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Letter from the Editors

Running into Business!

There we are! The second issue of the Journal of Business Chemistry is published. We are happy and proud to present you articles form North America and Europe, covering topics from Drug Development to Innovation Insights.

We thank, of course, all the authors of the second issue of the Journal of Business Chemistry for their great work and effort. From time to time it might be difficult for authors and editors as structures and communication paths are not yet perfect. Special thanks go to Marion Brinks, Kathrin Duwe and Verena Potysch who helped us a lot with the editorial work.

There is something new about the second issue as well. The Journal of Business Chemistry is indexed and abstracted in EBSCO. EBSCO Information Services is a worldwide leader in providing information access and management solutions through print and electronic journal subscription services, research database development and production, online access to more than 100 databases and thousands of e-journals, and e-commerce book procurement. For a new journal like the Journal of Business Chemistry this is a great opportunity.

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Research Paper

Organising Product Stewardship in Large Chemical Companies

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Abstract: The paper analyses the organisation of Environmental, Health and Safety (EHS) management in the chemicals manufacturing industry, focussing in particular on the implementation of the "Responsible Care" framework and the concept of "Product Stewardship". We conduct in depth interviews with two major manufacturers of speciality chemicals regarding their overall strategy with respect to product safety, the organisational structure of their EHS management, the decision processes involved in product development and their Product Stewardship management systems. The efficiency of centralised versus decentralised organisational structures for achieving product safety are discussed and suggestions are given how the incentives of companies to efficiently implement and follow Product Stewardship guidelines can be enhanced.

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Introduction

The wide range of Chemical Control Laws as well as the danger of legal product liability provide chemical manufacturers with direct incentives to pay attention to Environment, Health and Safety (EHS) issues. However, top management in chemical manufacturing has long recognised that efficient EHS management is not only necessary for legal compliance but is also crucial for achieving sustainable profitability and a positive image with the clients as well as with employees [1,2,3]. Leaders of the global chemical industry have therefore announced a major strategic review to re-vitalise and strengthen the Responsible Care initiative [4] and in particular the concept of Product Stewardship. So far, however, there is no published empirical study on the experience with EHS management systems and Product Stewardship in the chemical industry [5].

The purpose of this paper is to bridge this gap with a qualitative study of two major chemicals manufacturers. We will describe how EHS Management can be organised in general and present existing EHS management codes and systems. We will then demonstrate in detail, how far the Responsible Care initiative and the concept of Product Stewardship have been implemented in the two companies analysed and identify organisational factors which have led to the often sluggish adoption of the principle of Product Stewardship. The ultimate goal of our paper is to generate suggestions of how implementation can be improved. We hope that our analysis of organisational aspects of Product Stewardship will also provide some general insights into how EHS problems can be addressed with mechanisms falling somewhere between free markets and public regulation. This aspect might be particularly relevant for the understanding how the proposed new European chemicals legislation REACH will function at the company level.

EHS Management

Environment Health and Safety comprises a large range of issues as different as employee and general health and safety protection, process safety, environmental protection, distribution safety and the conservation of natural resources and energy resources. Most of these issues are subject to a high number of different regulations and requirements.

The few available studies on the adoption of Environmental Management Systems [6,7], which consider also organisational issues, demonstrate that the organisation of the EHS functions within the companies differs considerably. Whereas sometimes functions relating to EHS are entirely delegated to the relevant divisions, other companies have centralised these functions in a top management position. The advantage of a decentralised organisation is clearly that units at the division or operational level will be better informed about individual products and their potential risks. Putting the responsibility for EHS issues at their level may lead to earlier warnings and more efficient reaction. In addition line managers and supervisors know from experience what is doable and what is not.

The problem is, however, that the operational staff may have the wrong incentives to reveal potential problems and change existing processes and procedures. Another problem is that decentralising responsibilities may lead to informal, ad hoc, reactive and undocumented structures. If procedures and responsibilities are not written down, when the managers change, so will the company's ways of operating. Compliance to legislation cannot be consistently implemented or verified.

In order to benefit at the same time from the operational knowledge of line managers as well as from documented and formalised approach, most chemical manufacturers have decided to use a mixed organisational structure, establishing a small product safety office at headquarters, with a number of safety assignments at operating levels. In addition more and more companies now adhere to a EHS code or rely on a formalised EHS management system.

EHS Codes and Management Systems

Codes of EHS management practice and EHS management systems emerged as a tool of EHS policy in the late 1980s to change the behaviour of participating firms and to increase public

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confidence in industry's commitment to EHS. Codes are supposed to improve the company's performance by institutionalising new practices as for example community advisory panels and public EHS reports. Management systems have been created for a similar purpose, but provide much more detailed advice and rely on established certification mechanisms to verify that members are doing all that is required of them. We will briefly describe the most important codes and management systems. Note that there are numerous other national codes available throughout the world.

A ISO 9000

ISO 9000, the international standard for quality was the first management system developed by the International Organisation for Standardisation (ISO) in 1987 and has now been widely adopted. The ISO 9000 family of standards tries to implement good management practices with the aim of ensuring that the organisation can consistently deliver high quality products or services. ISO 9000 is a generic management system standard, meaning that this standard can be applied to any organisation, large or small, in any sector of activity, and whether it is a business enterprise, a public administration, or a government department.

B ISO 14000 and EMAS

The ISO 14000 series is the international standard for environmentally friendly management practices. It was established only in 1996 and has a similar structure as the ISO 9000 series. Since its introduction ISO 14001 certifications have grown rapidly, with currently more than 20000 certification being issued world-wide. The EU Eco-Management and Audit Scheme (EMAS) is similar to ISO 14001. The scheme has been created in 1995 [8] and was originally restricted to companies in industrial sectors.

C OHSAS 18001

OHSAS 18001/2 is an international health and safety management system specification which was created in 1999 through the concerted effort from a number of the worlds leading national standards bodies, certification bodies, and specialist consultancies. A main driver for creating OHSAS was to try to remove confusion in the workplace from the proliferation of certifiable OH&S specifications.

D Responsible Care (RC)

Responsible Care is a voluntary program of self-regulation, which specifically addresses the problems of the chemicals manufacturers and integrates the requirements of chemical legislation. RC originated in Canada in the late 1970ties. Canadian chemicals firms developed this code as the principals regarding the management of chemicals. Initially RC failed to receive broad acceptance. However the 1984 disaster at a Union Carbide plant in Bhopal, India, which killed 3,000 people, and a series of other safety events[1] transformed RC from a small voluntary activity to a major world-wide initiative [9].

Currently 47 countries are adopting RC programs. A recent report published by the International Labour Organisation [10] provides an international evaluation of a large number of RC programs. It shows in particular that there is still a lack of effective codes of management practice in order to measure Product Stewardship. CEFIC [11] reports on the current situation of the European RC Program. Overall the "Responsible Care" initiative has been well received by the public but fiercely criticised by Environmental and Consumer groups: Critiques point out the lack of real progress measured in reductions of chemical spills, explosions and worker injuries [see e.g. 6,12]. They explain this fact with the lack of commitment for companies to measurable goals for reducing chemical hazards and objective assessment of progress by independent outside authorities. In order to address these critiques, RC is now moving beyond codes of management practices to a more formalised management system approach.

The most important instruments of RC at the company level are guiding principles and codes of management practices. Instruments developed

[1] E.g. the release of pesticide from a Union Carbide plant in Institute, West Virginia and the explosions in 1990 and 1991 at two Texas chemical plants which killed a total of 27 workers.

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most recently are measures of performance and a process for verifying and certifying company's EHS management systems. The RC codes of management practices address six different aspects of EHS policies roughly corresponding to different legal requirements: (1) Community Awareness and Emergency Response, (2) Pollution Prevention, (3) Process Safety, (4) Employee Health and Safety, (5) Distribution and (6) Product Stewardship.

Product Stewardship

Product Stewardship is the management code for assuring the safe handling and use of chemicals, throughout each chemicals' life cycle, that is from R&D, design, manufacturing, marketing distribution, use, recycling and disposal of chemical products. This is the most important part of the code covering the legislation like the Dangerous Substances Directive in the EU or the Directive on Existing Chemical Substances. The "Responsible Care" code provides twelve detailed Management Practices (MPs) in Product Stewardship that have to be respected. These twelve practices can be roughly divided in three categories. We will briefly review the relevant recommendations made in each of these categories:

Management Leadership and Commitment (MP 1-3)

The first three Management Practices deal with managerial and organisational aspects of Product Stewardship. They explain how to give directions, provide resources, set priorities, establish responsibilities. They also describe how to establish goals and responsibilities how to evaluate performance against these goals.

Information and Risk Characterisation (MP 4-5):

Management Principles 4 and 5 stress the need to continually increase the body of knowledge surrounding chemical products in order to improve hazard identification and risk characterisation.

They explain how to collect hazard information, how to review and evaluate this hazard information for disclosure requirements and how to communicate this information via Material Safety Data Sheets and Labels. The Management Principles also explain how to use this information to characterise „Risk".

Risk Management (MP 6-12):

Finally the largest number of Management Principles concern risk management, the cornerstone of Product Stewardship. Good risk management means first that all technical possibilities to reduce or completely eliminate risk should be considered and only in the second place efficient reaction to hazard that have already happened.

