Knowledge Management and Innovation at 3M

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3M's objective is to become the most innovative company in the world. To be innovative in highly competitive industries and global markets requires the effective use of Knowledge Management. 3M employs a wide range of Knowledge Management systems, but the appropriate environment has to be in place before people will be motivated to input and access such systems. 3M concentrates on the 'tacit to tacit' area in the belief that if this is functioning well, other aspects of Knowledge Management will fall more readily into place. The willingness to share knowledge between individuals is directly affected by the culture within a company. This paper outlines how 3M creates and sustains its innovation and learning culture.

KNOWLEDGE MANAGEMENT: A CULTURAL ISSUE

More than Technology

3M sees Knowledge Management more as a cultural and organizational issue than a technological one. The company has many systems in place and is continually adding to them. Formal training programmes, learning by doing, help desks, intranet, Internet, Lotus Notes™, video conferencing and IT-based databases are available to a vast range of employees. The Technical Planning and Coordination Group updates and maintains best practice and key player databases. For its more than two dozen core technologies, the company knows who are the people working in each area on what subject, and it is also linked to many universities specializing in areas of particular interest to 3M. An important requirement is that a company knows what it knows and 3M continually maps on databases what and where the technological skills it needs are located.

But if a company invests in a Knowledge Management infrastructure similar to 3M's it will not find this the sole answer to achieving a Knowledge Management environment. Of the four key areas of Knowledge Management outlined by Nonaka, 3M puts its major emphasis on the 'tacit to tacit' area (the transferring of an individual's experience and knowledge to other individuals).[1] People have to be motivated to access and share information and to convert that information into knowledge. If the business processes are in place and the context is appropriate then Knowledge Management systems can flourish and people will input their knowledge into systems for access by others; but in the wrong context a Knowledge Management infrastructure will atrophy.

Effective Knowledge Management has parallels with effective innovation. For innovation to take place, a company needs caring people who are willing to share for the greater good of the company and creative people who have the ability to turn ideas into practical products and services.

Generosity, Freedom and Safety

A company cannot order people to be caring and creative. All it can do is attempt to create an atmosphere of generosity, freedom and safety in which innovation can flourish. Effective Knowledge Management is essential to innovation and it too needs an atmosphere of generosity, freedom and safety if it is to act as the river on which innovation can sail.

Since 3M's disastrous beginning in 1902, when a group of investors by mistake bought a mountain containing worthless mineral to start a business to mine corundum to manufacture sand paper – and the company did not achieve a profit for 14 years – considerable efforts have been made to create an atmosphere that will support innovation.

Requirements for Successful Innovation

For a company to be successful in innovation, 3M has stated that it needs vision (what it wants to be),

foresight (a knowledge of where the world is going), an understanding of its core competencies (which will assist in setting Knowledge Management priorities), stretch goals (which in the case of 3M requires every single business, no matter what its history, to have at least 30% of its sales from products not in the line four years ago), freedom for employees to achieve those goals, and an atmosphere which enables and encourages people to give help and draw help from others.

To guarantee such conditions for innovation are in place and sustained over time requires a long-term commitment from top management, the recruitment and retention of the right people and a strong support and recognition programme.

TOP MANAGEMENT'S LONG-TERM COMMITMENT

Total Company Involvement

Some companies appoint a New Products Manager and expect the person rapidly to launch new products. If that person struggles for 18 months and achieves little, he or she is moved to other duties or leaves the company. Such a situation could be repeated with newly appointed Knowledge Officers. Innovation cannot be farmed out to one or two individuals; it must permeate the entire fabric of an organization and every department within a company, not just technical or marketing. And in the same way Knowledge Management cannot be left to one or two individuals.

At 3M Knowledge Management does not just bubble up from middle management; top management see it as one of their major duties to encourage knowledge linkages. Share price is a constant issue for the board. 3M has an example of the positive effect on the share price when Knowledge Management programmes are explained, as witnessed by 3M's Vice Chairman, Ron Mitsch, when he spoke to New York financial analysts. He outlined the linkages salespeople from different industrial divisions have made to benefit customers and how, at breakfast meetings, they teach each other about their various products and discuss customer problems that can be solved by technologies from other groups.

Tradition

William Waldergrave commenting on what makes for an innovative scientific nation has written:

> "It needs order and institutional memory. It needs, in short, tradition."[2]

3M encourages a sense of tradition. Lifetime employment and promotion from within are important traditional 3M policies – the average service at 3M is decades and employee turnover is low. Such experience in depth cannot by definition be duplicated quickly by competitors, even if those competitors have sophisticated Knowledge Management systems in place. An important role for Knowledge Management is, of course, to leverage the experience in the heads of employees so that downsizing, or staff turnover cannot damage the competitive edge and innovative ability of a company. Such a role for Knowledge Management is, however, at present, difficult and may, in its totality, be impossible to achieve. For 3M to follow other companies into short termism in the hope that Knowledge Management will fill the experience gap is considered detrimental to its long-term competitive position.

