A GUIDE TO CHEMICAL SERVICES

AN INFORMATION NOTE FROM THE UK CHEMICALS STAKEHOLDER FORUM

Under a linear model, the business incentive is to grow sales in order to generate maximum returns, in direct conflict with the drive for resource efficiency. Service-based models extend the business incentive for improved resource efficiency to the product itself and its delivery, leading to enhanced product durability and a reduction in waste.

This note provides an easily accessible introduction to the chemical services model. It has been produced in order to influence stakeholder behaviour both at a national and international level in all parts of the supply chain.

It will be of value to all those who are concerned about sustainability.

April 2013

1 Introduction

The UK Chemicals Stakeholder Forum (UKCSF)[1] advises government on how industry should reduce the risks from hazardous chemicals to the environment and to human health that may result from the production, distribution and use of chemicals.

Recognising the changing circumstances in which chemicals are regulated, the Forum aims to be a strategic body, paying due regard to the promotion of sustainable consumption and production throughout the chemicals supply chain, to the life cycle of chemicals and to the precautionary principle. Through its work, the Forum aims inter alia to:

- advise Government on measures to promote the sound management of chemicals internationally;
- continue to promote voluntary action by industry in the UK where this can make a contribution to a reduction in the overall use of those substances recognised by the Forum as being priorities for action;
- communicate and encourage best practice and innovation, and encourage others to do so and;
- promote more effective linkages throughout the chemicals supply chain, and between all those with an interest in the future of a sustainable and competitive UK chemicals industry.

As part of its work to fulfil these roles, the Chemicals Stakeholder Forum seeks to develop guidance on key aspects of chemicals management which can contribute to the overall goal of reducing the use of and exposure to hazardous chemicals in the workplace, the home and the wider environment. The Forum's guide to substitution, published in 2010, forms part of that package. In this second guide, the Forum turns its focus upon how business models which aim at the supply of chemical services, rather than chemicals per se, can help to promote a greener economy by reducing consumption of raw materials, cutting waste, minimising exposures and contributing to greater sustainability through the supply chain from producer to consumer.

By outlining the basic concepts and opportunities, and supplementing these with the case studies of chemical services in action, this guide explores the potential for expansion of chemical service business models, ranging from enhanced after-sales chemical management services, through chemical leasing to approaches which aim at complete cycle management in a closed loop. The guide identifies the likely benefits and possible drawbacks of the different approaches, with the intention of broadening knowledge and understanding within both business and regulatory communities. Ultimately, it aims to promote greater development and take-up of chemical services approaches nationally and internationally, where they make sense, as well as to improve the sharing of the experiences of those who have adopted such business models to date.

[1] This report was produced by the UK Chemicals Stakeholder Forum & was drafted by a subgroup comprising: David Taylor (RSC) (Chairman), Patrice Mongelard (DEFRA) (Secretary), Susanne Barker (Engineering Employers Federation);, Rachel Harkness (University of Strathclyde); Mike Pitts (Chemistry Innovation Knowledge Transfer Network), and David Santillo (Greenpeace).

This Guide to Chemical Services builds on work conducted on the issue by the Forum since 2008, drawing in particular on the outcome of its Chemical Services Seminar in 2009, a follow-up survey of industrial practice in 2010 and presentations to the Forum by experts in the field in recent years.

A few representative examples of successful use of chemical services are described in the Appendix and in various parts of the report. These examples are merely intended to be illustrative and their inclusion does not imply any endorsement of the products or services by the Forum

2 Background

These business models aim to optimise the use of chemicals, save energy, and encourage the recovery and recycling of chemicals. They also represent a better use of technical expertise and create an alignment of aims and business models stronger relationship between the manufacturers of chemicals and those who use them. They also appear able to deliver benefits throughout the supply chain as well as wider benefits for society. However, in spite of all these advantages they do not appear to be widely established, yet, in the UK.