Case Studies

Previous Empirical Studies

There is only a handful of published studies on how firms respond to trade association codes like RC[2]. Howard *et al.* [6] explored RC adoption in the US at 16 mid-sized firms and found substantial variation in adoption practices except in local community relations and distribution practices. Korzinek *et al.* [12] have focussed in particular on the critical arguments of recent studies regarding the progress made with the implementation of RC. However, there is only one recent study about the implementation and organisation of EHS strategies and Product Stewardship in the chemical industry. This study [13] was conducted by the US consulting firm Pittiglio Rabin Todd McGrath (PRTM). They surveyed a total of 74 companies including 35 diversified industrial chemical manufacturers. The obvious conclusion is that there is no standard approach to product safety management and that only 33% of the companies have a formal Product Stewardship process in place. The question we want to address is why formal Product Stewardship approaches have not been adopted more widely. The PRTM study gives no indication of which companies have been more advanced, why some companies lag behind and

[2] For a survey of the literature see Nash [5].

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how barriers for the adoption of Product Stewardship can be removed.

The Approach

For understanding the complex organisational problems that arise from an implementation of a Product Stewardship Strategy, a purely quantitative approach as followed by the PRTM study cited above, is not very helpful. The success of such a strategy rests to a large extent on team-building, effective organisational-level cross-functional communication and the balancing of very diverse orientations like the ones of R&D, marketing and EHS. An optimal organisational design requires in particular effective communication [14,15] within the company between the different functions as well as with the supplier and product users.

The optimal structure, however, will depend critically on the industry and even within an industry on the product group analysed. In this respect the chemical industry will be very different from the large sample of industries analysed in the PRTM study.

In order to obtain a basic understanding of how Product Stewardship is implemented at the corporate and the divisional level in the chemical industry we used the case study methodology [16,17] exploring in detail two companies with similar size and product range but with different organisational structures, one of them being more centralised, whereas the other had decentralised more of their EHS functions.

We selected these companies based on information gathered from interviews conducted in 1999 and 2000 with management from Regulatory Affairs and R&D Departments of eleven European, seven Japanese and five US firms [18]. Both companies analysed are speciality chemical manufacturers which had already a few years experience with the implementation of Product Stewardship. We were able to talk to several executives at the corporate and divisional levels within each of the firms.

To be sure to capture different views due to different task assignments and experience we have interviewed in each firm at least one EHS person at the corporate and one at the divisional level. It should be mentioned that access to these chemical firms was not easy because operating knowledge of Product Stewardship is considered as a source of long-term competitive advantage.

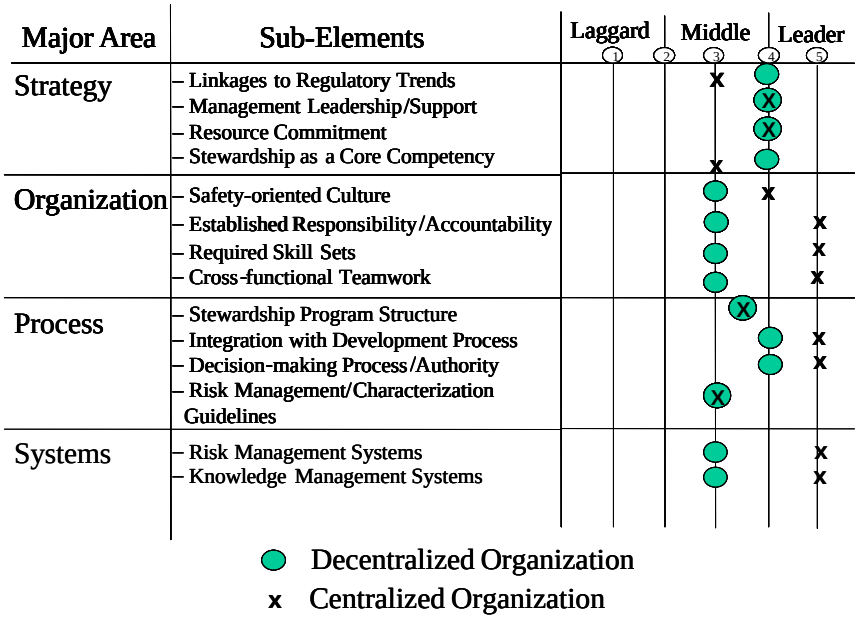

Figure 1: Quantitative results from the questionnaire.

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To obtain some quantitative as well as qualitative information we used more closed-ended, structured interview questions combined with open-ended, qualitative questions [19]. We first asked the participating executives to fill out a questionnaire similar to the one used in the PRTM study, comprising more than 50 questions organised in four main areas: strategy, organisation structure, process organisation and management systems. Based on their response to these simple questions we then tried to enlarge an deepen the discussion to understand their vision of the Product Stewardship Process. The main focus of the interviews was the analysis of management practices.

Figure 1 gives a short overview of the quantitative responses to our questionnaire, regrouping similar questions and the responses of the managers in the two companies. Below we will discuss these results in detail, taking also into account the insights gained form the in-depth interviews.

Strategy

The company's fundamental strategy regarding Product Stewardship should be the driving force behind its concrete efforts to achieve product safety. In order to analyse the firms' commitment to Product Stewardship, we have distinguished between several aspects of the firms' EHS strategy.

First, we tried to find whether the companies considered new regulatory developments and safety trends as important for their product development. Indeed, both of the interviewed firms regularly investigate regulatory and safety trends and are working proactively with regulatory agencies when developing new products. This corresponds to the findings of PRTM, where more than 50% of the firms consider linkages to regulatory developments important.

We have then investigated how deeply senior management is committed to Product Stewardship. We know from the literature on organisational behaviour that the involvement of senior management is crucial for the success of organisational change and innovative behaviour. Again, our findings as well as Keller's [20] results indicate a full support of senior management. In both companies, management has integrated aspects of Product Stewardship into the corporate goal system. However, only one of the companies interviewed has a formal Product Stewardship Program, which is regarded as one of the company's core competency and is continuously improved.

Finally, it is of course important for a successful implementation of Product Stewardship that the appropriate resources are provided by the company. Again this does not seem to be a problem at the companies interviewed. There is a significant indication for a strong resource commitment for the implementation of Product Stewardship in the PRTM and in our sample.

Summarising these results, it seems that both firms are indeed regarding Product Stewardship as an important aspect of their strategy and that they are willing to invest sufficient financial and management resources to achieve this goal.

Organisation Structure

In a next step we wanted to analyse how the strategic orientation of the companies is reflected in the organisational structure of their EHS management. Again we tried to identify several dimensions of an organisation's structure: We first analysed how well safety concerns were integrated in the decision process, i.e. how much the company's overall culture is safety-oriented. We then looked concretely at the assignment of responsibility, the knowledge base of Product Stewardship and the use of cross-functional teams. Interestingly, whereas both companies had similar goals regarding Product Stewardship the organisational arrangements to achieve these goals differed markedly.

The differences do not really appear in safety-orientation of the company's culture. Both companies interviewed as well as most companies from the PRTM sample integrate safety, environmental and regulatory compliance explicitly in their decision processes regarding it as top priority when assessing trade-offs. In particular, product regulatory compliance concerns, including the whole set of requirements posed by chemical control laws, seem to be always taken into account when new products are developed.

More interesting discrepancies can be found when looking at the assignment of responsibilities.

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How well responsibilities are assigned to clearly identified persons seems to be closely related to whether the Product Stewardship functions are centralised or decentralised. In fact, over the past years both companies in our sample have started to decentralise Product Stewardship decision-making and responsibility. This process is still ongoing and has reached a different stage at the two companies interviewed. Our result clearly shows that Product Stewardship responsibilities are better defined at the more decentralised company.

In fact the observed trend for decentralisation is typical for the entire industry. In most chemicals manufacturers, centralised units like Product Stewardship/Regulatory Affairs/Toxicology Labs etc. were decentralised during recent restructurings. Examples include Ciba SC, Clariant or Degussa. Only some companies like BASF or Bayer with their Toxicology Labs still have centralised units.

According to the managers interviewed the current trends towards decentralisation has two main reasons: Firstly emission protection and emergency responsibility laws require personnel in charge at the plant level. In addition "old-type" centralised units were too expensive and there was continued struggle to receive the required budget. During restructuring processes people from these units were moved to the level of divisions or business units to take-over Product Stewardship tasks. This creates the advantage to have Product Stewardship responsibility very close to the product. In general, there are only very few employees working on EHS and Product Safety at the corporate level, in most companies less than ten. They have to organise the implementation and control of Product Stewardship as well as to generate problem solutions for overlapping issues, which are not solved at the divisional level.

The difference between the more decentralised and the more centralised company are evident also in the third and forth dimension of the organisational structure we analysed. The centralised company has a formalised, well documented knowledge base for Product Stewardship and cross-functional teams, whereas the more decentralised company tends to rely on experience and a less formal organisation of cross-functional teams.

In particular cross-functional teamwork together with the assignment of a co-ordinator at the divisional level (Chemicals Manager or Product Steward) seems to be a the core elements of a successful Product Stewardship organisation. Product Stewards would lead the multi-functional teams. Usually these teams are comprised of all divisional functions, e.g. R&D, Supply, Production, Marketing, Application Technology, Regulatory Affairs. This team has to identify the potential risks of existing and newly developed products as well as the potential risks of the product portfolio of the entire division. The team has also to decide on a risk management program and its implementation.

