory of relativity when he thought about what he 'saw' when he imagined that he was chasing after and matching the speed of a beam of light (Shepard & Cooper, 1973).

Problem Solving: when solving a problem, we are striving for a goal but have no ready means of obtaining it. We must break the goal down into sub-goals and perhaps divide these sub-goals further into smaller sub-goals, until we reach a level that we have the means to obtain (Anderson, 1990).

Innovation

The definition of Innovation from The Oxford English Dictionary is "new methods, new ideas".

Innovation requires at its core thinking about a problem from a new perspective; it often involves taking conventional ideas and turning them around, combining them in different ways and producing a new 'idea' which in itself is 'new' but contains existing and often well known concepts. The key difference between this and creativity is that in Innovation there is no clear new intellectual leap or step change in thinking, it is essentially an incremental change which harnesses existing ideas in a different way.

Innovative thinking requires a particular skill - 'manipulation of visualisation' - the ability to both visualise and manipulate a problem within the mind. This is often referred to as 'taking the helicopter view' or 'standing back from a problem', coupled with the ability to mentally manipulate the problem, view it from a number of 'angles' and to 'zoom in' on various areas (Kosslyn, S. M. 1983).

The Relationship between Creativity and Innovation

Creativity => Screening => Innovation (Majaro, 1997).

There has been a great deal of writing over the last 15 years about the 'innovation pipeline' or 'innovation funnel', all of which advocates a system linking the creative or ideas stage to the innovation stage and then onto new product or service development. These all include some kind of filter that assesses the ideas or research coming from the initial stage and only passes a proportion, which are deemed to be of value, onto the innovation stage.

Industry has a notional target of 1 in 10 for this process, that is of every ten research activities undertaken at least one of them becomes a new product or service. This target is, in practice, rarely achieved and if used as a target can have a negative effect. However this is not the only problem - management of the research or ideas which do not make it through the process is poor, and often some years later when the market place has moved on it is difficult, if not impossible, to resurrect the idea. This is a breakdown in the 'knowledge management' process; see "Knowledge Management" below.

There is generally poor coupling between front-end research people (creativity) and product and service development teams (innovation), generally known as the 'innovation chasm'.

This barrier results in lost opportunities and inefficient use of business resources. We might assume that on investigation we could expose a single factor to resolve this problem but, as is shown later in this paper, there are many factors and most are 'sector specific'.

Management of the pipeline is key to the success of an industry. To do this 'gates' are set up where new ideas or research are assessed and provided with more time or capital if they are to be moved on/progressed, or archived if they are to be stopped. It is often useful to have a third decision point where the research is not fully funded but where sufficient time and support is made available to allow it to continue at a low level, which removes the need to 'skunk' research.

A notable example of 'skunking' was Tim Berners-Lee and his time at CERN creating the World-Wide-Web, which was carried out while managers thought he was doing something else. (see 'Weaving the Web' - 1999). Many researchers believe that a measure of the importance of a piece of new research can be determined by how often it is initially turned down by funding bodies but somehow continues anyway!

It is vitally important to manage and monitor this low-level work, so as to maintain continuity while assessing future market needs. While not advocating a reduction in the control of research effort, management must understand the need to embrace 'risk' and to take thought-through 'gambles'.

The Environment and Creativity

There is a belief that to stimulate creativity and innovation a particular type of environment is required. We would argue that the environment is important but that there is not just one solution. Many highly creative environments exist which, when compared to one another, are completely different. This is because they tend to be specific to the industry or sector in which they exist.

"If you visit Boeing it does not feel like a Silicon Valley start up, there is no one asleep under the desks, there are no dogs, there's no director of dreams and we don't play volley ball on a Friday. There's not a funky, 'can do', exciting, mellow atmosphere. No, in fact it's little bit boring, it's a little bit hierarchical and it's a little bit structured and do you know what, I'm really glad because Boeing makes airplanes and airplanes have been described as a million rivets flying in formation. Now, does it never strike you as amazing that these planes land and take off and land and take off and they do it for 25 years most of them without falling out of the sky and that's not an easy thing to do and I'm glad that the firm that makes them is in fact a little bit proceduralised, a little bit careful and a little bit structured they are that way for a very good reason."
- Rebecca Henderson, MIT Sloan School.

Enabling Creativity

Experience has shown that there are a number of factors that can influence the effectiveness of the work environment or 'ecosystem':

- Intra-team interactions
- Workplace layout
- Project supervision
- Higher-level management support
- Corporate culture
- Group dynamics (interaction between teams and other organisational units)
- External meetings or events
- Ideas management, including ideas storage and indexing

However for creativity to flourish the ecosystem must provide the individual and team with an environment which will both stimulate and support them.

