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# EDUCATING FOR INNOVATION: ENCOURAGING AN ENTREPRENEURIAL CLIMATE

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## ABSTRACT

Research suggests that, whilst the primary stimulus for change remains those forces in the external environment, the prime motivator for how change is accomplished resides with the people within the organisation. The purpose of this paper is to examine the human side of innovation and the role of education, learning and a supportive culture in overcoming the perceived barriers to entrepreneurism within the traditional public sector environment.

Reference will be made to theoretical models, to cultural studies within the author's organisation and to the entrepreneurial policies and practices of other comparable organisations in order to identify best practice.

## 1. INTRODUCTION

### 1.1 Definition of Terms and Objectives

Katz[1] defines innovation as "invention + exploitation", suggesting that innovation equates less with originality than with the use which is made of invention. Innovation generally triggers change: research suggests, however, that the prime motivator for how change is accomplished resides with the people within the organisation. The purpose of this paper is to examine the human side of innovation and the role of education, learning and a supportive culture in overcoming the perceived barriers to entrepreneurism within the traditional public sector research environment. According to management research, the appropriate combination of strategy, structure and culture is required to foster a climate of entrepreneurism: the author will therefore seek to demonstrate the extent to which alignment of organisational dynamics can maximise the commercial opportunities presented by scientific expertise. Identification of best practice will also serve to highlight the optimum route to innovation within the author's own organisation.

### 1.2 Organisational Context

The main responsibility of the UK Atomic Energy Authority (UKAEA) is to complete its nuclear mission by safely managing and decommissioning reactors and other research and development facilities. As a government funded organisation, the Authority aims to achieve value for money for the taxpayer, stimulate a strong decommissioning industry capable of competing in world markets and contribute towards a safe and clean environment. UKAEA also implements at its Culham site the UK's contribution to the European fusion research programme and has become a world leader in this field of energy technology. It is UKAEA Culham Division, based at Culham Science Centre, which is the focus of this study. Committed to the development of boundary-breaking technologies, and housing its own Innovation Centre, it represents an outstanding example of innovative capability. Such capability, however, is unlikely to be successfully commercially exploited without cultural change: this paper will therefore document the change process, incorporating learning from a variety of sources and making reference to the findings of primary and secondary research.

In 1997 the Fusion & Industry initiative was set up within UKAEA Culham Division in response to the government's wish to realise immediate benefits from fusion technology. On examining the way that public sector research establishments (PSREs) in the United Kingdom can more effectively commercialise their knowledge base, the Baker report[2] later identified the need to implement cultural and organisational change to generate commitment and encourage staff involvement in entrepreneurial activities. The report stated that "technology transfer is most effectively pursued in those PSREs which see it as part of their mission and culture". In response to this report Phase 1 of Culham's culture change programme tackled the issue of staff awareness of technology transfer opportunities, seeking to encourage involvement through communication of Fusion & Industry objectives and activities. Further proposals for future strategy were outlined in an internal report which set out the basis for a second phase cultural study. The processes which formed the basis of both phase 1 and phase 2 have been incorporated within this paper.

## 2. THE ROLE OF THE RAINBOW SEED FUND

UKAEA's potential access as part of a consortium to the 'Rainbow Seed Fund', i.e. venture capital seedcorn funding for the commercialisation of research and innovation, has been a catalyst in the culture change process, driving the need for marketable ideas. In a recent government competition for PSREs, UKAEA successfully bid for the £4m (~6M Euros) fund as

an associate partner in collaboration with core partners the Central Laboratories Research Council (CLRC), the National Environment Research Council (NERC), the Defence, Science & Technology Laboratory (Dstl) and fellow associate partner the Particle Physics & Astronomy Research Council (PPARC). The fund, managed by an Investment Manager, Operations Manager and advisory board, aims to identify suitable research projects for early stage investment, offering opportunities for Culham's research scientists to explore the commercial viability of their ideas and thus making the need for rapid implementation of the second phase of the culture change programme all the more pressing. At the same time membership of the consortium offers excellent opportunities for learning through information sharing and the exchange of ideas, a key element of change management.