Summarising the above discussion it seems that despite strong overall commitment to Product Stewardship, concrete differences at the organisational level can lead to differences in implementation. Most importantly a centralised structure seem to keep Product Stewardship responsibilities at upper levels of the organisation.

Process Organisation

After analysing the general organisation of the Product Stewardship functions in the company we looked in more detail at how the Stewardship program structure its integrated with the product development process and how the authority of decision-making in the process and the Product Stewardship management structure is organised.

Both companies had a formal Product Stewardship process. This process is in general clearly structured with defined starting and ending points, milestones and precedent relationships. Differences between the companies can be identified in the extent to which this process is fully documented. The centralised company had more complete and verifiable documentation which leads to an increased work load for the involved decision makers. It is worthwhile noting, however, that both companies of our sample were not really happy with the structure of their Stewardship Program, because of the work intensive formal procedures involved.

The second process dimension, the integration of Product Stewardship into the development process is crucial. Interestingly the centralised company considers its procedures to be better

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integrated than the decentralised company, which might be a problem of perception. Corporate managers might be unable to verify the integration at the divisional levels and divisional managers without full knowledge of the Product Stewardship requirements might feel that they are implementing and integrating these requirements correctly.

The same bias could be at work in the third dimension considered, the appropriateness of the decision making responsibilities.

Only the decentralised company has clearly identifiable Product Stewardship decision-makers which are different form the decision makers in the product development process. However, in both companies the decision on important questions are in general taken by cross-functional teams. Finally in both companies risk management and risk characterisation guidelines are being implemented, based on the RC Product Stewardship code. However, the divisional as well as corporate managers we interviewed agreed that these guidelines are not always well understood and furthermore not always followed.

Overall problems with the process organisation seem to be better identified at decentralised companies, even if the solution to these problems does not have to be more efficient. It should also be pointed out that both companies understand the adoption of Product Stewardship as an ongoing process and continue to develop and improve the management tools.

Management Systems

Finally we wanted to investigate how Product Stewardship management systems and knowledge management systems where used in the two companies. Product Stewardship management systems are computerised systems that identify and document project specific Product Stewardship actions to be undertaken during the product development process as well as during the entire product life-cycle. Knowledge management systems are simply comprehensive databases including all information on environmental, health, safety and regulatory compliance and registration hazards and exposures.

Both companies have internally developed systems of different complexity. The system of the centralised company is fully integrated, incorporating information from distributors audits, whereas the system of the decentralised company provides only basic guidance for most products tracked and is not used on a regular basis. Overall, the centralised company used more sophisticated state of the art technology than the decentralised organisation.

We have summarised the qualitative differences in all of the four areas again in Table 1. Clearly a centralised organisation makes it much easier to overcome resistance against changing established working habits from divisional mangers. This makes the adoption of sophisticated state of the art systems much easier. The involved managers on the divisional basis, however, did not seem to be convinced that these state of the art systems would lead to a more efficient work process.

Of course our results are derived from a very small sample, as we have deliberately restricted ourselves to examining two similar firms. It is not sure that our conclusions can be generalised. A more complete study would be a worthwhile goal for further research, however, including more firms will also imply comparing very different companies in which case it may be difficult to identify the reasons for the different Product Stewardship strategies adopted. Further research should also focus on how downstream users are integrated into corporate decision-making. This is one of the major goals of the Product Stewardship idea, but so far it is not clear how companies take into account the risk down the supply-chain.

Conclusion

The ultimate goal of an EHS code or a EHS management system is to systematise the way the work is done. If it is implemented well, Product Stewardship as defined by the RC initiative can be a powerful tool in driving continuous improvement in a company leading to better and simpler compliance, reduced EHS risks and liabilities, more cost-effective operations, and good positioning for future growth. However, our study shows that corporate organisation and policies can prevent efficient implementation of EHS systems.

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Dimensions	Company A (decentralised type – circle in Figure 1)	Company B (centralised type – cross in Figure 1)
Strategy		
- Contacts with regulatory agencies	Frequently	Rarely
- Allocation of resources by	Middle management	Senior management
- Amount of resources allocated	Sufficient	Sufficient
- Product Stewardship program	Formal but not always adhered	Informal and fully adhered
- Incorporation of improvement efforts	Usually continuous	Continuous
Organisation Structure		
- Integration of Product Stewardship concerns in product development processes	Informal	Formal
- Assignment of specific Product Stewardship roles and responsibilities	Informal	Formal
- Existing level of Product Stewardship skills and knowledge	Some	Sufficient
- Cross-functional teamwork	Informal	Formal and fully integrated
Process Organisation		
- Type and degree of programming of the process	Formal / not fully programmed	Formal / not fully programmed
- Integration of Product Stewardship and product development	Nearly fully integrated	Fully integrated
- Product Stewardship criteria clearly established	Yes, but not always adhered to	Yes, they are always adhered to
- Separate decision-making from Product Stewardship and development	Yes	No
- Tools for Product Stewardship management are in development	Yes	Yes
Management Systems		
- Product Stewardship and knowledge management system	Basic system / internally developed	Fully integrated system / internally developed
- Incorporation of information from distributor audits to ensure regulatory compliance and information of end users	No	Yes

Table 1: Qualitative results from the expert interviews.

This means that internal drivers are as important for the implementation of Product Stewardship as external drivers like regulatory expectations. Unless the Product Stewardship approach is well integrated with the organisational structure it will remain paperwork. In particular if standard solutions for Product Stewardship are adapted from existing EHS management systems without changing the company's culture, they are likely to end up as a collection of procedure notebooks in the plant manager's office.

If a management system for Product Stewardship is to improve the company's overall

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EHS performance close attention has to be given to how the design of the system interacts with existing management procedures and how the implementation and responsibilities are allocated on an organisational level.

On the organisational level all the concerned parties should be integrated in the program. One of the biggest difficulties in implementing management systems is overcoming the disjunction between the enterprise perspective and the business-unit perspective. The corporate perspective is focused on driving objectives, programs and results down the organisation from the top and this is how EHS management programs are usually started.

Often employees charged with implementing the system struggle to operationalise what they've been given. Work processes are complex, with frequent gaps and overlaps, and this complexity must be addressed. Department heads, managers, supervisors and employees all get involved at different times, and the chain of command is not always clear. Successful implementation means that the system must adapt horizontally to new and existing work processes, even though the management structure and accountability operate vertically. A good way of doing this is setting up cross-functional teams. It is also very important to include among the team members some of the people who will be implementing what the team designs.

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References

[1] Ciba (2003) *Environment, Health and Safety Policy*, Basel: Ciba Specialty Chemicals.

[2] Clariant (2002) Environment, Safety, Health ESH: Clariant's position, Muttenz: Clariant International Ltd.

[3] KPMG (ed.) (2002) *International Survey of Corporate Sustainability Reporting.*

[4] ICCA (2003) International Chemical Industry Strengthens its Responsible Care Initiative, Press Release, International Council of Chemical Associations.

[5] Nash, J. (2002) Industry Codes of Practice: Emergence and Evolution, in T. Dietz and P.C. Stern (eds.), *New Tools for Environmental Protection: Education, Information and Voluntary Measures*, Washington, D.C.: National Academy Press.

[6] Howard, J., J. Nash and J. Ehrenfeld (2000) Standard or Smokescreen? Implementation of a Voluntary Environmental Code, *California Management Review* 42(2): 63-82.

[7] Florida, R. and D. Davison (2001) Why Do Firms Adopt Advanced Environmental Practices (And Do They Make a Difference)? in C. Coglianese and J. Nash (eds.) *Regulation from the Inside – Can Environmental Management Systems Achieve Policy Goals?* Washington, DC: Resources for the Future, 82-104.

[8] European Commission (1993) Council Regulation (EEC) No 1836/93 of 29 June 1993 allowing voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme, *Official Journal of the European Communities* No L 168/1.

[9] Nash, J. and J. Ehrenfeld, (1997) Codes of Environmental Management Practice: assessing their Potential as tools for Change, *Annual Review of Energy and Environment* 22: 487-535.

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[10] Munn, K. (1999) *Responsible Care and related voluntary initiatives to improve enterprise performance and health, safety and environment in the chemical industry*, Geneva: International Labor Organization, Working Paper 109.

[11] CEFIC (2002) *Responsible Care, Status Report 2002*, Brussels: CEFIC.

[12] Korzinek, A., A. M. Warhurst and S. Scheuer (2003) *A new chemicals policy in Europe – new opportunities for industry*, Brussels: WWF European Toxics Programme and the European Environmental Bureau.

[13] Keller, W. (2002) Best Practices in Product Stewardship, in *RubberChem 2002 – The Third International Rubber Chemicals, Compounding and Mixing Conference*, Munich, 11-12 June 2002, Shawbury: Rapa Conference Proceedings, 147-60.

[14] Galbraith, J. (1977) *Organization Design*, Reading, MA: Addison-Wesley Publishing Company.

[15] Nonaka, I., and H. Takeuchi (1995) *The Knowledge-creating Company*, Oxford: Oxford University Press.

[16] Eisenhardt, K. M. (1991) Better Stories and Better Constructs: The Case for Rigor and Comparative Logic, *Academy of Management Review* 16(3): 620-627.

[17] Yin, R. K. (2002) *Case Study Research, Design and Methods*, 3rd ed. Newbury Park: Sage Publications.

[18] Fleischer, M., S. Kelm and D. Palm (2000) *Regulation and Innovation in the Chemical Industry*, Sevilla: Institute for Prospective Technological Studies (IPTS Publication EUR 19735 EN) (ftp://ftp.jrc.es/pub/EURdoc/eur19735en.pdf).