The Seven Elements

Our research has identified seven key elements which make up this ecosystem, all of which are important, some more than others:

- Management Structure
- Incentive system
- Peer interaction (internal and external to the organisation)
- Societal recognition
- Physical environment
- Knowledge system tools
- Social networks.

If individuals and teams believe they have these, then the basic framework of support exists, but this is a belief based on trust.

The key elements of 'management' are expanded below.

Encouraging Creativity

Examining leadership, structure and culture in more detail we see the following as key factors when it comes to facilitating creativity:

- Leadership style - ideally participative, democratic and non-authoritarian.
- The job - should offer the researcher both discretion and autonomy.
- Organisational structure - a non-hierarchical, flat structure with no perceivable boundaries.
- Culture - supportive of risk-taking, open to new ideas and encouraging non-traditional thinking.
- Attitude - flexible, sharing of thoughts and able to work around preconceived ideas.
- Skills - skilled in terms of knowledge, learning, and creativity techniques.
- Value - understanding and valuing employee creativity.

It should not be assumed that a business is easily able to adopt these. Too often a company will give nodding approval to the ideas but will not ensure that the culture really reflects this way of working.

It is also important to consider 'timing', the acceptance or dismissal of a new idea will often be dependant on the where the organisation is in its own development cycle, a great idea introduced at the wrong time can easily be dismissed as having no value – see section 'Managing Disruptive Technology'.

It can be seen from the issues raised that this is a complex area, however it can be reduced to a small number of primary management drivers:

- Corporate support
- An appropriate leadership style and organisational structure
- An understanding of the skills, tools and environment required

Empowerment

"If a team is charged with the responsibility to be creative and/or innovative then they need the authority to see their best ideas implemented - this authority can of course be delegated elsewhere if it is better for a manager or another group to do the implementation - but if the authority to do something is removed then total disillusionment follows soon after".

Professor Mike Payne - Head of the Theory of Condensed Matter (TCM) Group at the Cavendish Laboratory, University of Cambridge

Technology as an enabler

There are a number of technologies which can help in enabling teams and the area of 'Knowledge Management' is discussed in a later section.

In the last two years many organisations, both academic and industrial, have experimented with wireless networks to enable a more flexible way of working. Individuals are able to gather in an ad-hoc manner with their laptops and this can encourage creativity as it reduces barriers both in time and in location. There is good evidence to show that this can be very effective, however this assumes that we have already selected the 'right' people who will flourish in this type of environment.

There are clear benefits both in terms of collaboration and efficiency. However it must be remembered that always on-line means never off-line and some find it very difficult to switch off; this in turn is a management issue which must be considered.

Recruitment and selection

Recruitment into 'Research' is often from Universities at either graduate or postgraduate level, with most industries having processes which combine interviewing and tests.

We have found that graduates who have spent time in industry as part of some kind of internship programme are often the best recruits, mainly because they have a real experience of the working environment and the company has a good understanding of them and how they perform. But it is essential that we understand that the recruitment of 'creative' people is not the same process as for the business as a whole. The competences and skills we need in our best research people are very specialised and the selection of these people is therefore also very specialised.

This will create tension in a business as the numbers of people brought into research will generally be low in comparison with the rest of the company and therefore a special process for these small numbers will often be at odds with 'corporate policy'.

It is essential that a company understands the role of new young research people, that is as the 'life blood' of the company. Mistakes made in selecting these people will have major implications for the future of the business in the years ahead. Our experience has shown us that new very bright young graduates can both add value and bring new thinking remarkably quickly if the ecosystem is right. But this is in itself a form of disruption and if an organisation is not able to embrace this then there will no gain for it or the individual.

Unfortunately, although the initial recruitment is of major importance, it is not the only critical time, this often occurs around two years after recruitment when the person begins to become part of the business. At this point there is a danger of losing the creative spark they had when they joined the company. Large companies can easily 'mould' people into corporate drones without intending to do so. It is essential to monitor young graduates as they develop and to maintain their academic interests via suitable challenges.

Generally there are two ways of identifying creative and innovative people.

The first is to look at their past performance. It is assumed that those with a proven history will have the right approach and therefore will be able to deliver in any situation. This is clearly flawed. As a test it is a good starting point but takes no account of 'potential'.

The second approach is to monitor teams and give those displaying the desired attributes the freedom to develop their ideas. This method relies on good 'screening' and monitoring and can be hit and miss. However its efficiency can be improved by considering the issues raised in "The Environment and Creativity", above.