In July 2009 the UK Chemicals Stakeholder Forum organised a workshop on Chemical Management Services and Chemical Leasing to explore the current state of their application in the United Kingdom and why this was not increasing more rapidly. 30 participants drawn from industry, consultancies, academia and government heard presentations from people actively using these business models and then participated in a discussion. It was clear that whilst finer distinctions between chemical management services and chemical leasing could be made there was a good understanding of the common business model that underpins these terms. Both were about long term supply chain partnerships, optimising processes and reducing waste, deriving value from services and expertise. There was general agreement that not all chemical companies were committed to move towards these business models and that many of the wide range of existing contracts demonstrated the difficulty of adapting a business to both supply chemicals as well as supplying services associated with these chemicals. It was also recognised that a gap currently existed in promotional activity to raise awareness of chemical leasing in particular. The model appeared to require the initial intervention of a facilitator, or trusted mediator/honest broker to manage the relationship between supplier and user.

Workshop participants opined that considerable care was required in the creating of partnerships between suppliers and end users of chemicals since there could be potential conflicts with Competition and Intellectual Property laws if these partnerships were “extended” to include other parties. For example this might arise if two companies who had submitted separate tenders were asked to collaborate to work on an improved joint tender, or if information about a company’s product was disclosed to another company in order to solve a particular problem arising from the product.

Although Chemical Management Services contracts were identified as having some key common underlying elements such as driving costs down (important at all times but more so in a recessionary climate), using less product and reducing waste streams - in reality they covered a wide spectrum of business support and different levels of contractual engagement between suppliers and buyers. Moreover, chemical management services represented a knowledge-based business. Consequently it

was very challenging for the workshop participants to think in terms of a standard template for contracts for such services.

As a consequence of this workshop and its insights, in 2010, the UK Chemicals Stakeholder Forum tried to estimate the degree to which chemical service business models were currently found in UK industry. Two questionnaires, one targeted at potential suppliers of services and the other at potential users, were developed with the assistance of the Chemical Industries Association and Yorkshire Chemical Focus and were widely circulated via the Forum membership. The results confirmed that, although many organisations offered a wide range of 'after sales' technical advice, there were relatively few examples of formal service based business models being in use in the UK.

3 What do we mean by the service based business model?

Traditionally, manufacturers created value by making products and delivering them to customers. Ownership of the product was linear: resources were extracted or harvested, processed, a product was made, sold and the consumer or owner of the final product ultimately disposed of it when it was no longer of use to them.

However, this traditional view of manufacturing as purely production or process-led industry no longer holds true. The current economic climate - which has seen UK manufacturers being buffeted by weaker demand, increasing material price volatility and unrelenting competition from low-cost overseas producers – is prompting companies to look again at how they run their business. Manufacturers that once competed on price and quality alone are now increasingly turning to services to provide a competitive edge. While product is still king, the line between traditional manufacturing and the service sector is becoming increasingly blurred.

The breadth and scope of service based business models varies widely across industry. They can range from fairly basic maintenance support and extended warranties right through to a company offering a seamless service involving everything from design to installation, servicing and ultimately, disposal. The key feature of these service based models is a shift away from simply selling a product towards a greater emphasis on delivering the function or improved functionality of a product, whilst diversifying revenue streams and carving out competitive advantage in the process.

Some of the more common business service offerings include:

- **Maintenance support and extended warranties.** Maintenance contracts, extended warranties or help desk support has been driven by the increasing sophistication of manufactured goods, particularly in industries such as electronics and mechanical equipment. They encourage repair activities and extend product durability. Examples include Neumatic, the UK-based manufacturer of Henry the vacuum cleaner: Neumatic offer customers a life-time guarantee and can offer spare parts for every product it has made.