[19] Kvale, S. (1996) *Interviews: An Introduction to Qualitative Research Interviewing.* Thousand Oaks: Sage Publications.

[20] Keller, W. (2003), Best Practices in Product Stewardship - a separate analysis for the chemical industry, PRMT: Frankfurt/Main.

Appendix: Questionnaire

The questionnaire contains more than 50 questions to be answered either with yes or no or on a 5-point scale. The following examples illustrate the type of questions asked.

Strategy: Does your company communicate proactively with regulatory agencies when developing new products?

- Scaled from (1) “never” to (5) “always”

Organisation Structure: During the development of new products to which extent are cross-functional teams used to integrate Product Stewardship concerns with R&D, manufacturing, marketing, sales and representative end-users?

- Scaled from (1) “no cross-functional teamwork” to (5) “fully integrated cross-functional teamwork”

Process Organisation: What type of process is actually followed to integrate Product Stewardship concern?

- Scaled from (1) “no process followed” to (5) “formal and fully programmed process followed”

Management Systems: Is a Management System in place that documents product related environmental, health, safety and regulatory compliance information as well as actions taken or to be taken?

- Scaled from (1) “no system in place” to (5) “fully integrated system in place”

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Research Paper

Virtual Communities as an Organizational Mechanism for Embedding Knowledge in Drug Discovery: The Case of Chemical Biology Plattform

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Abstract: In this paper, we document the lessons from the development of chemical biology platform in a major pharmaceutical company, and the outcomes of the early phases of this experiment. Although the concept of chemical biology is not new, its evolution and deployment in the drug development process is relatively new. The present experiment thus has to deal with both the scientific novelty of chemical biology, and organizational challenge of embedding it in the ongoing process of drug development. The notion of virtual communities or platforms overlaid on the traditional matrix of drug development served to introduce the approach, with some remarkable outcomes.

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Introduction

In spite of widely heralded breakthroughs such as the human genome project, the innovation performance of the pharmaceutical industry as a whole has been lackluster. Although the specific figures are often under dispute, there is general agreement that the increasing costs of R&D[1] coupled with a stagnating number of chemical entities reaching the market often are interpreted to be signals of declining innovation performance in the industry as a whole. This 'innovation deficit' is not due to the lack of diseases needing remedies, or of drug targets, upon which drugs can be designed (1). Rather, it is attributable to the process of drug innovation or the means by which targets are brought into the market.

No doubt recent years have witnessed remarkable innovations in the process of drug discovery and development. Advanced technological innovations have made it possible to do the screening of compounds for chemical properties at a high rate. But these innovations have not resulted in innovation efficiencies expected by their proponents; they have simply sped up our ability to screen compounds. The failures of these innovations call for rethinking the approach to the problem.

In this paper, we summarize a case study of the introduction of chemical biology (CB) platform to speed up the process and enhance the effectiveness of the drug discovery process in a major pharmaceutical company. CB platform deploys emerging ideas from knowledge management to distill lessons from past experiences in drug development; but unlike many KM approaches, CB approach opens up new scientific frontiers at the junctures of chemistry and biology, relevant to drug innovation.

The scheme of this paper is as follows. In the first section, we outline our view of KM as practiced in organizations. Our intent is not to be exhaustive in our treatment of KM, but highlight a few ideas to anchor our discussion of the development of CB platform. In the second section, we articulate the concept of CB to highlight the scientific novelty of this emerging field, as well as the unique features of this platform that set it apart from other KM exercises. Thus our treatment here is not to highlight the scientific aspects of this field, but the excitement, uncertainties and risks associated with its introduction. In the third section, we summarize the industry and organizational contexts that prompted the introduction of CB platform. In the fourth section, we discuss the introduction and preliminary outcomes of introduction of CB platform. Finally, we highlight the major lessons from the experiment.

I. Knowledge Management Approaches: An Overview

Knowledge Management (KM) emerged over the past five years or so as a significant management discipline with its own body of concepts, language, and practices (2). Broadly conceived, KM enables, supports, and encourages the following three interrelated foci:

1. The processes of discovering or creating new knowledge and refining existing knowledge;

2. The sharing of knowledge among individuals, and across all organizational boundaries; and,

3. The continued development and use of knowledge as part of individuals' day-to-day work, and as part of decision-making.

But knowledge is not managed for its own sake. Rather the intent is to contribute to superior organizational performance (3), internal operating proficiency (4), and the quality-of-life of organizational members.

The evolving understanding of knowledge in organizational settings unavoidably brings in its wake two central knowledge challenges: (1) how to bring individuals together to create, share, and leverage knowledge, and (2) how to do so most efficiently and effectively in the interests of achieving the goals outlined above.

[1] The December 2001 estimates by the Tufts center suggest that the R&D costs for a new prescription drug have risen to slightly over 800 million dollars, due to rising clinical trial costs, expanding development programs, more chronic and degenerated diseases, and longer development times.

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Two broad approaches to managing the knowledge challenges appear to dominate both the literature and practice in organizations: Organizations deploy human and organizational arrangements to practice KM; they also deploy information technologies to contribute to knowledge work. The organizational and IT approaches have been applied to both intra-organizational and inter-organizational locales (exchanges within and across the organization's boundaries respectively). These two locales involve different contextual features that influence the content, direction, and intent of KM. For example, knowledge sharing-- a central focus in much of intra organizational approaches-- is influenced by the threat of intellectual property loss when applied to exchanges across the boundaries.

The *organizational approach* to KM explicitly addresses the human side of knowledge. It involves *managing* four interrelated elements so that individuals and groups better generate, share and leverage knowledge: 1) The choice, adoption and implementation of procedures or methods to bring individuals and groups together (who otherwise might not do so); 2) The formal and informal organizational settings in which individuals interact; 3) The organizational routines (e.g., process reviews, business case development) in which work occurs; and, 4) the organizational context in which all interactions and work take place, for example, creating and sustaining a knowledge-friendly culture (5,6,7).

The technological approach to KM involves the choice, adoption and implementation of information and related technologies. It requires the management of at least three distinct but related elements: 1) technologies that enable data gathering, massaging, mining and other data integration tools: these tools often involve establishing and refining many forms of data bases and/or automating, reconfiguring or integrating organization routines, processes or "best practices"; 2) technologies that enable data and information dissemination, distribution and deployment often requiring and enabling direct organization-wide or select involvement by individuals and groups; and 3) technologies that enable direct and real-time interactions among and between individuals and groups, often in distant geographical quarters, so that they can converse with each other, share data and information, as well as offer opinions, judgments and critique (8,9). Its overarching intent is to enable the timely provision of more and higher quality data and information, both selectively and generally, to individuals and groups throughout the organization.

The technological approaches dominated the early stages of KM, and were useful in understanding the patterns within explicit knowledge as captured by electronic data bases. However these approaches could not migrate to scientific disciplines within organizations. Recently organizational approaches (e.g., communities of practice or COP's) have been introduced as KM mechanism in scientific circles. However, in most of the current practice, these approaches were a means of transferring tacit knowledge from scientist to scientist. Several characteristics of chemical biology approach pose unique challenges to KM, a topic to which we now turn.

II. Chemical Biology

Two intertwined characteristics of CB set it apart from current KM applications. First, it is an interdisciplinary field that necessitates collaborations across disciplines; second, at present, it is in an embryonic stage that creates significant uncertainty about its definition, content and potential. We will take up each before we discuss their implications for drug development.

Interdisciplinary field

Historically, chemistry was primarily focused on structure and synthesis, and biology with function. Research into structure-function relationships remained an undeveloped interdisciplinary topic. In drug discovery both disciplines are important. As articulated by Wess, Urmann, & Sickenberger (2001), chemistry is necessary for the identification of new lead compounds, their optimization to clinical candidates, and for the provision of sufficient amounts of these substances for further studies and for development or scaling up. Biology's need is transparent: After all, drug discovery is for treating biological malfunctions in the human body.

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Over the years, the dialogue between chemists and biologists have been deepening, partly stimulated by the pressures of the pharmaceutical industry. Yet the chasm between the two remained, and many of the interdisciplinary aspects of the relationship between the two remained undeveloped. Recently, decoding the human genome has led to the estimate that out of more than 30,000 human genes, at least 1,000 are significantly involved in the emergence and course of disease (11). In turn, this has led to the conclusion that there might be 5000 to 10,000 genes that are targets for new drugs. These conclusions imply that the race is intensifying in the pharmaceutical industry as to who can develop the targets into commercially viable drugs. Furthermore, given these advances in biology, chemists now have a strong incentive to evolve their field as to remain relevant in today's research context.

One approach to sketching the structure - function relationships is chemical biology (CB). 'Chemical biology' is a term arguably first advanced by Schreiber and Nicolau in a series of papers (12, 13). In a broad sense, CB aims to create biological response profiles by small molecules, selected on the basis of our state of knowledge about the structures and functions of biological targets. To accomplish this, however, biologists and chemists have to *jointly* generate knowledge about the structure and function of biological targets, and turn this knowledge into new molecules and then create relevant biological responses. Although the field is beginning to be established in the academia, it had not been implemented in the pharmaceutical industry.