Our experience has shown that there is no substitute for experience and that schemes such as internships can provide real insight into the suitability of a candidate.

Measuring Creativity

Both Industry and Academia have long struggled with metrics for creativity. The recording of patents and ideas gives some measure but this can provide a false impression. Measurement of outcomes can be far better but the time between idea and successful outcome can be protracted. Alternatively the licensing of patents or ideas can give a more accurate view of the value of the creative process but will never tell the entire story.

However business must be able to place a 'value' on research, there is a cost which is often significant and a measurement of the return on this investment is key to the future viability of the activity. The essential lesson is to measure outcomes.

A pragmatic solution is to measure a number of these:

- Intellectual Property - number of patents produced / licensed.
- Insight - papers/presentations produced either on key business issues or future markets. – things which add to our understanding.
- Business Impact - specific changes in strategy or business models which have resulted from research activities.
- Revenue / Cost Reduction – revenue changes which can be attributed directly in total or in part to research.
- Business Development – the enhancement of new business collaborations through research partnerships.

Business Value

In order to measure the revenue impact of research on a business, it is essential to record all research output in detail and to archive this in a system which has a very high quality search and retrieval mechanism. When a new product or service is successful it will then be possible to trace it back to any original contributing research.

However it is important to note that there may be a considerable time lapse between research and business impact; in the area of ICT this can be between four and six years, this is relatively short in comparison to other sectors but the challenges are the same.

It should also be recognised that a culture shift may be needed for the marketing department of a company to 'recognise' in revenue terms the value of any original research which has contributed to a new product or service.

In our business this is known as the 'innovation dividend' and this represents the 'value' of the research in new revenue and profit.

Organising for Innovation

In Tom Peter's introduction to '*Serious Play*', a book on innovation by Michael Schrage of MIT, he says "Rapid Prototyping is the cornerstone, the cultural fountainhead of the innovative enterprise".

New software tools have become available in the last five years that allow ideas to be visualised quickly. This visualisation of concepts and ideas is key to moving them forward.

In the past, ideas would be 'story boarded' for a client or customer, but these were by their very nature fixed and there was little possibility for interaction. At best the client for a new product or service would comment on the ideas and these comments would be added to a new draft.

With modern visualisation tools the client and end customer can interact with the model and changes can be made very quickly. This is especially so in the case of new technology products and services, where a model containing new ideas and concepts can be 'mocked-up' and then tried by the customer or client in a way which is very close to using a full prototype but without the costs or development time. This type of rapid prototyping allows many areas of the business and its customers to become involved in the early stages of the development of new products and services. It eliminates errors which occurred in the traditional requirement-capture processes, where it was found that early prototypes rarely reflected the product team's original vision.

Clearly identifying a model for a new product or service quickly allows the development team time to use creative and innovative solutions within the confines of the model framework.

This seems to place story-boarding as the poor relation of rapid prototyping - that is, of course, an over simplification. Prototyping can be used to demonstrate technical feasibility, whereas storyboarding can be used to postulate a wide range of scenarios. Rapid iterative prototyping allows rapid convergence on the intersection of customer desires and technical realities.

Collaboration

In the ICT sector it is almost impossible for any one company to do all of the research it needs and hence the need for collaborations with both Academia and industry. But this is not the whole story.

In the US we have worked for many years within 'consortia' where a number of companies jointly sponsor areas of pre-competitive research. This has a number of benefits:

- Research is discussed with consortia partners who bring an alternative and often enlightening point of view.
- The research teams have a rich and varied interaction which can lead them in directions they may not have considered.
- Research outputs can be 'tested' with a group of players rather than a single client.
- Individual companies meet with other sponsors as well as the research teams which again leads to a far richer interaction.
- Research costs are shared, which generally leads to larger projects which are of more value to the sponsors.

However, this model will only be successful if the sponsors are open to collaboration with one another as well as the research teams, and the best results tend to be when an open innovation policy is adopted.

There are examples of the success of this model in a closed environment (that is when the information is not shared outside of the sponsor). However, in an academic collaboration this can be a difficult model to maintain as the researchers generally need to publish their work and, unless the sponsors meet all of the costs of the work, the academic institution will generally own the output.

If the research is kept at the 'pre-competitive' stage of development then collaboration around a single or group of Universities has been shown to be very successful and this model is now being used much more widely.

Networks

The area of information and communications technology (ICT) is now so broad that no one person can be a domain expert. Therefore in order to develop new business solutions in this highly complex area it is essential to work as part of a network of experts. This model of 'pooling' creativity is not new and has been one of the 'tools' academics have used for some time to solve complex problems.