Continuity

Promotion from within and lifetime employment policies mean that 3M people get to understand and know each other well. Senior people have worked in or visited many different countries. They have a personal connection with a wide variety of people and that makes knowledge transfer, using electronic communication, across different cultural boundaries effective.

Continuity of employment and global personal networks result in people helping others over and over again without immediate expectation of return. These people know, however, during the next ten or 20 years, that when they need help they will get it. The Canadian biologist, Dr. Hans Selye, summed up this concept by coining the words 'altruistic egotism'– helping others for one's own benefit.[3] A sense of continuity allows that atmosphere to flourish.

Loyalty Over Time

Some companies, worried about long-term pension responsibilities and the need for head count flexibility, employ people on short-term contracts under the mistaken belief that fresh new employees along with Knowledge Management systems will generate innovative ideas. These short-term people may, however, not be interested in loyalty to the company and the sharing of knowledge for long-term innovative success. Their interest may focus primarily on their profession, and making sure their CV looks attractive to their next employer. They may not be looking for freedom to innovate; they may not be looking for an opportunity to help others who in the long term may be in a position to return that help.

In the short term they know they will be leaving to work elsewhere. What they want is specifically structured experience that is quantifiable and measurable. But innovation often happens at the margin and it does not always start as an Eureka shriek. It can be a gentle flame that needs fanning. But who has the time to do that nurturing if job horizons are short? So innovation happens and Knowledge Management works best when employees trust their company will be loyal to them over time.

Tolerance of Mistakes

Long-term commitment at 3M also allows for mistakes to be tolerated. Top management taking the long view can tolerate a few mistakes. Lew Lehr, a recent chairman, commented, "As befits a company that was founded on a mistake, we have continued to accept mistakes as a normal part of running a business."

3M's ceramic business began as a result of mistakes in the development of a new abrasive grit. The Post-it® Notes adhesive was developed by Spence Silver from a mistake. The unique quality of the Post- it® Notes adhesive was that it was weak, but unlike other weak adhesives, it did not get harder or softer over time, but stayed consistently weak, and a new stationery product using the special properties of the adhesive was invented by Art Fry.

On the other hand, short termism may increase intolerance. Mistakes will be considered an expensive waste. Investigating mistakes, learning from them, will be time consuming, and if horizons are short, mistakes will be ignored or squashed. As William McKnight, another 3M chairman, said, "Mistakes will be made, but if a person is essentially right, the mistakes made are not as serious in the long run as the mistakes management will make if it is dictatorial." He said that in 1944, well before the empowerment movement started.

Story Telling

Top managers who joined the company when they were young and who have absorbed the company's traditions and stories, re-tell those stories to reinforce the values and atmosphere that encourage innovation. A case in point is the story about Dick Drew ignoring his boss in the 1920s when asked to stop developing Scotch™ masking tape and yet he carried on successfully. This story was used by Lew Lehr in the 1950s when he was ordered to stop developing adhesive backed surgical drape, but he also continued successfully. Richard Miller, the inventor of immune response modifiers, in the 1990s again had the story in mind when he carried on working with his ideas even after his project had been officially terminated and he had been put on the unassigned list.

Top management at 3M, all of whom know these stories, continue to allow a healthy disregard for management. They are loath to say no to anybody passionately working in an area of their choice and as a result innovations of tremendous importance to the company have been developed.

Flat Organization

Top management's tolerance for mistakes is in line with its policy of establishing a flat organizational structure and allowing important decisions to be made at all levels. 3M's aim is not just to try and achieve 'a sustainable competitive advantage'. Its aim is continuously to develop, to adapt and to search for new sources of temporary advantage. That is why 3M has done laboratory work in space and has invested considerable time in becoming the first western company with a wholly owned subsidiary in the People's Republic of China. When everything is considered tentative, everybody has to remain flexible and to keep learning. 3M wants to be swiftly adaptive and it knows that the best adaptive systems are the ones which are self-organizing.

The above points were summarized many years ago by the 3M statement: "Make a little, sell a little, make a little more and keep learning with the market." The company has been compared with a nickel and dime store many times over. Rather than a hierarchy, it is a collection of networks.

Innovation Approaches

But doing these things are not enough to generate innovation. Management needs to be in touch through Knowledge Management processes with all the various opportunities for innovation. For example, trend intersections, an example being Warner's 'edutainment', need to be studied. Technology inflection points such as electronic chips becoming memory chips need to be assessed. Multi-technological approaches and how the company can alter fundamental customer value, such as CNN's 24 hour news, need to be examined. 'Synectics'® type brainstorming, and 'Idon'™ type scenario planning need to be carried out to generate ideas that can become new industries.