Embryonic Field

Given the relatively recent emergence of CB, the scientific uncertainty surrounding the efficacy of this approach is unknown or at best uncertain. At this stage of development, CB promises rich dividends by concentrating research into structural and functional relationships. Patent remedies to address this problem are not yet available in the pharmaceutical industry. Rules need to be found for the design of profiles and a technology-integrated and information-based approach that transcends the synthetic skills and particular preferences of the chemists or the historic areas of activity of the firms needs to be followed.

The embryonic nature of the field is reflected in another set of circumstances. Currently, there are no individuals who are professionally trained and certified as chemical biologists; there are few universities which offer programs in this field. Thus for aspiring scientists, there are few role models of success: They will have to innovate and chart their own paths as they participate in the development of the field.

Traditional	Chemical Biology
➢ Trail and error, high throughput technologies	➢ Focus on selected target families and systems biology approaches
➢ Limited success rates for new biological targets	➢ Accumulation of knowledge on chemical and biological structure spaces, learning curves
➢ Separate functional disciplines	➢ Interdisciplinary problem solving
➢ Sequential processes in biology and chemistry	➢ Parallel processes
➢ Low degree of specialization in chemistry	➢ Specialists in chemistry, new skill sets
	➢ Networks of knowledge, partnering

Table 1: „Traditional“ versus „Chemical Biology“ (adapted from Wess [10]).

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Implications for drug development

CB implies a radically different process of drug discovery. This approach was first articulated by Douglas in his 2000 keynote address at the Drug Discovery and Technology conference (14). See Table 1 for these differences. Especially in lead generation, the existing approach relies on trial and error method combined with high throughput technologies, sequential orientation and dominance of functional silos. CB requires a focus on targeted families and system biology approaches, interdisciplinary problem solving and parallel, information-driven and technology approaches.

These differences have two major implications:

1. Since CB involves reorienting the process of drug discovery, any drug discovery and development organization that wants to institute CB will have to undertake a significant organizational change effort.
2. CB requires building up scientific knowledge, a process that can benefit from knowledge management (KM) approaches being instituted in organizations. Although KM has to date been employed in operations and management decision making, CB requires adaptation of these approaches to deal with the uncertainties of this embryonic field.

III. Industry and Organizational Context

Industry context

The pharmaceutical industry of the 21st century faces unparalleled challenges. Rising clinical trial costs due to difficulty in recruiting patients, expanding development programs, more chronic and degenerated diseases and longer development times have led to a condition where the innovation productivity of the industry – new medical entities relative to the dollar invested has declined. This perceived lack of productivity is worsened by the industry-wide realization we underscored above, brought home by the recent successes of the human genome project -- that there are finite targets which all firms will be interested in their attempts to find cures for various diseases. These conditions, together with increasing societal expectations are putting pressure on pharmaceutical firms simultaneously to speed up and increase the effectiveness of the drug development process.

Various organizations have responded differently to these threats. But the organizational contexts of pharmaceutical firms display similarities.

Organizational context

As in a typical pharmaceutical firm, project teams are the units of innovation in Aventis. Various projects are managed by cross-functional teams. However, at Aventis, the Research and Development organization is made up of a matrix of globally coordinated as well as site specific functions. For example, chemistry, functional genomics, toxicology, clinical pharmacology are globally coordinated functions with units at each of the three major Discovery sites. Each discovery site has groups of Biologists (molecular biologists, biochemists, pharmacologists) that specialize in specific disease or therapeutic areas and form the core of the early stage cross functional teams. The role of the functions, be they globally coordinated or site-specific, is to supply the best people (knowledge) and technological solutions to address the specific challenges of the project team. These project teams drive drug discovery and development, with leaders expected to make decisions.

These teams operate in the Drug Innovation & Approval (DI & A) group within Aventis. DI&A is organized into functions and disease groups: Global functions cut across therapeutics areas, whereas therapeutic areas confined to a single site. Thus, individuals operate in a matrix, function or therapeutic area and project teams. Aventis renamed its R&D organization: Drug Innovation and Approval (DI&A) to emphasize the importance of its scientists focusing their activities on discovering innovative drugs and getting them approved. Unique to Aventis, DI&A organization is the Lead Optimization (LO) organization, consisting of the globally coordinated disciplines of Pharmacokinetics, Toxicology, Clinical Phase 1 and 11A. Lead Optimization bridges Discovery and late stage clinical Development, Phase11B and 111. The disciplines in LO support the project

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team in early testing whether a compound demonstrates the biochemical proof of concept and finally the clinical proof of concept, before the company commits the significant resources that are needed in late stage, Phase 11 and Phase 111 development.

In the past, Aventis scientists were project-focused: they did a project and moved on to the next. As a result there was no cross-project transfer of learning. Functions enable knowledge capture and transfer, but their focus is naturally functional excellence, albeit global. Site-specific disease groups similarly limit knowledge capture and deployment to their respective disease groups. The limited cross project transfer of knowledge led to a context where 'targets', the focus of CB, were typically not tracked.

IV. Introduction of CB Platforms in Drug Development

Early discussions

CB at Aventis was the first implementation in large pharma, and it did not happen overnight. Over a period of three to four years, prior to the introduction of CB platform, discussions among very senior R&D managers focused on the gaps in the then prevalent drug discovery approaches. By 2000, this group had arrived at the conclusion that the links between structural biology and chemistry remained a major gap, and the trial and error approach can be improved by the deepening the knowledge of 'chemical biology.' This conclusion was imbued with a sense of urgency when it became clear that Craig Venter and others had arrived at an incredible breakthrough in the human genome project. Douglas in one of two keynote addresses at the 2000 Drug Discovery Forum & Technology forum in Boston decided to commit Aventis to the application of chemical biology, as one way to take advantage of the potential classes of targets that were implied in the other keynote address that was presented by Craig Venter.

Management strategy

After the initial decision to commit to CB approach, the task of crafting a management strategy to implement this approach began. Although the senior leaders had a clear conception of what CB should do, the rank and file scientists who would actually be developing the scientific concepts, models and methods of CB were not privileged to be part of these early deliberations. An initial decision was to appoint a leader for the initiative. The chosen leader of the CB initiative was a long-term insider, a well respected scientist, with global experience, and strong interest in philosophy and innovation.

A first approach to sparking the interest of the scientists met with mixed results. A kick off meeting on CB with 25 promising Aventis scientists was held in Germany with the help of two McKenzie consultants in the fall of 2000. There was no real excitement and a lot of skepticism: Unlike the senior managers, they did not see much value in the new approach. The leader of the CB initiative initially considered the meeting to be a disaster: It was "scary" to hear such skepticism from young scientists.

Out of these early experiences, deliberations and other concurrent initiatives being implemented in the Aventis organization emerged a management strategy that was built upon three major anchors: (1) Incremental or pilot approach; (2) Project focused science; (3) The concept of virtual platform.

1. Incremental approach

This approach was a direct outgrowth of the experiences with other organizational changes that Douglas had introduced in some of the Aventis predecessor companies.. The skepticism of scientists convinced the senior R&D managers that rather than adopting an organization-wide approach, it may be necessary to adopt a slower, incremental approach to introduce and build the CB initiative on a pilot basis The pilot approach involved starting with a small group of scientists focused on a specific set of projects, and over time following up with several other projects. It was easier to locate a small number of enthusiastic scientists within the corporation, and their successes, both scientific and organizational, would ensure the interest of others.

Over the period of two years, Aventis launched four CB platforms: 1) Kinase, 2) G Protein Coupled Receptors (GPCRs), 3) Protease and 4) Ion channels and transporters.

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2. Project-focused science

As we saw in the conception of CB, the scientific challenges involved were interdisciplinary lying in the intersection of chemistry and biology; thus, CB involved scientific work requiring removal of the basic/applied science divide. The focus was on rapid learning and knowledge development, through leveraging results of experiments on specific members of a class to determine applicability or reason for differences in results with other members in the class. Such knowledge should improve the predictability of finding good lead compounds for members of the target family (Kinase, GPCRs, Protease, or Ion channel and Transporter). The senior managers chose to focus this CB approach on the support of the work of ongoing project teams to ensure that 'better compounds, faster' are produced. This approach involved keeping the effectiveness of drug development at the center stage, and developing CB initiative as a means to enhance the business objective.

During the early stages, covered by the study, the CB platforms initiated focused on the performance of lead (compound) discovery and generation, the earlier stages of drug development. The expectation was that CB platforms should be able to demonstrate results in the short run with respect to the speed and efficacy of lead generation. The choices of the platform were guided by the extent to which they were likely to facilitate drug discovery. Indeed all the four platforms accounted for over 60 % of compounds produced within the company in the 4 years following their introduction. The initiatives that fell outside of Aventis's main projects were not covered by this approach.

3. The concept of a virtual platform

As we noted earlier, like most pharmaceutical companies, Aventis R&D organization is a matrix: scientists belong to a function and to a disease group *and* to a project team. In this structure, functional excellence and knowledge of the disease are systematically brought to bear upon the drug discovery and development decisions. However, the knowledge of the target classes is ad hoc, and judgmental. Indeed, as we have noted earlier, the promise of CB is to infuse the drug discovery and development with the knowledge of the target classes, so that the process can be sped up and made more productive. This means a *third* dimension, over and above function or disease group and project, should be added to the prevailing matrix.