Web 2.0 tools

With the advent of new Internet applications, such as wikis, blogs and social networks, communities of researchers are able to work together, irrespective of their location.

A number of large multinational organisations are deploying 'on-line social networks' for their employees to use with the objective of enabling the 'chat around the water fountain' to take place when people are thousands of miles apart. Using these social networks together with corporate wikis and blogs can allow people to share knowledge and information in a simple and easy way.

Trust is of course key in these interactions and our research suggests that this trust must be built up in face to face meetings where the participants can read the non-verbal signs, before on-line interactions can take place successfully.

We have seen that networks can successfully exist within organisations and between organisations. Researchers in a business network with their colleagues within the business and also with academic partners outside it. However participants need to understand clearly what can be shared and what may be 'commercially sensitive' within their respective organisations and it should not be assumed that all will be aware of the 'institutional policy' on this.

It is our experience that when these networks work well they are able to greatly enhance the speed at which people interact and develop solutions and as a by-product tacit knowledge is often made explicit and can be shared with others. The value of this should not be underestimated as in modern knowledge based industries there are time pressures which often make knowledge sharing in an effective way difficult. This social exchange of information via a central application can harness knowledge and allow it to be accessed by others.

Talent Management

We often hear about schemes and initiatives, within large organisations, for managing 'high flyers'. These organisations will probably also have a programme for developing those not labeled in this way. We have already mentioned that the environment is important, but the management is even more crucial. With world class management we can get around a poor environment.

However people in the 'creative' part of the organisation, often in Research, will rarely have specialised management education outside of these 'high flyer' schemes. This will potentially create a business problem, as managing creative and innovative teams is a skill that must be continually developed. It is essential that leaders in a creative/innovative department understand the need for both 'time' and 'space': time to think about a problem and the space - that is the lack of physical or organisational barriers to thinking - to do so.

A culture of value and support is also needed. Researchers must feel their work is valued by the organisation and they must feel that they have sufficient support. Good communications from the senior team in a company can enable this. Generally, creative people need little encouragement or motivation, but they do need a good listener or sounding board and someone who can organise a route to exploitation.

Ideally the leader should be both well-versed in the area of research and grounded in the needs of the organisation and the market place. The leader should also have good links into the organisation's sales and marketing channels to ensure a good information flow between both parts of the organisation.

However, this assumes the separation of people skills into either creativity or leadership and some people are able to master both! But generally the constraints imposed by leadership roles limit creativity.

We would argue that the essence of creativity is exposure to multiple incomplete perspectives and models, therefore it is important that 'researchers' are not isolated from the business world.

Funding Research in Industry

Industry currently has a number of models for the funding of research within organisations. One is the tried and tested conventional model of feeding a percentage of overall corporate revenue back into the business to fund the research activities. Another is funding research through the sale or licensing of IPR and Patents, in effect making it self-funding.

There are strengths and weaknesses in both models, They are dependent upon an annual investment appraisal and funding cycles and this can lead to inconsistency in funding over say a 2-5 year period, in some cases varying funding levels even within a single year.

This is at odds with two of the 'enablers':

- higher-level management support
- corporate culture

Research teams need both stability and support. For creativity to thrive there must be 'security' of this support over the lifetime of the research.

An individual will need time to think and this must not be clouded by concerns over the day-to-day corporate support for the work. This is not to say that the projects and programmes should not be regularly and rigorously reviewed.

Reviews should be transparent and honest and a mechanism should exist to ensure that research can be expanded or reduced in line with both corporate strategy and project success. Research teams should be aware of this process at the commencement of their activity and should understand clearly how the quality of their deliverables will impact on any review.

Another key factor is that of 'reality checking'. Security of funding must be tempered with a broad and up-to-date view of the world outside of the technical domain.

Outside of corporate funding there are a number of sources of additional funds, ranging from 'matching' (co-funding of research) to 'top-ups' (the provision of additional funding) . These are available from various government initiatives in both the UK and Europe. Deciding factors in the use of these by industry tend to be driven by either risk mitigation, cost sharing or knowledge enhancement via collaboration.

Working closely with Customers

Understanding a customer's business needs, their goals and their aspirations will enable a company to deliver new solutions and technology to support them.

This seems like a very good way to work; however for a research organisation to provide maximum value it must maintain some autonomy. Moving to a position where Research is driven totally by product lines in support of their clients' needs can be dangerous, as new and creative ideas which focus on future needs can be managed out and this will lead to a very short-term focus. This is not to say that the research division within a company should not be well integrated into the product lines. In order to provide maximum value to a business an element of the research must remain relatively autonomous and able to examine areas of new technology and research not necessarily associated with the company's current product or service objectives.