With the above options in mind 3M has taken two main approaches to innovation: firstly defining needs that could use 3M technology – 'knowledge by design'; and secondly, developing new technologies that then require product applications to be found – 'knowledge by emergence'.

- 'Knowledge by Design'

In the area of needs seeking technologies, top management is involved by initially defining, through planning systems, those customers it wants

Figure 1: Knowledge transfer

to work with and then encouraging technical people to become part of those end-user customers' adaptive systems. This way technical people are in a position to define the customers' unarticulated needs which may lead to new innovations.

An example here is 3M's graphic business, which began when panels of flexible plastic material were screen printed to create advertising and informational displays on the side of truck trailers. From this experience, the business learned to use the material for graphics around petrol stations and on the sides of buildings, and then for 'floor graphics' as advertisements in supermarkets. Another example, Thinsulate™ material, launched as a warm lining for ski and climbing jackets, has spread into camping gear, uniforms and acoustic dampening for cars – a continual learning process combining what 3M has to offer with what the market might need.

- 'Knowledge by Emergence'

As for the second approach where technologies, often emerging from serendipitous situations, are looking for a product definition, there are a number of examples. 3M obtained its first fluoro chemical patents in 1945. One hundred lab scientists worked on the programme until 1953 without any application being discovered, until during that year, a lab scientist, Patsy Sherman, dropped some chemicals on a tennis shoe and found that it was dirt resistant. The result was Scotchgard™ chemicals to protect textiles and Scotchban™ chemicals to protect paper. Another example is random web technology which was supported for six years before an application – floor matting – was developed.

Cross Divisional Co-operation

Top management's long-term support for innovation is important to prevent groups becoming 'turfy', that is, people protecting their own patch and keeping out possible new ideas. Internal monopolies are more difficult to maintain when Knowledge Management systems are in place, but nonetheless managers who fight for territory can be damaging. At 3M top management's long-term commitment to innovation encourages cross divisional co-operation.

An example here is 3M's microreplication technology developed by Roger Appledorn. Microreplication produces three dimensional patterns in plastic film. It was first used in the 1960s as a thin film with tiny grooves for replacing the glass back plate in overhead projectors, and enabled 3M to become a leader in the field. Because of the stretch targets placed on all 3M businesses for new product sales, other groups were motivated to assess the new technology and see where it fitted into their work. As a result, the technology was picked up by the traffic sign business, to make a brighter surface; it was used to enhance the liquid crystal displays on personal computers which resulted in a greater brightness at a lower battery usage; and it was used by the abrasives group to design a far more effective sandpaper which produced a finishing system requiring fewer belt changes. It is also being used for new fasteners and as anti-counterfeiting for bank notes (see Figure 1).

Coping with Chaos

The path of innovation rarely runs smoothly, especially where technology is the driver. Companies like to have clear objectives, to develop a plan, then take action, check the variances and take new actions if it is necessary to bring a project back in line. But innovation in its early stages is a 'loose' activity and can follow a chaotic path. Standard Knowledge Management approaches and processes will be vital for effective 'tight' implementation, but may not always be capable of igniting the spark in the first place. People create that spark, so top management must make allowances and not move too fast to judge, assess and audit projects. Pulling up a tender plant to see if it is still alive kills it.

RECRUITING AND KEEPING THE RIGHT PEOPLE

If innovation and effective Knowledge Management is furthered by having people with a depth of experience, it is important the right people, who fit the culture, are recruited in the first place.

3M has found the ideal people are those who want to start things rather than inherit businesses. They are interested in freedom to do their own thing

rather than money or power. They are action orientated and prepared to take some risk with their future. 3M recruiters search for people who are creative (those people who can live in contradiction and perceive opposites as true at the same time), have a strong worth ethic, are self-motivated and resourceful, and are problem-solvers with broad interests.

Broad interests seem to be a distinguishing feature because it is often people with broad interests who are eager to learn, willing to explore ideas with others, have a multi-disciplinary approach, and are happy networking both face to face and by electronic means.

To retain such people requires a culture in which they can flourish. Cultures found within companies range from the 'innovative' (divergent and learning) with its opposite of 'controlling' (convergent and efficiency conscious) to 'supportive' (empowered and caring) with its opposite of 'directive' (profit before people). 3M's culture is one of learning and experimenting, but in a highly competitive environment there have to be strong cost control systems. As Lawrence and Dyer have pointed out:

"For the readaptive process to be sustained, organizational members need to learn in order to be innovative and need to strive in order to be efficient."[4]

A balance between learning and efficiency is the target. Processes for improving efficiency can take a long time to set up, but cannot be allowed to become too rigid. Intuition is needed to trigger the moment when it may be necessary to jump out of the process for the sake of innovation.