## 3. INNOVATIVE LEADERSHIP

Wickham[3] states that "entrepreneurship is about creating and managing vision and communicating that vision to other people. It is about demonstrating leadership, motivating people and being effective in getting people to accept change". It has also been said that "cultural change spreads not because the top is in control of the spread but because the top creates the right climate for the change to spread"[4]. Whereas public sector management is obliged to concern itself with stability, with optimising performance within the existing environment, the creation of an entrepreneurial climate within a predominantly risk-averse research community demands appropriate leadership to dilute the tension between the actual and the possible and thus drive change forward. Baker[2] refers to this as "leadership-driven commercialisation", recommending the promotion of risk management and a "more mature understanding and handling of risk".

The above theories put forward by Wickham[3] and Stacey[4] lie at the heart of Culham's cultural change process, with Fusion & Industry management seeking to introduce policies and practices which facilitate entrepreneurism and a readiness to recognise the potential benefits of managed risk-taking. The significance of committed and enthusiastic leadership will be explored further in sections 7 and 8 where the commercial growth and cultural development of other comparable organisations and institutions are outlined as part of a benchmarking exercise.

Wickham refers to the importance of 'communicating the vision' and it is communication which has had a pivotal role in driving the learning culture, signposting the commercial opportunities for those engaged in innovation and the processes through which they might be realised. The following section outlines the various types of publicity which have been used to overcome organisational barriers and encourage entrepreneurial activity.

## 4. COMMUNICATING THE VISION

A variety of mechanisms have been used within the research division to publicise the entrepreneurial message, including roadshows, leaflets, newsletters, posters, teamtalks and the internal and external web pages. Publicity is a consistently applied communication tool to foster and facilitate the climate of cultural change, and a number of key contributors to the communication process are identified below.

### 4.1 Leaflet: 'Your Questions Answered'

A Fusion & Industry focus group held in May 2001 identified specific problems raised by the move towards a more entrepreneurial culture, summarised in a set of key questions typically posed by staff. The group found that staff "remained unclear as to the relationship between commercial and operational commitments and the level of involvement expected". It was therefore strongly recommended that such questions be addressed in order to clarify this relationship, eliminate potential conflict and thus maximise successful implementation of the

proposed changes. These questions, together with the management response, formed the core section of a 4-page promotional leaflet, including questions and answers such as:

- **Q:** "In terms of consultancy, can we go beyond fusion-specific skills, e.g. use of general problem-solving skills?" **A:** *"Yes, our general problem-solving capacity is equally valuable to industry as fusion-specific expertise and will enable us to support a wider range of businesses."*
- **Q:** "Should we be pro-active or simply reactive?"' **A:** *"We should be as pro-active as operational/programme commitments will allow. The government is encouraging research establishments to realise the economic benefits of their work through a cohesive commercialisation strategy."*

The leaflet also included details of Fusion & Industry aims and activities and an advertisement for the forthcoming 'Rainbow Roadshow', an event designed to raise staff awareness of the opportunities presented by UKAEA's membership of the Rainbow Seed Fund consortium.

### 4.2 Roadshow

The roadshow was held as a follow-up to the leaflet, in which a management panel addressed staff concerns and pointed to the need for innovative and marketable ideas. Those able to attend the roadshow have since formed a supportive core and are a key driving element in the continuous process of cultural change. At the same time a small number of those unable to attend requested further information, visited the Industry team for individual discussions or accessed the presentation via the Culham Intranet.

### 4.3 'Rainbow' Days

As an ongoing means of communication and progress assessment, visits to Culham Division are made at regular intervals by members of the Rainbow Fund operations team to discuss with individuals any ideas with commercial potential and which might be eligible for funding. The visits are advertised internally, raising the Rainbow profile and serving as a regular reminder to staff and contractors to explore possible commercialisation routes for their research.

### 4.4 Fusion & Industry Newsletter

The target readership for the quarterly newsletter produced by Fusion & Industry was originally intended to be external, the aim being to raise awareness amongst the business community of the numerous possible applications of fusion technology and to generate interest through presenting examples of innovative techniques and collaborative projects with industry. However, the newsletter has become an equally useful internal publicity tool through communicating success stories, with internal circulation having effectively more than doubled over the last year due to rising demand.