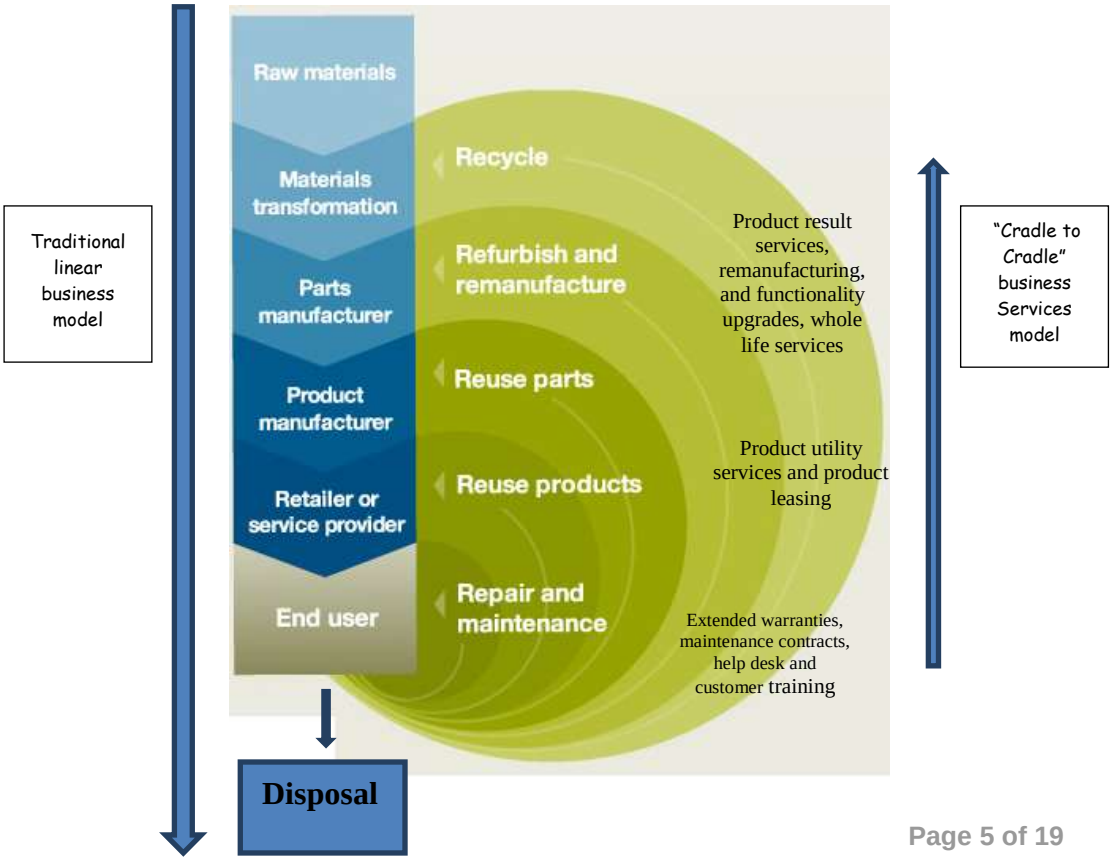
- **Customer training.** Under this business model training is supplied to customers to help them derive the maximum benefits from a product. It can take a number of forms ranging from customer training seminars and on-site training support, to more basic online access to user manuals, e-learning and web-based training materials. This model can enhance product durability as

customers learn how to use products effectively. It is typically offered by companies selling electronics and machinery.

- **Functionality upgrades.** Upgrades can range from software updates for ICT equipment to retro-fitting equipment with new technologies in order to deliver improved performance. For example, one communications equipment manufacturer has moved to producing modular components which can be updated as technology advances. This provides a cost-effective solution for customers and extends the life of the product whilst ensuring that the product can be enhanced with new technology if required.

- **Product utility services.** Under this business model the ownership of the product remains with the service supplier so goods are leased or hired rather than sold. This is a common offering in the machinery and transport sectors. A variation of this model can be seen in Caterpillar's remanufacturing activities. Caterpillar provides customers with a discount when buying new/refurbished equipment, based on any returned parts/plant. This provides Caterpillar with a supply of raw materials and allows them to regenerate workable components. Customers can buy remanufactured products in an "as new" condition or sometimes better in terms of durability, life span and performance but at a price well below that of a new product.

- **Product results services.** With product results service models, suppliers guarantee levels of performance and frame contracts on outcomes. The most quoted example of this is Rolls Royce's "power by the hour". Within this scheme, customers pay a fee, under a contract, for every hour an engine runs. In return, the company maintains the engine and replaces it if it breaks down, increasing product durability. As a result of the adoption of this model spare-parts and long-term servicing operations have now overtaken sales to account for 63% of the engine division's sales. Product results services provide customers with greater certainty of the total costs over the life of a product and removes an element of risk, chiefly that of unexpected costs.