The balance of short term business driven and longer term research driven work is very much sector dependant and in our area of work it is currently around 80/20, with 80% being driven by the business.

Horizon scanning has been through many incarnations over the past decade but the ability to detect disruptive changes, early in their life cycle, is absolutely key to a business. All too often in the past companies have dismissed new technology as not being able to support the services their current technology provided; as they had failed to examine the development / time plot for the new technology. It may not have provided the services needed at the time of assessment but it was developing so rapidly that when it did deliver it became a major threat and the company was unable to respond. Memorable examples are the evolution from mainframe to minicomputer and from minicomputer to PC.

Language Barriers

When we communicate with others using the same language, we assume common understanding, but this could not be further from the truth! Our contextual framework is our reference, not our language. How often have you spoken for some time with a colleague only to find that when you both relate the ideas exchanged to a third party, you find that there was not in fact the 'meeting of minds' that you thought had taken place? This is one of the fundamental barriers to creativity and innovation in a team, the ability to share ideas at an early stage when they are not fully formed. This is often enhanced by familiarity; teams who know one another well and have worked closely with each other for some time are often better at sharing ideas, but there is no guarantee!

Alternatively, teams brought together for a specific task or problem sometimes find idea sharing easy as they tend initially to define boundary conditions and context before attempting to work together on the problem. Individuals and teams often find that a shared visualisation often allows them to ensure that they are all on the same wavelength and a simple Whiteboard can be the 'tool' for this. A diagram on the board then transcends language barriers and allows inconsistency resolution.

There is currently a drive to use multidisciplinary teams and we have found that this strategy can lead to particularly innovative solutions when addressing problems. The downside to this approach is ensuring common understanding. When we mix social scientists with technologists, for example, we can spark completely new lines of thought, but only if they have a common reference and vocabulary and they have a method for ensuring understanding. This can best be accomplished by using a facilitator who understands both groups, or is able to place themselves in the mindset of both groups simultaneously. We have found that facilitators with either a social science background or one of philosophy are particularly good in this role. (examples, Crucible Initiative and Philosophy in Business, Cambridge University)

Technology Roadmapping

Establishing and communicating the links between technology developments and company strategy can present an ongoing challenge for many organisations. However technology research and development is for many companies an important strategic asset and therefore there is an absolute need within these companies to link their R&D strategy with the company's overall direction.

A tool to facilitate both the linkage and visualisation of the technology and business strategy is the Technology Roadmap. This roadmap can display the path from technology development through product or service development to a business / market sector. This type of tool enables businesses to visualise, for senior management teams, the way in which a particular technology development will allow the company to move into a specific business or market sector.

The technology roadmap can also be used as a model for examining technology development strategies. A number of strategic directions can be visualised and senior management teams are then able to examine these strategies with a view to establishing which best suits the needs of the company and where best the investment should be made.

One of the major benefits of technology roadmapping is the establishment of a link between technologists and the commercial functions of a business as this shared visualisation is examined during its creation. The process can bring together sales and marketing with business strategy and technology groups, all of which will play a part in early discussions, and all of which will finally buy into the overall roadmap and its timeframe. As mentioned in the section "Language Barriers", this process of bringing together a number of different disciplines around a common visualisation often leads to increased understanding and greater creativity.

In high technology businesses, it is essential to have this level of understanding, as investment decisions will often involve trade off between different technology alternatives. Without this common vision of the overall objectives, this type of decision-making would be impossible.

This roadmapping can be enhanced by the production of 'future personas', that is a visual representation of people in a 'future world' scenario. In terms of offering a common visualisation of a technology, or a concept, personas can truly bring the technology to life by illustrating its application and benefits in a future scenario of use. Personas are usually derived from market segmentation (which in turn is derived from a deep understanding of the market-place) and are usually applied to concepts designed for consumer and small-business markets. Personas can then be used to demonstrate a 'day in the life' of a future user of the technology, or a series of related technologies.

The persona itself is created to reflect the technology needs of that future individual and encompasses 'hard' data such as what they likely spend on technology is, their income bracket and their educational background, coupled with 'softer' data such as their aspirations, their concerns for themselves and their families, and, importantly, their attitudes to new technologies. This gives a clear picture to work from and provides a context in which the scenario of use is set. It provides a rich and compelling method for demonstrating the applicability and appeal of a new technology.