Effective culture change, however, requires more than a series of publications and events: it requires a central core of committed individuals driving change from within, seeking to influence and educate by example. The mechanism through which this is being achieved will be described in section 5.

## 5. FROM HIERARCHY TO NETWORK

### 5.1 Industry Champions Network

Organisations as 'webs of participation', with the ideas of individuals fitting into a matrix of innovation, is far more easily achieved within a network, where decisions are integrated horizontally, than within a hierarchical structure which is incompatible with the short lead times necessary to stimulate ideas. For this reason a team of entrepreneurial champions, representing

a range of fusion expertise areas, has been established within Culham Division "to scatter the seeds of desired attitudes and values, creating pockets of commitment"[5]. The champions, nine enthusiastic and highly motivated volunteers, act as exploitation scouts, identifying potential commercial outlets through discussions with colleagues and at the same time sharing best practice and reinforcing desired behaviours.

The network also has an evaluation function, assessing internal participation levels, the marketability of ideas and the extent to which successful exploitation is being achieved. In the longer term the group will reflect on the emerging needs for improvement and identify possible ways forward, valuable data which can be fed into the strategic planning process. Measuring the growth of the Industry programme in this way will provide a clear indication of future needs.

In terms of measurement of its effectiveness, evidence suggests that the team, although only very recently formed, has already identified a number of potential opportunities and is proving successful in generating innovative ideas through the creativity of its members.

### 5.2 Commercial Awareness Training

The extent to which the champions are able to influence the internal climate depends not only upon their drive and enthusiasm but also upon their knowledge of entrepreneurial issues. Provision of commercial awareness training workshops for selected groups is currently being arranged to enhance the capability and commitment of supportive individuals, with the first tranche of training aimed at the champions network. The workshops will cover topics such as market assessment, investor needs and intellectual property rights (IPR). The opportunity of attendance at a series of public seminars will also be made available to Culham staff by the Rainbow Fund operations team. In addition it has been suggested that appropriate visiting speakers from industry and the Rainbow consortium could offer valuable lessons in success and failure and demonstrate that the latter is sometimes a necessary first step on the entrepreneurial road.

### 5.3 Team Creativity and a Learning Culture

It has already been argued that broad-based behavioural change necessitates the team approach. Where a diversity of thinking patterns is represented within the team, creativity will be greatly increased. Although creativity is not exclusively a product of social interaction – it is sometimes possible for an individual to be more productive in generating ideas than a team - research suggests that even the brightest individuals will not be able to outperform an average but dynamically balanced team in terms of innovative output: "creativity is within a person; innovation is within a team"[6]. Exploitation of team dynamics thus creates the potential to engage in continuous incremental innovation, since it is the dynamic mix which determines the team's performance capacity. For Culham's Industry initiative the champions network presents an excellent opportunity to cultivate an entrepreneurial approach through enhancing team creativity, which in turn will encourage innovative ideas and solutions. The possibilities in terms of idea generation for a team having a balanced mix of personality types has already been evidenced by the champions network, since team meetings yield a rich profusion of ideas. It is possible that similarly creative behaviour could be generated more widely where team membership were not confined to function but extended to include a range of thinking styles.

A recent research project has been carried out internally to identify the extent to which human dynamics determine innovation levels, i.e. the extent to which collective behaviour can be directed towards delivery of organisational strategy through the control of individual perception. Teams consist of individuals who each brings a particular interpretation to any process. The challenge for organisations is to manage perceptions and to channel the resultant behaviours towards the desired end. Such a task can be difficult within a traditional public sector

environment but research suggests that there is immense potential for highly regulated regimes such as UKAEA to overcome the barriers of structure and systems through the strategic use of high performance teams. The findings from a study of three high-profile UKAEA teams, formed according to function, pointed to the role of the leader in nurturing individual talents and combining them to maximum effect in line with business strategy. Teams were measured against a set of seven identified competencies, highlighting low performance in three specific areas: creativity, continuous learning and networking. Interestingly, these are areas key to the success of the Fusion & Industry programme and it is therefore important that consideration be given to team composition where creative solutions are sought, and that efforts be made to increase networking opportunities and encourage a learning culture.