- **Whole life services.** This is an integrated service solution where a whole-life service is offered to customers, from design and development through to manufacture, maintenance and ultimately to disposal. It could see a supplier taking responsibility for one or more areas of a customer's business. It is currently more common in the electronic and transport equipment sectors. An example is offshore construction where companies supply not only the manufactured product but also take responsibility for design, materials testing, process outsourcing and off-site assembly and disassembly.

Significantly, all these service based models change the incentive for resource efficiency (see figure).

4 How are service-based business models being applied in the chemistry using industries?

4.1 INTRODUCTION

Chemists and chemical engineers are trained to make molecules. Consequently the majority of chemical industry business models are based on selling volumes of molecules. The picture however is not that simple; customers are buying the benefits those molecules deliver and business models that enable the user to maximise those benefits deliver the most value. When control of the substances is managed by the expert producer, use of the material to provide the end benefits is maximised.

This 'service' approach can range from knowledge or 'know-how' of how to use materials effectively right through to taking back the 'molecules' after use and processing them so that they can deliver similar benefits again. With the latter 'closed-loop' approach, the business model is a somewhat counterintuitive i.e. 'deliver more by selling less'.

The rest of this section is devoted to the investigation of the service approach within chemistry-using industries and describes the three main service-based business models that enable innovative chemistry-based solutions: chemical management services (CMS), chemical leasing, and closed-loop models. Although the subsequent discussion is divided into three parts, in essence the three indicative 'types' of business model actually form a continuum with no clear dividing line for example between 'chemical management services' and 'chemical leading'.

4.2 CHEMICAL MANAGEMENT SERVICES (selling know-how with the material)

Many businesses already deliver some form of service support by selling additional know-how. This may be user-guidance, tailored formulations or delivery systems or even process development. These services increase the value proposition and can work to the benefit of both parties: the user gets a more certain outcome while the provider builds a relationship with the customer. Taking the idea of know-how further, Chemical Management Services (CMS) is a strategic long term business model, in which the customer engages with a service provider to supply and manage the customer's chemicals and related services. This leads to a shared objective to reduce the 'total lifecycle cost' of a chemical used by a downstream company. CMS focuses on taking control of the 'hidden costs' of a chemical by external management – labour, inventory, waste, Safety, Health and Environmental data etc. The manufacturer gains a partner in its efforts to manage chemicals more efficiently; the supplier becomes more integrated into the business by providing a differentiated,

value-added service. This is fundamentally different to the situation where several suppliers compete to provide the same product, which could be seen as a new risk which needs to be considered in the light of the reduced costs.
Essentially, under a CMS contract, the contractor's compensation is tied mainly to the quantity and quality of services delivered, not a chemical volume. The supplier's profitability is therefore independent of the volume of chemicals sold. In other words, the suppliers no longer get paid based on how well they can sell, but rather on how well they can manage. This scheme is accomplished by basing supplier compensation on performance-based metrics and fees, not chemical sales. CMS therefore goes beyond invoicing and delivering product, to optimising processes, continuously reducing chemical lifecycle costs and risk, and reducing environmental impact. Since the contractor specialises in delivering such services they are often performed more effectively and at a lower cost than companies can do by themselves.

The key to successful chemical management contracts lies in understanding the costs from procurement, through use, to disposal of the chemical. At each stage, a company incurs costs of labour, materials, equipment, and the more elusive costs of space and capital, all to support the management of the chemicals.

These 'hidden' costs are not always well understood by companies. They are typically equivalent to the value of the chemical itself but in the case of the disposal of "toxic" materials.can easily be 10x the cost of the materials. They arise from storage, disposal, and wastage & management costs. CMS offers efficiencies in these over the full lifecycle of the chemical in the company. This model uses holistic life cycle thinking to deliver reduced chemical use with associated reduction in costs, and waste generation.

