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.

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

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

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[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.

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

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

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.
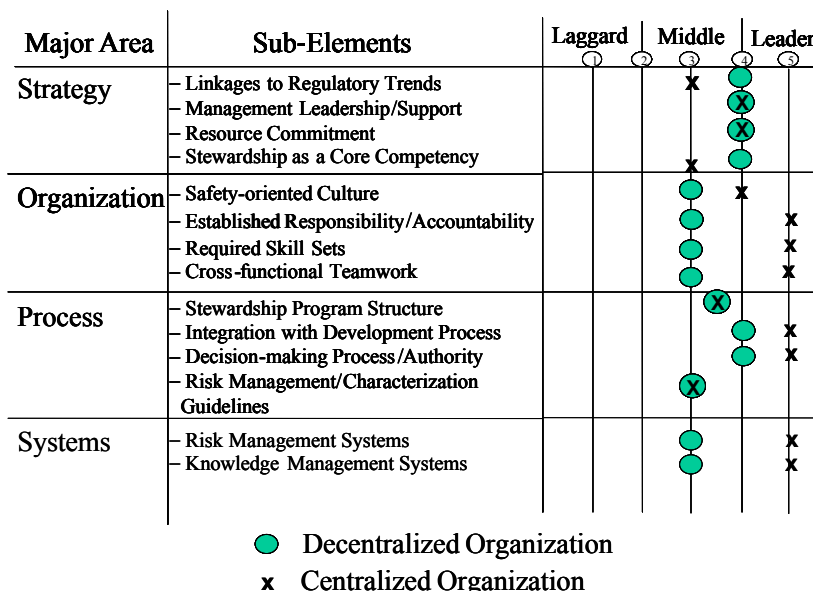
Figure 1: Quantitative results from the questionnaire.

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.

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

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.

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

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.

Acknowledgements

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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"