Additionally, for the purposes of design, personas are often used to validate a technology concept. Designers can use the persona and its related scenario to 'road test' the concept with real users: to see if the innovation 'has legs' or needs further iterations to be validated and put into further development.

Managing Disruptive Technology

The concept of 'Disruptive Technologies' was developed in the mid 90's and championed by researchers such as Clay Christensen (Harvard) and Rebecca Henderson (MIT).

At the heart of this methodology is the observation that successful companies often lose market dominance at times of technological change, even if these changes or innovations seem relatively minor, at the time, to the external observer.

Products and services have a life cycle often represented by a 'S curve'. Initially take up is slow, then as the product matures in the market it will often move to a steady rise over time, finally reaching a 'plateau' where there is little overall growth as the market nears saturation. However new and potentially disruptive products and services will be at different points on their 'S Curve' and can 'leapfrog' over the mature dominant offering, moving rapidly to greater maturity. These are known as 'disruptive technologies' in this model.

Every company is a product of its history and at any point in time has a particular combination of resources, processes and values. This is more than just the formal assets of the business and includes the ways in which strategic decisions are made, priorities set and investments for the future decided. This mix changes during the life of a company and may lead a company to be more or less responsive to disruptive innovations.

Often how a company reacts to the news of an innovation or disruption will depend upon how it views the change. The change may be synergistic with its way of doing business, in which case it can be embraced; however if the change is seen as a potential threat it may create critical and significant tensions in the business.

Against this background we might expect major companies to be most likely to develop the next generation of technologies that open up the futures laid out by their strategists. However, it is equally likely that the revenue from their existing markets will delay the transition to a new technology, either through deliberate choice or unfortunate allocation of skills and assets – leaving the new and disruptive technologies to incubate elsewhere. It has been suggested that this is the trap that awaited IBM and the PC.

Large companies are likened to super tankers, they take a long time to change direction and therefore need to 'see' the need to change very early so as to have the time to make the 'course correction' before tragedy strikes. This requires a foresight or 'horizon scanning' activity, with tight coupling to the corporate strategy team. Academia can often provide this 'service' to large organisations, but a very good interaction between the company and their academic partners is key to the dissemination of the information.

However, what this work has shown is that there is a great opportunity here if appropriate actions are taken by a company. Seeking out disrupters, incubating them in under-observed markets – or in the ‘garages’ of ‘lead users’ - can be a very valuable and cost effective process, enabling major players to remain agile and responsive in fast moving markets.

In Summary

- Companies must organise for innovation and execution, even if this means organisational separation of rival product sets (not the only approach) and all of the management issues which that entails.
- Companies must be very aware of the subtle ways in which management and governance styles and priorities affect the optimal balance between ‘milking the cash cow’ and building a new future.
- Not all companies are created equal in the face of any given innovation - forewarned is forearmed. If a technology is disruptive for you but sustaining for your enemy, then you had best start working on the problem now.
- Not every bandwagon should be jumped on; sometimes you are actually good enough at what you do to drive down upstart competition - for now.
- Creativity, execution, markets and strategy are not conveniently separated.

Knowledge Management

In traditional research groups, knowledge is passed from tutor or research leader to student or research assistant. In some of our older Universities, key ideas or lines of thought can be traced back many years. Generally people stay in areas of research for many years and this system, coupled with the regular publication of papers, ensures that knowledge is both passed on and documented.

In industry there are factors that work against this; there is a propensity for people to move from company to company to enhance their careers and therefore the ‘institutional knowledge’ is lost and few papers are published aside from those for specific journals within the company. This makes the need for systems that support Knowledge Management all the more essential. It was mentioned earlier in this paper that one specific problem which knowledge management could greatly improve was that of ‘ideas storage’.

Research departments in industry often produce ideas for new products and services that are well ahead of the market place (the idea is sound and

feasible but the market is either 'not ready' or demand does not yet exist). Being well ahead of the market-place might seem to be a good thing, but there is a large down-side. How does the company keep the idea fresh while waiting for the market-place to catch up and for a demand to exist which will allow the idea to be moved down the creativity/ innovation pipeline? (Generally demand must be perceived to exist to allow funding to be made available in a business). Here is where a knowledge management system can really pay for itself. If the system can 'store' the idea, that is 'put it on ice' until required, then the value to the company is great. If the system can allow searching for these 'stored ideas' when a change in the market place occurs, then they are not lost and can be used.

However it is important to stress that the system is only part of the answer; a good process for capturing the 'idea' and any surrounding material at the time of storage is also essential. The person creating the information may well have moved on when it is later required, therefore as much information as possible about the idea, what led to it, and possible applications must be documented.