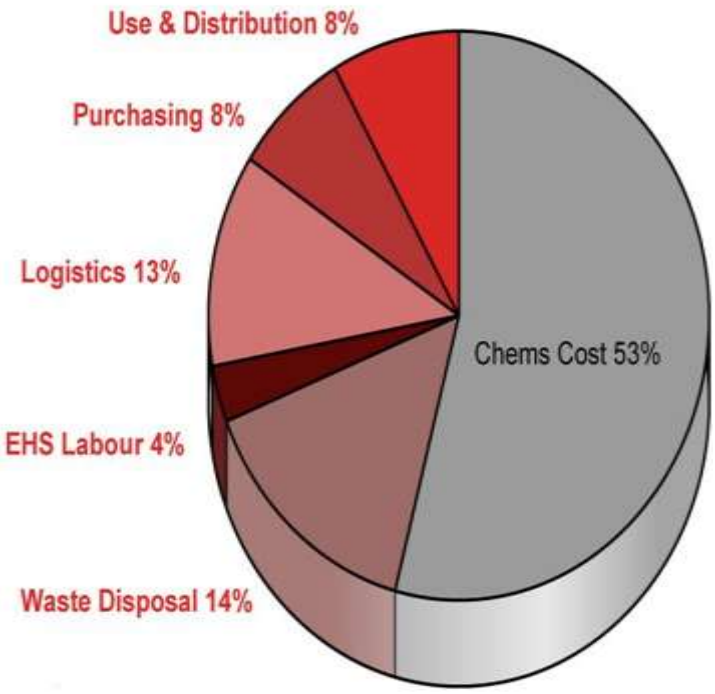
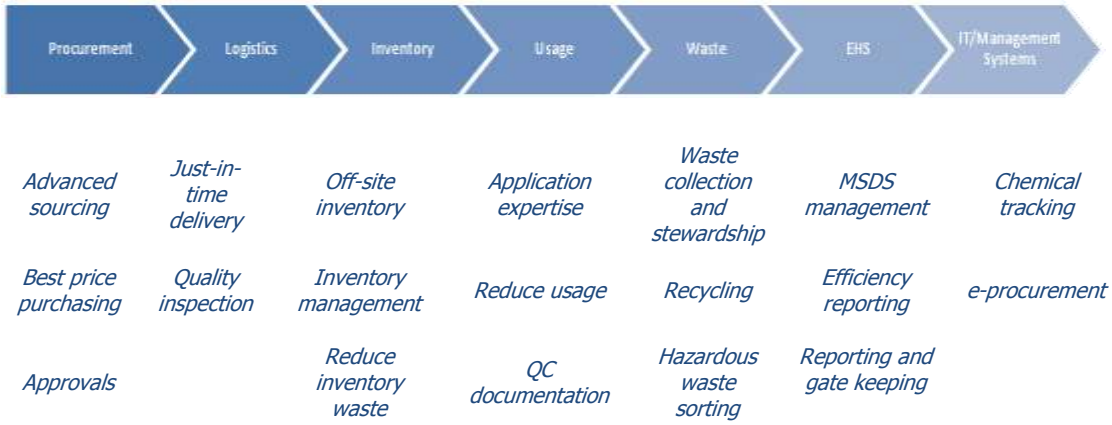


Figure: Typical 'hidden' costs of chemical management
[*Courtesy of HaasTCM]*

It works best where the volume of chemicals use is substantial. Economic modelling suggests that the largest benefits occur when total annual spending in this area is greater than ~£500k.

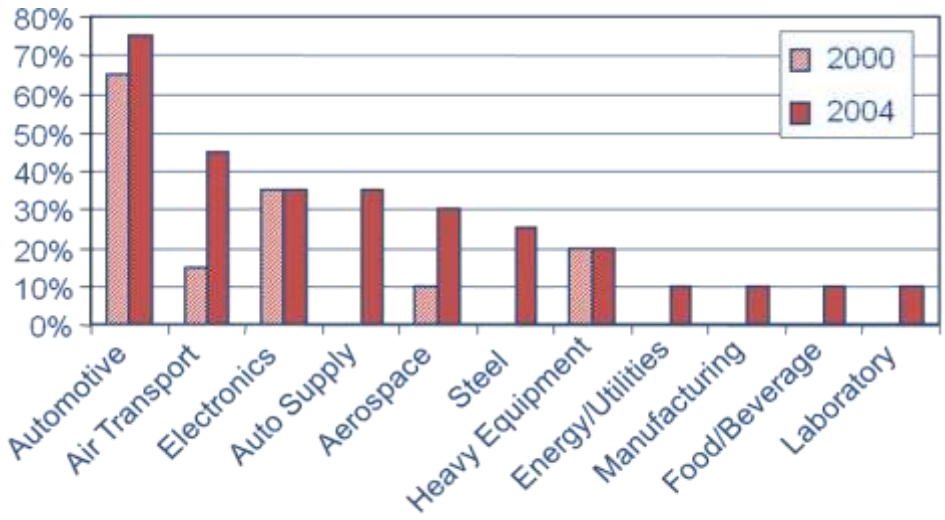
CMS is usually contracted to a chemical service provider, or Tier 1 supplier. A chemical service provider may be a chemical supplier, waste hauler, or environmental engineering firm that offers a range of services to manage a company's chemicals. They may purchase and deliver chemicals, maintain the inventory, and track MSDSs, implement process efficiency improvement, collect data for environmental monitoring and reporting, and manage waste collection and disposal operations.