## 6. THE REAL VALUE OF PERCEIVED INCENTIVES

### 6.1 Motivation and Reward

In examining the human side of innovation, an organisation's capacity to innovate must be viewed in the context of the individual's willingness to change, i.e. in terms of staff motivation levels and the rewards which might be offered to facilitate such change. Baker[2] refers to the "need to re-balance incentives to encourage and reward scientists in knowledge transfer activities".

It has been argued, however, that intrinsic motivation is more likely to drive creativity and originality than extrinsic reward, which may increase the volume of ideas but not their quality. In looking beyond micro intentions to the wider significance of their work, research scientists need to be encouraged, through positive feedback, to perceive that the successful transfer of work is in fact part of their reward system, while some token recognition of their efforts might serve as a supplementary incentive.

Such views were reinforced by the findings of the 2001 focus group members, who suggested that financial reward for significant industry achievements be restricted to individual bonus awards, while the prime motivators would be their interest in the challenges presented, the possible contribution by industry to fusion research and the investment in the future of science.

Although the political and scientific value of entrepreneurism is indisputable, internal primary research has since indicated that such benefits are not perceived by staff as sufficient to warrant the additional time and effort which commercialisation activities would incur, a view shared by other Rainbow Fund partners. At the same time the Government recognises the potential difficulty in striking the balance between provision of adequate staff incentives and retaining core public sector values, and has consequently produced a guidance document for PSREs[7]. The culture in research establishments has traditionally been to value the excellence of research almost exclusively. According to the Office of Science & Technology (OST), the culture should now value not only the scientific excellence of research but also the impact it makes on the nation's prosperity. One way to achieve this culture change is to offer staff incentives which encourage them to maximise the economic potential of their research.

### 6.2 Rewards to Inventors Scheme

Without perceived incentives it is unlikely that the majority of Culham's research scientists will be sufficiently motivated to pursue commercial opportunities, given the heavy core research demands on their time. Discussions are therefore being progressed to identify a suitable 'Rewards to Inventors' scheme, based on the practices of comparable organisations. Features of other PSRE reward schemes include:

**(a) Shared Income**

The idea of the 'Rewards to Inventors' Scheme is to reward financially those who invent commercially viable technology. This technology can be either a product or a process. The most common form of incentive scheme, explicitly aimed at rewarding innovation and knowledge transfer, shares with the relevant individuals a proportion of the PSRE's income from successful commercialisation projects. These generally work on a sliding scale, allocating a higher proportion (up to 100%) of the first several thousand pounds of income to staff and a lower proportion of the income thereafter.

**(b) Allocation of Income to Departmental Budget**

An additional option is sometimes offered, whereby individual inventors who wish to waive their entitlement to any share of exploitation income in favour of their departmental or group budget may do so. A departmental benefit can be advantageous in encouraging management support and lessening the perceived conflict of interest between the organisation's core research mission and the individual's pursuit of commercial activities. The Baker Report$_2$ underlines the need for PSREs to develop policies to manage conflicts of interest rather than allowing fear of potential conflicts to prevent involvement in commercial exploitation.

**(c) Paid Consultancy**

Another form of incentive which the OST recommends is that of allowing staff to take positions as paid consultants to outside companies during official time. It is suggested that senior PSRE managers give prior approval to each consultancy and consider setting a maximum limit on the amount of working time a member of staff may devote to external activities. The OST also suggests that the terms of such consultancies be checked to ensure that the PSRE's intellectual property is properly protected and that no liabilities are incurred.

## 7. SHARED LEARNING

A benchmarking exercise involving interactions with selected European fusion associations and other comparable UK organisations has been carried out to gather data on their entrepreneurial practices and policies. This has provided a valuable source of learning in areas such as the strength of management leadership, promotion of commercial awareness and entrepreneurial training, and the perceived benefits of commercialising research, all of which will provide guidance for the setting up or refining of our own policies in line with good practice. An indication of the key learning points from a number of the organisations consulted is outlined below, with the emergent common themes summarised in the final section.