For the organizational form, Aventis settled upon the concept of *virtual platform*, an idea borrowed from the notion of communities of practices (COP) in Knowledge Management (KM). A virtual platform is a 'collateral organization,' made up of scientists with significant experience, working parallel to the existing drug discovery and development matrix. Several key characteristics of this virtual platform may be enumerated:

- *Catalytic function:* The function of a virtual platform is to influence through knowledge the discovery and development process. Since CB focuses on the linkage between structural biology and chemistry, it enables more rational decisions. A virtual platform is expected to infuse the project teams with knowledge about the targets pertinent to the challenges they are facing. This may result in speeding up of discovery or early termination of potentially infeasible compounds and targets.

- *Target focused basic research:* A CB platform is expected to create new insights regarding the linkages between chemistry and biology. This may involve distilling the experience of various projects regarding particular target classes, both within and outside the company to draw generalizations, including computer based modeling. Indeed, this research provides the necessary knowledge base to carry out the catalytic function.

- *Internal organization:* A virtual platform has a clear internal organizational structure. It has 1) a platform leader, and a core team consisting of several members, 2) a sponsor, who is a member of the senior management team that supports the leader and the core team, 3) several strategy groups, each led by a core team member working on specific scientific or science-related challenges, populated with individuals drawn from R&D organization as when and necessary. Each platform has significant *operational autonomy*,

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Characteristics	Platform #1	Platform #2	Platform #3	Platform #4
Focus	Kinase	GPCRs	Protease	Ion Channels & Transporters
Scientific Complexity	Relatively low heterogeneity			Relatively high heterogeneity
Projects	Difficult projects		More difficult	
Ease of data access	High	Lack of availability of global view		Acquisition of external data
Extent of in-house knowledge	High			Internal & External
Knowledge of CB	Low →			Increasing
Availability of libraries	Large →			Much lower

Table 2: Scientific Characteristics of the Four Platforms.

although all the platforms are encouraged to learn from one another. Thus, a virtual platform is not a team, but an organization with at least four levels. In theory, it interfaces with the project teams as and when necessary.

There are significant similarities between the virtual platform approach and prevalent KM approaches. The virtual platform is about knowledge capture and deployment; it uses IT to its advantage for both its operations (use of website) and codification of knowledge (e.g., creation of libraries and data bases); it resembles COP's. There are important differences as well. First, the virtual platform concept focuses on generating *new* knowledge, not merely knowledge capture. Second, being project-focused, it cuts the delay between knowledge capture and deployment. Third, a virtual platform is significantly larger in size, sometimes resembling a small bio-tech firm.

Implementation

Over two years, Aventis implemented four platforms: Kinase, GPCR, protease and ion channels and transporters. As noted earlier, they were chosen for their potential contribution to the business purpose. For example, Kinase was chosen as the platform given its significance for two very important disease groups: oncology and immunology, and also due to the fact there was a large in house library of compounds making it an easy 'demonstration project.'

A comparative summary of the scientific characteristics of the four platforms is presented in Table 2. As shown in the table, the four platforms were oriented to different disease groups, and had different degrees of in house expertise to rely on. They were markedly different in terms of the key scientific challenges for several reasons:

- The targets themselves were different. For example, Kinase, unlike ion channels and transporters, represented a relatively homogenous group.
- The drug discovery projects addressed by the platforms differed in complexity.
- Internally, the accessibility of the data posed differing challenges to different platforms.

Indeed these differences imply that the activities of various platforms would differ significantly. Similarly, a comparative analysis of the organizational characteristics of the four platforms is presented in Table 3. The table underscores several highlights:

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Characteristics	Platform #1	Platform #2	Platform #3	Platform #4
Focus	Kinase	GPCRs	Protease	Ion Channels & Transporters
Temporal order	First	Second	Third	Fourth
Process consulting assistance	External	External	Internal	Internal
Internal organization structure	Platform leader Core team Strategy teams	Platform leader Core team Strategy teams	Platform leader Core team Strategy teams	Platform leader Core team (7-8 members) Strategy teams (5 to date)
Total number of people	> 300	Nearly 300	100 – 120	50 – 60

Table 3: Organizational Characteristics of the Four Platforms.

- There was a standard template for almost all the *internal* organization characteristics of the platforms. Of course, the platforms differed in their total size.

- The tasks confronting each platform and the adopted mode of operations differed from one another in significant ways. This reflected the differences in scientific challenges enumerated above.

- There was an attempt to learn from the earlier platforms. For example, in later platforms, internal consulting replaced external consulting. This was facilitated by a 'Book of Knowledge 'that captured experiences, problems and solutions as the Kinase and also later platforms were established. Similarly, later platforms, *by intention*, adopted a planned approach, unlike the earliest one, Kinase.

- Over time, interface with the project teams became stronger. The Kinase group members were reluctant to inject their knowledge into the working of project teams; this reluctance decreased over time, and was much less in ion channels and transporters.

- Technology alliances were common, which spanned the spectrum from setting up scientific advisory boards, to purchase of data bases, outsourcing of some activities.

Indeed, one of the difficulties of assessing the accomplishments of a virtual platform, or for that matter any catalyst, is due to the fact that a platform's influence is indirect, i.e., through the effectiveness of project teams' decisions. Nevertheless, there is reason to believe that the platforms yielded a significant return on investment.

V. Key Lessons Learned

The introduction of CB platform in Aventis represented a two-dimensional revolution in the way a pharmaceutical company conducted its drug discovery process. On the one hand, it represented a scientific revolution, opening up an interdisciplinary field, Chemical Biology, hitherto a neglected approach to natural sciences. No doubt this revolution was made necessary by the failure of technology based approaches to drug discovery to deliver; it was also made necessary due to the competitive pressures triggered by the success of human genome project. On the other hand, it required a major organizational change within Aventis to accommodate the use of knowledge to enhance the effectiveness of drug discovery. Although any verdict on the long term

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effectiveness of CB platform will have to wait until the affected drugs are commercialized, the preliminary success of this approach emboldens us to suggest three key lessons from this experience: 1) strategic direction of a revolution; 2) Dynamic of management; and 3) Challenges of accountability.

1. *Strategic direction of a revolution*: Revolution often does not occur in one leap. It sometimes comes through a series of *baby* steps. At the same time, the failure of the giant leaps may also serve as a prompt to rethink the approach to managing a revolution. Revolution involves both *failures and successes*. It is the management of failures or rather, framing them as occasions of learning that determines how quickly the revolution will spread. Finally, it requires in the beginning, a small band of committed individuals who are willing to share their experience, both successes and failures. Establishment of a living 'Book of Knowledge 'helps in the sharing of experiences. The key to managerial success is to be able to identify them early on and nurture them.

2. *Dynamic of management*: Top down direction was essential. The direction took the form of the design of organizational mechanisms, not scientific approaches. Indeed the dynamic of management is essential: specifying the overarching goal, finding people, resources, and time in a matrixed organization, when most of these are not under the control of platform leaders.

3. *The challenges of accountability*: Work approaches to various tasks differed across platforms, and their outputs were not standardizable. Also, measuring the effectiveness of catalytic function is tricky. We focused on examples not quantitative data. Thus, managers will not be able to hide behind numbers when forced to defend their decisions. At the same time, signaling to external scientific and financial communities is necessary to demonstrate the sense of accountability. Above all the contribution of the platforms was enhanced by having shared and aligned objectives between the core members of the platforms and the heads of functions, whose members were supporting project teams of relevance to the particular platform.

The approach to building the CB platform employed the concept of virtual platform, akin to the communities of practice which have dominated the organizational approach to KM. The virtual platform concept employed communities of scientists to examine the knowledge base; in that it was similar to COP's. However, the virtual platform differed from COP's prevalent in KM practice in several ways. First, the platform was built to create knowledge from an interdisciplinary group of scientists; second, there was relatively tight linkage between knowledge acquisition and utilization, and consequently more tangible results; by the utilization of technology (including computer modeling), virtual platform interfaced organizational and technological approaches in KM. In this way, virtual platforms were an improvement over the COP's. However, we do not know conditions under which COP's and virtual platforms can be successfully introduced in organizations; this remains a major research opportunity for the future.

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References

[1] Wess, G. (2002). How to escape the bottleneck of medicinal chemistry. *Drug Discovery Today*, Vol. 7, No.10, May 2002, 533-535.

[2] Narayanan, V.K. and L. Fahey (2002). An application of Rescherian Epistemology ot Knowledge Management: Implications for IS/It professionals. Paper presented at the *Connecting Learning and Critique Conference* held at Cambridge University, UK, July 2002.

  ISSN 1613 – 9615

[3] Hanson, M., Nohria, N. and Tierney, T. "What's Your Strategy for Managing Knowledge?" *The Knowledge Management Yearbook 2000-2001*, Butterworth-Heinmann, Boston, MA, 2000.

[4] Drucker, P. "Knowledge-Worker Productivity: the Biggest Challenge," *The Knowledge Management Yearbook 2000-2001*, Butterworth-Heinmann, Boston, MA, 2000.

[5] Brown, J.S., and Duguid, P. *The Social Life of Information*, Harvard Business School Press, Boston, MA. 2000.

[6] Leonard, D. and Sensiper, S. "The Role of Tacit Knowledge in Group Innovation," *California Management Review*, (24:3), 1998, pp. 112-132.

[7] Spender, J.-C. "Making Knowledge the Basis of a Dynamic Theory of the Firm," *Strategic Management Journal*, (17:2), 1996, pp. 45-62.

[8] Marwick, A. D. "Knowledge Management Technology," *IBM Systems Journal*, (40:4), 2001, pp. 814-830.