The services along the 'chemical lifecycle' can include:



Chemical Management Services originated in the US in the 1990s and now over 75% of the automotive sector, for instance, uses Chemical Management Services due to the strategic and cost benefits they can deliver. GM cars were able to reduce their Tier 1 chemical suppliers from 14000 to 5 who in turn operate with only 8000 Tier 2 companies.

Looking more widely, CMS is now employed by a number of sectors including aerospace and defence, energy/utilities, electronics, biotech, manufacturers, education, public services, food & beverages[2] (see figure below for the expansion of this sector).



Source: *CMS Industry Report 2004*, CSP industry surveys and estimates.

Industry Sector Users. Companies in the UK whose US parent companies already utilise CMS are in the forefront of expanding this business model into the UK and Europe. Likely lead sectors are electronics, aerospace and food. Due to the tracking of materials throughout a company this model enables other sustainable business models to be employed such as closed-loop recycling. With the advent of REACH and chemical companies and chemical users needing to develop stronger relationships and better understand how chemicals are used, CMS has an increasing role to play.

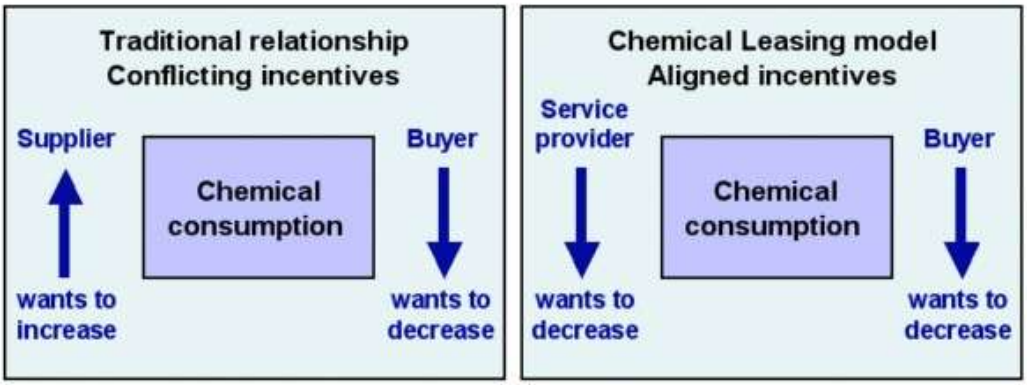
[2] www.cmsforum.org

4.3 CHEMICAL LEASING (managing processes)

Traditionally, chemicals are sold to customers, who become owners of the substances and therefore responsible for their use and disposal. This can lead to a misalignment of business models: suppliers want to maximise sales whereas customers want to maximise results. Suppliers have a clear economic interest in increasing the amount of chemicals sold, which can result in inefficient use of materials and negative impacts on the environment.

Chemical Leasing[3] is essentially selling chemicals on their effect (functionality) rather than volume (price/unit). For example rather than selling paint by the litre, a chemical leasing model would see it sold on m^2 coverage. This is an extension of models well-used within the chemical industry where solvents and catalysts are 'leased' and the waste materials are returned to the provider for reprocessing/recycling.

This model requires the chemical supplier to be the expert with the know-how that adds the value. Consequently the economic success of the supplier is not linked with product turnover anymore; chemical consumption becomes a cost rather than a revenue factor for the chemicals supplier. The supplier is driven to optimise the use of chemicals and improve recycling in order to reduce the amount consumed, which leads to improved environmental performance.