PROGRAMMES FOR SUPPORTING A KNOWLEDGE MANAGEMENT ENVIRONMENT AND INNOVATION

Organizational Structures

To maintain the balance and ensure that there is not an over emphasis on efficiency and controls at the cost of learning, 3M has put a number of organizational structures and recognition programmes in place. The organizational structures relate to fairs, technical audits, special interest chapters and the 15% rule.

Fairs, Technical Audits and Chapters

Fairs consist of displays of technologies which are available for product development. 3M people are invited from around the company to examine ideas on a confidential basis to assess whether the technologies can be applied in the various markets in which 3M operates. Technical audits of the various labs take place on a regular basis and are carried out by a team from other labs around the world. An example might be the technical director of the library systems group auditing the abrasives laboratory activities.

Bringing together people, face to face, or by video conference, who have diverse backgrounds in a supportive review environment can result in the generation of new ideas. In addition, the company allows work time for special interest chapter groups to discuss issues across divisions.

15% Rule

An important support for innovation is signalled by 3M's 15% rule which states that 3M people can spend 15% of their time working on innovative ideas of their own choosing. This figure of 15% is not a hard and fast percentage. Not everybody uses it – and some take far more than 15% time – especially when a promising idea takes form as a likely product. But the message is clear; it is saying it is OK to try something not on the main line. The consequence of this 15% rule has been a number of important new businesses for the company.

Grants

Money as well as time is required for innovation. The 15% rule helps with the issue of time. Genesis and Alpha grants help with money. Technical people can apply for 3M Genesis grants to buy equipment to assist them in the development of their '15% ideas'. Or they can use the grant to pay for temporary labour to do some of their existing work while they spend their own time developing their '15% project'. The Alpha grant is for developing ideas, such as new processes, which fall outside the technical area (see Figure 2).

Recognition Programmes

Organizational structures and support programmes which encourage learning and knowledge transfer are underlined by the recognition programmes. 3M knows that the inventors of new industries and products are the critical people in the company. Through the dual ladder process they can be promoted to vice-president level without having to have any management responsibility. 3M also makes certain that inventors are known and recognized across the company through articles and presentations. As a result 3M people tend to know more about 'the heroes of innovation' than they do

Figure 2: Programmes to assist learning

about senior management. To develop a new product for 3M is the commercial equivalent of immortality, so for others to see inventors recognized is a spur to their own activity.

There are a number of award programmes to recognize innovation. The Golden Step Award is given for reaching a certain sales volume with a new product; the Circle of Technical Excellence Award is for considerable technical contribution; while the highest accolade for an inventor is his or her admission to the 3M Carlton Society.

Awards are not confined to technical people. Sales, marketing, logistics, finance and production people are included in the Pathfinder Programme which gives awards to teams for developing and launching new products within a country. There is also an award to motivate marketing people to check what is going on elsewhere and overcome the issue of crossing boundaries. This is the Pathfinder Merchant Award presented to those teams that have taken an idea developed in another country and then launched it in their own country. To make certain learning from sales and marketing programmes and other areas is not lost, a Sales and Marketing Professionalism Award and a Quality Award programme are also organized and the results published.

It might be considered odd that in a British or non-American culture employees are happy to cover their office walls and desks with plaques and award statuettes. But a well decorated office or work area gives the employee a greater chance of having his or her ideas listened to, especially if, at first, those ideas sound crazy. The plaques on the wall are a sign that the person has achieved great things in the past and could do so again. Somebody with a strong record but a possibly shaky idea may well attract support faster than a person without a strong record who has what seems on the surface an outstanding idea.

MOTIVATION: THE KEY TO KNOWLEDGE MANAGEMENT

Knowledge Management processes are being used by companies to reduce the need and therefore the cost of face to face meetings. At 3M, where the three Ms are said to stand for 'meetings and more meetings' that is also the aim as demonstrated by 3M's efforts to ensure the effectiveness of dispersed teams. But it is 3M's experience that these systems work far more effectively if the appropriate culture is in place. Long-term personal relationships with people selected because their attitude and personality fit the free flowing innovative culture of a company seems to be the necessary condition to have in place if Knowledge Management systems are to work.

If the motivation is there and this is enhanced by the right atmosphere, people will use Knowledge Management systems, even in companies where the systems are not that sophisticated, to achieve their objectives. On the other hand, a sophisticated Knowledge Management system in the wrong environment will achieve little in the way of innovation.

3M's record proves it is open to new ideas and it will continue to incorporate the best of the Knowledge Management approaches into its strong culture to ensure it achieves its mission to be 'the most innovative' company in the world. ❑

References

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