[9] Ruggles, R.L. *Knowledge Management Tools*, Butterworth-Heinemann, Boston, 1997.

[10] Wess, G. Urmann, M. & Sickenberger, B. "Medicinal Chemistry: Challenges and Opportunities," *Angew. Chem. Int. Ed.*, 2001, Vol.40, No.18, 3341-3350.

[11] Drews, J. (2000). Drug discovery: A historical perspective. *Science*, 287, 1960-1964.

[12] Schreiber, S.L. & Nicolau, K.C. (1996) *Chemical biology*, Vol. 3, 1-2.

[13] Schreiber, S.L. & Nicolau, K.C. (1997) *Chemical biology*, Vol. 4, 1-2.

[14] Douglas, F. "Drug Discovery Paradigm for the New Millennium," Keynote speech delivered to *Drug Discovery Technology 2000, IBC's Fifth Annual Congress*, August 14-17, Boston, 2000.

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Practicioner's Section

The Human Side of Innovation

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Introduction

„I am not very creative", that's what most people say. In addition, most people relate creativity to outstanding geniuses i. e. Einstein, Leonardo da Vinci, Michelangelo. However, creativity is not a privilege of a specific group. Everybody has creative talents. There are different ways of being creative and contributing to the innovation process. One can be creative by supporting a climate of mutual respect and to encourage a challenging atmosphere, by motivating others and supporting them or by solving conflicts in order to foster creativity. In the business context such as in a R&D department the role and the output of creativity can be very clearly defined (see figure 1). And questions answered like: Are you creative? And if yes, how creative do you rate yourself? Are you aware of your creative talents and are you aware of the creative talents of your colleagues?

For Henkel with Thomas Müller-Kirschbaum as Head of Research and Development and his chiefs of staff Juan-Carlos Wuhrmann and Alexander Ditze, it is vital to make use of the creative potential of his employees at its best. The Henkel R&D Management is very advanced in steering its innovation processes. One of the few things they hadn't looked at yet was what they call "the human side of innovation". Together with the Institute for Applied Creativity (IAK) in Cologne – Germany – they agreed to step into new territory to discover, release, and develop the creative talent of each employee in their department. In this article we show how Henkel and the IAK established such a new program.

The objectives of the creative-talents program for Henkel R&D

In order to have a successful implementation the following objectives were defined for the Henkel creative-talents program:

1. Supporting the individual creative talents of the key R&D employees and helping them to

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Figure 1: Required individual contribution during an innovation process.

answer one of the key pre-requisites in the innovation process: am I using my preferred talents to the fullest extent in my job and is the environment around me providing the opportunity to do so?

2. Leveraging and synchronising team talents, to answer the question: do we appreciate the different talents within the team and are we using them to best advantage? Looking at the team's chart of preferences, what patterns do we see and what impact does the pattern have on our performance?

3. Developing the organisation to address the question: are the organisational structure and innovation strategy in line with the talents of the team and how can we develop our innovation culture?

The scientific background of the Creative Talent Management

The method is based on the findings by the Swiss psychologist Carl.G. Jung. Jung was lead by experience and research about personal differences. He traced patterns how you recognize information, define problems and challenges, and then go about producing creative responses and solutions. Jung defined eight different patterns for receiving information and making decisions, which are the key elements for creative thinking [1]. Each of the patterns of differences is equally valuable and equally creative.

To make his model more accessible and to help define these preferences, Kathrine Briggs and Isabel Myers developed the Myers-Briggs Type Indicator (MBTI) - an individual questionnaire and feedback instrument. Other instruments can be used as well to address personal creativity styles but the MBTI has many advantages. It is a validated, tested, and easily accessible personality inventory [2]. Thus, the MBTI serves as a valid

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platform for the eight creative talents. Lynne Levesque from Harvard Business school has managed through in depth research to transform the results of the MBTI into the eight creative talents (see above mentioned source). In her book "Breakthrough Creativity" she describes in detail the model. Creative Talent Management looks individually at the 4 preferred different functions which Jung has described such as:

How we perceive and collect data: By intuition (1) or by our senses (2).

How we make decisions: Through our logic (3) or through our feelings (4).

The focus of our energy when being creative lies on extroversion (consulting first with other colleagues) or introversion.

The MBTI questionnaire is used to reveal the preferences of each participant. With these four preferences (intuition, senses, logic and feelings) combined with either extroversion or introversion,

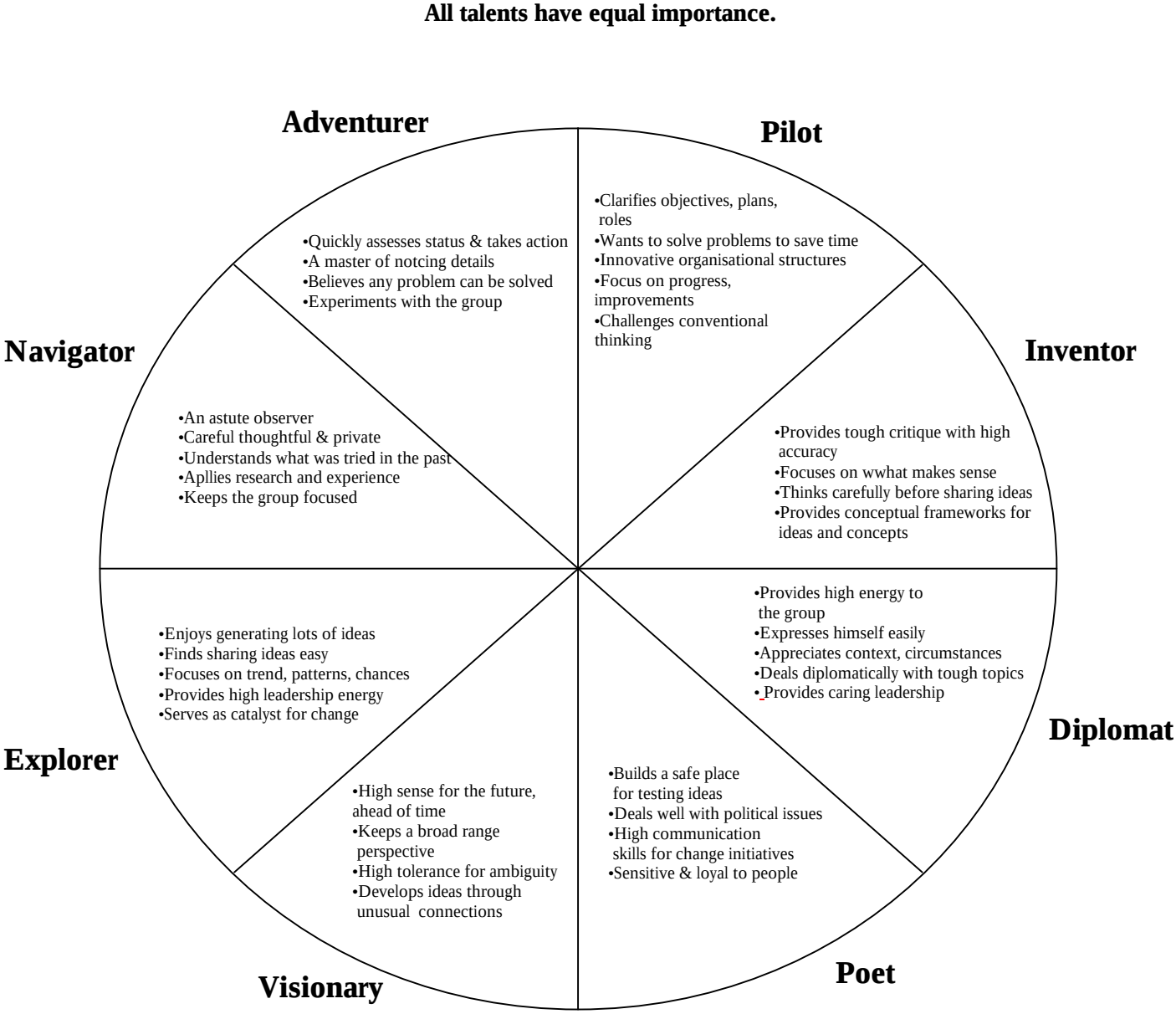

Figure 2: The role of each talent during an innovation process.

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we arrive at eight different talents. These talents are described in detail with regard to their contribution to creativity & innovation.

Each participant receives a feedback as to which talents he/she uses preferably (dominant talent) and which talents serve as auxiliary helping talents. The feedback given to each participant focuses on the following creativity/topics:

1. The uniqueness of each talent
2. The team contribution of each talent
3. Which specific questions does each talent ask in creative process
4. Overall contributions and input of each talent
5. Possible obstacles and barriers which each talent has
6. Recommendations how to make specific use of this talent and how to deal with the individual obstacles

(see figure: 2)

Jung believed that each of the eight creative talents is equally valuable and equally creative. In most of the teams not all talents are represented which is not necessarily the key issue. However it is vital for a team to identify which talents are present and to create awareness for the missing talents. People in the team could take the role of a missing talent.

The process at Henkel R&D

Over 80 managers have completed the program in 2003.The key issue was to support their innovation champions with creative know how and the opportunity to reflect on their leadership how to foster creativity in R&D. The whole program was run on a voluntary basis.

Apart from motivational aspects (everyone in the division has creative potential), it was vital for the management to get the message across, that apart from tools human aspects of innovation should not be neglected and be made aware.