### 7.1 Organisation 1

- **Management direction**

This organisation is comparatively new to the promotion of commercialisation, having started to move in this direction within the last 3-4 years, but management is committed to entrepreneurial values, generating a positive message to staff, who are enthusiastic and exploit whatever opportunities they can to encourage spin-off.

- **Promotion of commercial awareness & training**

No staff training has been given in commercial awareness, although this might be a consideration for the future.

- **Perceived benefits of commercialising research**

No financial incentives are offered to reinforce cultural change. IPR exists in the form of patents: by national law these are the property of the individual but any benefits gained must pass to the employer, thus removing the potential for conflict. There are perceived benefits, however, in that scientists enjoy the additional dimension to their work which collaboration

with industry provides and appreciate the importance of industrial applications to the future of science. Motivation is therefore primarily intrinsic.

### 7.2 Organisation 2

- **Management direction**

There is strong management enthusiasm for entrepreneurial activity with an excellent support package offered to start-ups, e.g. sponsorship of external consultancy, the possibility of part-time employment and up to 3 years' leave in order to start-up with the option of returning to the research centre. A contract may be drawn up between the start-up and the organisation for use of equipment or for common research projects.

- **Promotion of commercial awareness & training**

Training in marketing and management is offered in co-operation with the local chamber of commerce.

- **Perceived benefits of commercialising research**

The organisation focuses not on incentives but on support measures to stimulate technology transfer. The benefit of participation in entrepreneurial activities is perceived to be the enhanced image of the organisation: no financial incentives are currently offered (although discussions are taking place with financial representatives), other than in the context of IPR: there is a personal reward for a patent application and around 10-20% of the income from royalties for the inventor.

### 7.3 Organisation 3

- **Management direction**

Management is supportive although the institutional structure and mindset can be barriers to commercialisation. Knowledge transfer with industry is seen as a beneficial two-way process and cross-group discussion is actively encouraged to promote knowledge and competence.

- **Promotion of commercial awareness & training**

No specific commercial awareness training is given but awareness is promoted through open days and exhibitions. Networking with other organisations is seen to be a valuable element of culture change, along with cross-fertilisation with the on-site university departments.

- **Perceived benefits of commercialising research**

Again the commercialisation of research is perceived to enhance the organisational image, with royalties from IPR being split three ways between the employee, the organisation and its subsidiary.

### 7.4 Organisation 4

#### 7.4.1 Site A

- **Management direction**

There is strong support at senior level but there is a need to 'dilute the tension' between commercial and operational needs at middle management level.

- **Promotion of commercial awareness & training**

Commercial awareness is raised by means of internal roadshows given to individual departments and involving group leaders. The training offered covers mainly IPR issues and takes the form of departmental away days.

- **Perceived benefits of commercialising research**

In terms of incentivisation, sliding scale rewards are offered to inventors with an ex gratia award of £500 (~ 738 Euros) per patent to be shared by the inventors. The benefit of participation, however, is primarily perceived to be the recognition gained from patent applications.

### 7.4.2 Site B

- **Management direction**

There is clear management direction, with commercialisation objectives and monitored targets. A team of 4 commercial 'experts' drives the entrepreneurial process.

- **Promotion of commercial awareness & training**

The extent to which scientists understand their role in the commercialisation process is highly variable and for this reason an inventors' handbook is in preparation. Commercial awareness is generated via a wide range of marketing mechanisms, with training given for selected staff. Ideas are shared through networking at all levels - locally, nationally and internationally.

- **Perceived benefits of commercialising research**

A formal Rewards to Inventors scheme is in operation and an IPR policy is also currently in preparation. It is, however, questionable whether staff perceive these to be adequate reward for participation since staff commitment to the commercialisation strategy is fairly low.

## 7.5 Organisation 5

- **Management direction**

There is evidence of strong management commitment within the organisation.