New tools for communicating

One of the biggest advances in society recently has been the ability to quickly produce and transmit data digitally. By adding structure to the data, we have access to huge amounts of information which we can transmit quickly and then change or recall easily at a later date: be it audio, video, text or graphical information.

We have the ability to mix audio and video with text, as well as being able to provide metadata in order to catalogue and retrieve non-textual information to help us analyse the information to form a knowledge base.

Networks such as the Internet allow knowledge transfer to happen quickly and effectively.

Today we have a fantastic array of choice in how we communicate. Media is easily produced as static textual documents, audio, graphical and video data, and combinations of all of these formats can be delivered by web servers over the Internet. Even a simple instant message can be augmented with voice and video, and the resulting conversations may be saved by the participants for use at a later time.

The barriers to producing good quality media have never been so low; webcams may be bought for as little as £10 and email and instant messaging are available from most internet connections. Wikis and blogs allow information to be created and published with the delay in reaching the target audience measured in seconds.

Blogs and Wikis

Blogs and wikis allow users to contribute to content. Blogs tend to follow an editorial metaphor; the 'editor' posts an idea or statement, then the audience may add comments but does not have the ability to edit the original piece. Wikis allow one user to make an initial post which may then be altered, permissions allowing, by anyone in the audience.

Both applications provide a tool for editing the content quickly and easily, on-line. As the audience is potentially anyone with a browser-based device, good usability is essential. The key attraction of these tools is that no user needs to learn any complex mark-up language or download any software.

The use of these tools has led to:

- Complete separation of content and presentation
- The ability to search content simply.
- Easy updating of the content without direct access to the host server

By separating the content and presentation of the 'pages', producers can use very simple, yet consistent mark-up language (in comparison with HTML for example). Text pages may be created and published very quickly by anyone who can physically access an Internet browser; making editing by smart phone or thin client entirely possible.

With the most popular tools full auditing is easily achieved without the need for a configuration client; which can be a major advantage in a geographically dispersed team and the use of an intuitive user interface means little or no training is required.

Audio and Video content

The more popular video sharing utilities such as 'YouTube' provide a library of video media which may be easily accessed. Each video is captured with useful meta-data by the providers. YouTube allows the providers to add consistent information about their videos which in turn allows consumers to extract their desired material reliably.

Before a user may provide video material, they complete a simple registration which requires four pieces of information: their email address, date of birth, name and nationality; the entry 'barrier' is low. It is argued that YouTube may limit this criteria because it is reputation based (more like eBay than email) so users become known for good or less good content. Anyone can ask for a video to be 'moderated', which may mean the video is removed, such as in the case of insulting or offensive material.

Considerations on setting up a repository in an organisation

As with any process, it is always worth considering some formal guidelines governing the content of any wiki, blog or video repository. Tools may be included into the build to ensure these are followed if required; however care should always be taken to ensure such guidelines do not quell the creative process.

Using audio and video in a business

It may not be obvious why a company should need the ability to share audio and video files. This is easily answered - people are 'time poor'. They need to take on knowledge and information in the most effective way; in many cases listening to an audio file or watching a video of a talk is the best way to do this. Many of these 'consumers' are already accustomed to accessing such information via their smart phones and MP3 players.

Far more can be gained by listening to the author of a new idea than by just reading about it. And watching that person can add yet more value; complex ideas may be explained and the context understood.

The Corporate Incubator (Bringing Entrepreneurship into the Equation)

A number of large industry players have created their own business incubators, so that they are able to benefit from ideas that are not 'core' to their business. These companies have found that a by-product of their creativity process is the generation of novel new ideas that do not necessarily have, without a major change in strategy, an application within their own business. To gain the maximum value from these ideas they have created new small businesses around them with the long-term objective of realising value for the parent company through the sale of the new company. An additional benefit is that the parent company can 'buy' products or services from the spin-out, which will continue to develop them based on their total sales and client feedback.

This can have both positive and negative attributes. On the positive side it can generate significant additional revenue streams for a relatively small investment, assuming that Venture Capital (VC) funding can be attracted. It can also create an entrepreneurial approach within a research team. On the downside a company's best people can be lost to these new businesses. Those not making a success of their good ideas after a period of 'incubation' can become disenchanted when returning to the large corporate infrastructure after a period working in a small company environment.

Profit from great ideas

A position which has grown out of this is one where ideas not core to the business are either 'licensed' to other operators or, if judged not suitable for this route, are published openly to stimulate markets.

However, having channels which allow 'non-core' ideas to be monetised is key to the long term viability of a corporate research group.