Therefore, questionnaires were handed out, analyzed (see figure 3), and strategic options developed.

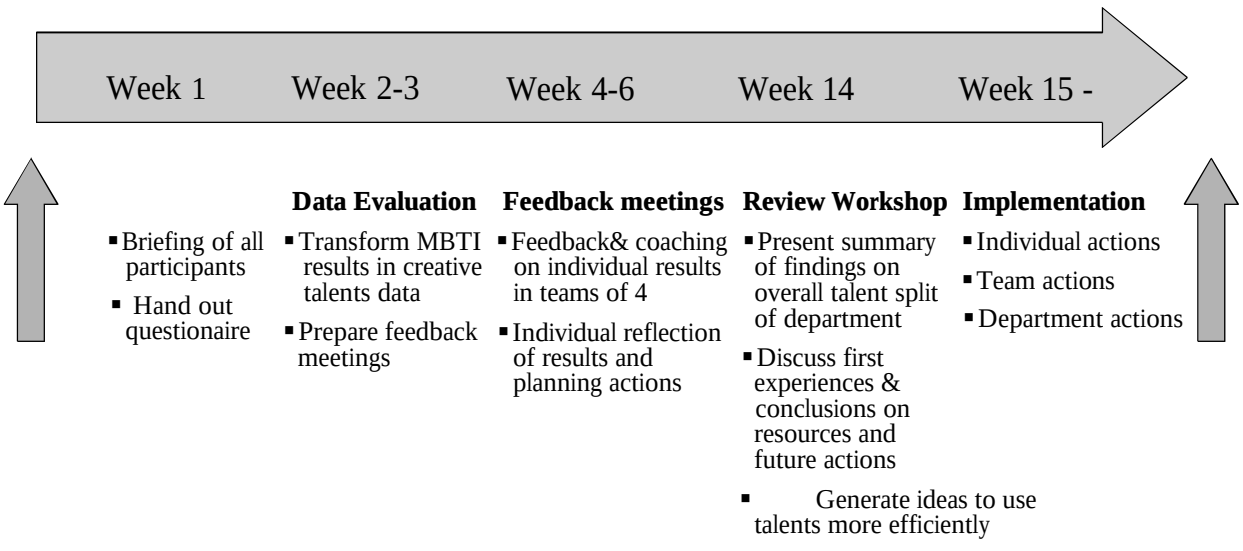

Figure 3: The roadmap for the creative talents coaching process.

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Results and Insights

As Thomas Müller-Kirschbaum expected, 65% of the dominant talents were Pilots or Explorers and 50% of the auxiliary talents were Visionaries and Inventors.

The mission of the R&D department was to deliver viable product solutions. Thus, the strengths of the dominant talents seemed to be aligned with this mission. Still, this mix was a specific Henkel mix (see figure 4).

However, there was a concern regarding the level of experimentation and willingness to make mistakes. The target of the project was to improve the cooperation within the group of R&D managers and to better apply creativity along the innovation process. Therefore, each manager voluntarily made public his/her dominant and auxiliary talent to the rest of the group. Everybody's talents were known to all others, communication within the group could start on a different level. Given the preponderance of certain talents, the team wondered whether other talents felt heard and appreciated in the team. According to Alexander Ditze, the team also questioned how well they were building relationships, both within the team and with other groups, given the low proportion of Diplomats and Poet talents. However, many participants felt positive towards the outcome of the project. Here are some of the comments:

"We have started to listen to different talents in a more appreciative manner"

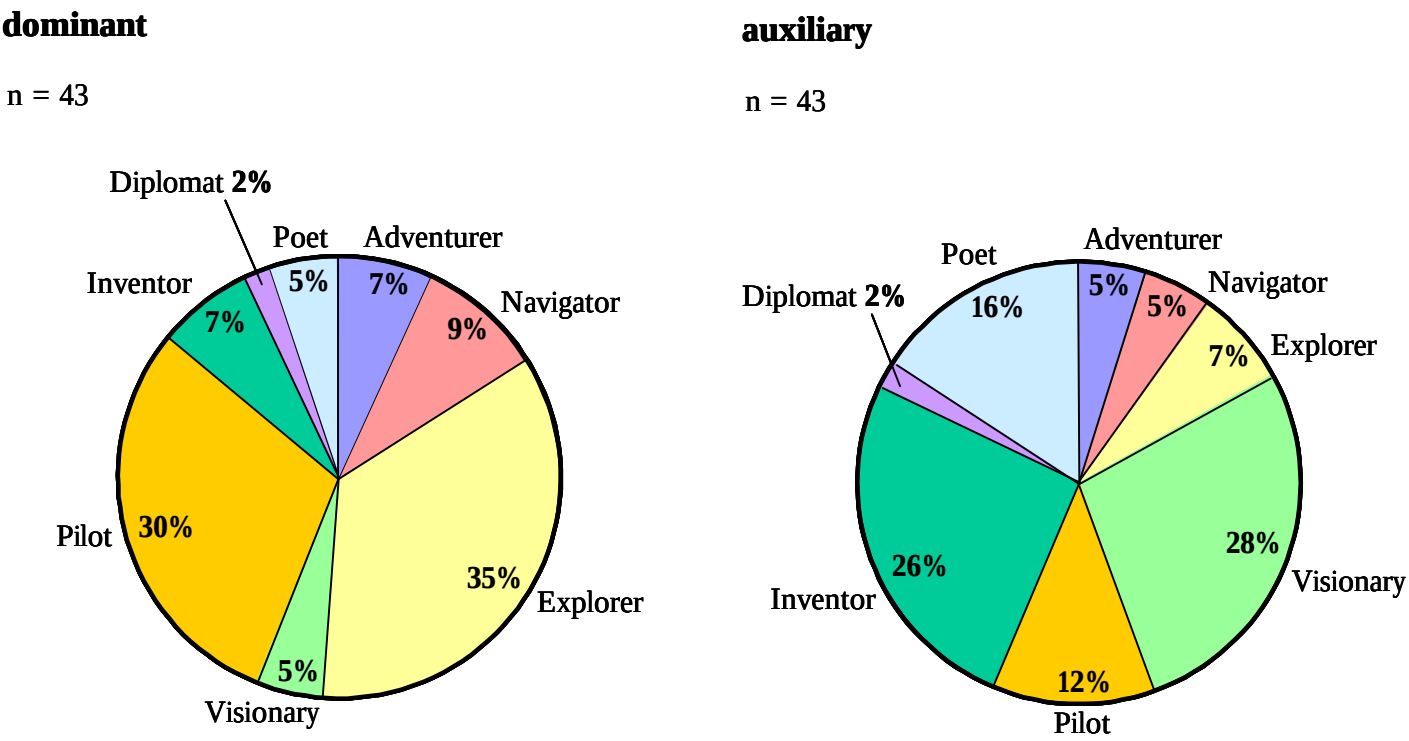

Figure 4: Talent Distribution within the R&D Group.

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"I believe in diversity of the talents. A mono culture of talents will lead to more of the same output"

"This initiative will certainly not stop after a couple of months. It will accompany us the next 2-3 years"

In order to solve the recognized problems the first, initiatives were started, such as:

- Starting a process of appreciating the different talents within the organization
- When establishing new teams, consider the creative talents and the skills
- Sharing the knowledge amongst the R&D employees more openly
- Nourishing the innovation culture with tailor made activities
- Making sure the environment for those with Visionary and Inventor talents was working, given their preferences for more private space and reflection.
- Involving other departments such as Marketing and other groups within R&D in the effort to identify and leverage talents, for more inter-departmental creativity and innovation.

The team agreed that the Eight Creative Talents were a relevant and important foundation for identifying and developing individual creative potential. The team gained important insights about individual differences for gathering information and making decisions and how these impact creative contribution.

References

[1] C.G. Jung; *Psychologische Typen*, Gesammelte Werke, 6. Band, 1960, 4.Aufl. 1989

[2] Lynne C. Levesques, *Breakthrough Creativity, Achieving top performance using the eight creative talents*, Davies-Black Publishing, Palo Alto, California, 2001

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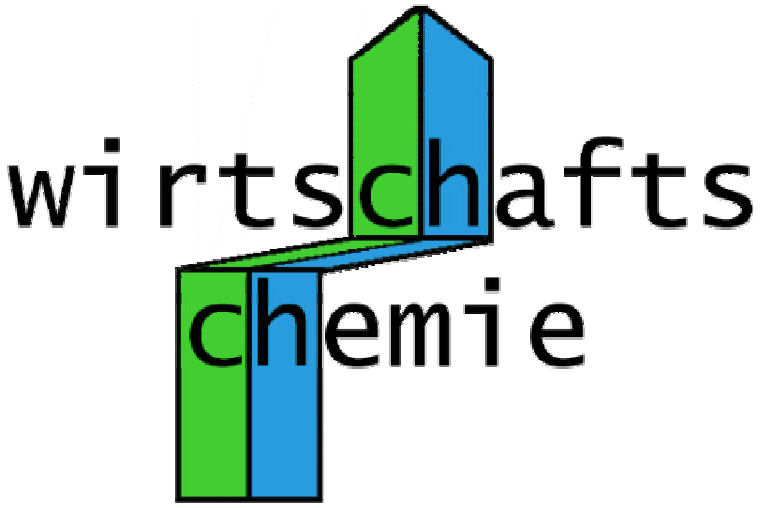

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