- **Promotion of commercial awareness & training**

As a result of brainstorming exploitation issues at a staff seminar, an exploitation best practice network was set up with representatives from each of the research centres meeting several times a year. 4 exploitation scouts were also recruited. The organisation also has access to a mentoring network of financial and legal experts and a network of external commercial experts.

- **Perceived benefits of commercialising research**

A Rewards to Inventors scheme on a sliding scale is in operation, along with the organisation's own Innovation Fund, both of which are seen to be an effective means of incentivisation.

## 7.6 Organisation 6

- **Management direction**

There is strong support at Chief Executive and Board level but some ambivalence at Department Manager level.

- **Promotion of commercial awareness & training**

The scientists' understanding of the entrepreneurial process is variable. Awareness is promoted through roadshows, briefings, brochures, information sheets and the Intranet. Training is offered to research groups on request and to technical leaders and group leaders. In terms of commercialisation experts, 3 people are assisted by 2 technology transfer staff, along with 6 patent attorneys. Ideas are shared externally via the Rainbow Fund partners and through interactions with other PSREs.

- **Perceived benefits of commercialising research**

An appropriate reward strategy is still in the process of being determined. The extent of staff incentivisation is variable, with some keen to pursue commercial opportunities and others showing little interest.

## 7.7 Organisation 7

- **Management direction**

The structuring of the Technology & Exploitation Group is significant in that, as part of the Programmes Group, it is represented as core business to avoid the perception that exploitation is a separate activity. There are also key performance indicators for the Industry Co-ordinator and Technology Transfer Co-ordinators which involves measurement of outputs such as number of spin-outs and number of licensed technologies.

- **Promotion of commercial awareness & training**

Staff understanding is generally low but there is interest from a core group. The team is seeking to change its culture through presentations, technology workshops and networking with industry. In terms of specific training, an Enterprise Awareness course and an Enterprise Fellowship scheme are offered, the latter proving very successful in generating start-ups. Workshops, technology events and an Industry Club are used to raise awareness. Ideas are shared through a knowledge transfer group and through networking with other organisations.

- **Perceived benefits of commercialising research**

There is currently no Rewards to Inventors scheme. The benefits of entrepreneurism are generally perceived as participation in a valuable activity, achieving the organisational mission, enhancing its image and investing in science and the future.

## 8. SUMMARY

The results of the benchmarking exercise in section 7 and the internal cultural studies highlight the significance of the human element in innovation and the role of a learning culture in encouraging entrepreneurial values.

**Clear management direction** is needed, together with tangible support in terms of training, assistance and flexible career options. It is important that such direction be cascaded to lower levels to reinforce middle management commitment.

**Communication** is the key to culture change, not only in terms of promotional material and marketing mechanisms, but also in terms of information sharing and collaboration across organisations. All participants in the various cultural studies which have been outlined acknowledged the value of networking in educating staff and encouraging entrepreneurism.

**Intrinsic motivation** is the real driver of the commercialisation process. Where extrinsic rewards do not match the individual's perception of benefits, they will not provide sufficient incentive to create the desired culture: it is therefore vital to identify the potential benefits **as they are perceived by staff** and align strategy accordingly in order to achieve success.

**Enhanced team creativity** will increase innovative output; i.e. promote the generation of ideas. This can be achieved by facilitating the dynamic balance of team members.

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**References**

1 Katz R (1997), The Human Side of Managing Technological Innovation, Oxford University Press
2 Baker J (1999), Creating Knowledge, Creating Wealth: Realising the Economic Potential of PSREs
3 Wickham P A (1998), Strategic Entrepreneurship, Financial Times Pitman Publishing
4 Stacey R D (2000), Strategic Management & Organisational Dynamics, 3rd Ed, Prentice Hall
5 Mabey C, Mayon-White B (1993), Managing Change, 2nd Ed, Paul Chapman
6 Cartwright J (1999), Cultural Transformation, Prentice Hall
7 OST paper (July 2000), Good Practice for Public Sector Research Establishments on Staff Incentives and the Management of Conflicts of Interest