Conclusions

We have seen that everything from the funding model to the management structure will affect the creativity of a team. Industry would like to see at least one in ten of its creative ideas downstreamed or integrated into a new product or service via the 'innovation pipeline'. However this is too simplistic a model as it assumes a direct path from research via development into deployment. With corporate incubation, new products or services can be made available to the company via an external route. The environment is often the focus for a company but we have seen that this is sector and activity specific and what works for one may not work for another.

There are, however, some things that are not specific to an industry or sector and are generally agreed to be generic:

- Leadership style - participative, democratic and non-authoritarian.
- The 'job' - people should have both discretion and autonomy.
- Organisational structure - a non-hierarchical, flat structure with no perceivable boundaries.
- Culture - supportive of risk-taking, open to new ideas and encouraging non-traditional thinking.
- Attitude - flexible, sharing of thoughts and able to work around preconceived ideas.
- Skills – 'learning and creativity' techniques.
- The organisation - understanding and valuing creativity.

As well as these generic points there are areas that have been found to be key in our ICT sector.

Multidisciplinary teams can enhance creativity, but 'language' problems need to be considered and managed for maximum benefit.

The use of prototyping to demonstrate technical feasibility can be useful and storyboarding and the visualisation of concepts and ideas is key to moving them forward.

Then there is the problem of measuring the outcome. There is an argument that states if you cannot measure it then you should not be doing it. Measuring the number of licences or patents can give a view of the value of the creative process but it will not provide a detailed picture. It is essential to review in

detail the valuable contributions of creativity within a business or institution and then build metrics around these.

We have seen that using academic partners to provide early warning of disruptive technology and business change is essential to large businesses that need time to change their strategy and business models. However, both culture and communication are core to the successful execution of these processes.

Once key changes have been identified to improve the performance of an organisation it is essential that these be driven both 'top down' and 'bottom up'. Therefore it is essential that there is buy-in from both the Board and the teams to any change in culture.

The power of collaboration

Innovation does not happen in a vacuum. Innovation takes place when knowledge, information and experience are shared. Isaac Newton said "If I have seen further it is by standing on the shoulders of Giants."

Working in collaboration with colleagues in academia and industry allows us to work with great thinkers and people with alternative views on the world. This will ensure that our eyes are open and our view is unencumbered with local issues.

Our chosen field of ICT is increasing in complexity every month. Managing creativity and innovation against this background is a challenging task and one which can only be mastered by working closely with others. The need to 'update' the knowledge of individuals is now something which must happen several times a year, and without using all of the forms of modern communication this would be impossible. Never has 'communication' been so important because without it we cannot move forward intellectually and without this advancement we will not make the best use of our creativity.

References

People

Tim Berners-Lee <http://www.w3.org/People/Berners-Lee/>

Rebecca Henderson <http://web.mit.edu/rhenders/www/home.html>

Michael Schrage <http://web.mit.edu/bin/cgicso?query=michael+schrage>

Tom Peters <http://www.tompeters.com/>

Clayton M. Christensen

http://dor.hbs.edu/fi_redirect.jhtml?facInfo=bio&facEmlId=cchristensen

Professor Mike Payne - <http://www.tcm.phy.cam.ac.uk/~mcp1/>

Sir Isaac Newton - Pigmaei gigantum humeris impositi plusquam ipsi gigantes vident "If I have seen further it is by standing on the shoulders of giants."

http://en.wikipedia.org/wiki/Isaac_Newton

Publications

Cooper, L. & Shepard, R. (1973). *Chronometric studies of the rotation of mental images*. In W. Chase (Ed.), *Visual Information Processing* (pp. 135-142). New York, NY: Academic Press.

Kosslyn, S. M. (1983). *Ghosts in the mind's machine: Creating and using images in the brain*. New York: W. W. Norton & Company.

Anderson, J. R. (1990). *The adaptive character of thought*, Hillsdale, NJ: Lawrence Erlbaum Associates.

Majaro, Simon (1997) *The Creative Marketer*, Butterworth-Heinemann

Schrage, Michael. (1999) *Serious Play: How the World's Best Companies Simulate to Innovate*, Harvard Business School Press.

Berners-Lee, T. (1999) *Weaving the Web : The Original Design and Ultimate Destiny of the World Wide Web by its Inventor*, HarperCollins

Initiatives

Crucible Initiative <http://www.crucible.cl.cam.ac.uk/>

The Management of Disruptive Technology (Steve Whittaker) - <http://www.stevewhittaker.com/>

CERN / W3 <http://www.w3.org/>

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