When applying chemical leasing, the producer does not just provide the chemical, but also know-how on how to reduce the consumption of chemicals and how to optimise the conditions of use. While in the traditional model the responsibility of the producer ends with the selling of the chemical, in chemical leasing business models the producer remains responsible for the chemical during its whole life cycle, including its use and disposal. The producer/supplier has the benefit of selling know-how rather than material and developing a long-term relationship with the customer. The approach requires careful choice of the unit of operation, i.e. the basis on which the end result will be paid for.

Typical chemical applications that suit a chemical leasing approach include services such as cleaning, coating, colouring, cooling/heating and greasing. Generally where recycling is possible the model will work well. Likely lead sectors are, again, electronics, aerospace and food.

[3] www.chemicalleasing.com

There may well be companies operating a chemical leasing type model but under a different name[4]. Figures on adoption of this model and case studies are difficult to obtain however, as companies tend to want to protect their competitive advantage. Despite this, the following international examples provide sound evidence of this model's promise.

In Egypt, a chemical leasing agreement between AkzoNobel Powder Coatings and electrical technology firm ABB ARAB is based on AkzoNobel being paid for each square metre of material using its electrostatic powder coating process. This has led to efficiency improvements which have cut powder use by a fifth and reduced losses during production from 12% to 4%.

A pilot programme supported by the Austrian government and the United Nations Industrial Development Organization (UNIDO) has six projects helping to refine the approach and show that under the right conditions, chemical leasing can deliver substantial environmental benefits and cost savings for suppliers and buyers. The six included a partnership between the Dow Chemical subsidiary SafeChem (a specialist manufacturer of chlorinated solvents) and cleaning equipment specialist PERO AG, which led to a chemical leasing contract with an Austrian car parts manufacturer in 2005. Under this agreement the suppliers are paid per part cleaned. By optimising the process, the suppliers halved energy use, reduced the need for spare parts and service costs by two thirds, and have reduced solvent use by 72%.

The wider pilot project was a success partly thanks to the strong commitment from and champions within the Austrian government. Importantly there was also a clear vision of the product service model which was being pursued. Furthermore, a subsidy programme and promotion activities help encourage wider take-up of the six chemical leasing services offered.

Research conducted as part of the Austrian project determined that 4,000 Austrian companies (mainly SMEs) would qualify for the application of such models. It suggested that roll-out of the model would cut the country's annual use of 153,000 tonnes of chemicals by one third: 53,000 tons per year would not have to be used or paid for, and would therefore not result in emissions or waste. On average, the authors of the pilot study calculate that users of these new business models can expect cost savings of up to 15%.

Comparisons between the state of chemical leasing in Austria and in the UK highlight that here in the UK there seems to be confusion over terminology (service models, leasing, chemical management etc.) with little central guidance and promotion of the model.

4.4 CLOSED-LOOP MODELS (remanufacturing, recycling etc)

It has been recognised for many years that the manufacturer of a product has an ethical, and increasingly a legal, responsibility to ensure that the product has a minimal effect on human health and the environment throughout its life cycle from the extraction of the original raw materials to the final discarding of the product. This is usually known as "Cradle to Grave" responsibility.

In the 1970s Michael Braungart modified this concept to introduce "Cradle to Cradle" thinking. This attempts to model human industry on nature's processes, viewing materials as nutrients circulating in healthy, safe metabolisms. According to the

[4] 'Time to rent chemicals rather than buy', Susanne Baker, ENDS REPORT 411, April 2009

Cradle-to-Cradle approach, certain materials should be considered so valuable that closed-loop supply chains for them should be enabled so that they can be repeatedly recycled. This has been traditionally applied to high value metals such as gold and silver. However, most metals are easily and infinitely recyclable and this concept has now been extended to some plastics, notably, where used in u-PVC window frames.

Closed-loop models may be the ultimate in Chemical Service Business Models and can incorporate both Chemical Services and Chemical Leasing approaches. They take a whole life cycle approach to the materials used in goods and services and furthermore, strive to keep materials within the economic system, rather than letting them become waste. In the closed loop system there effectively is no such thing as waste.

As an example Veolia and GSK have recently entered into an agreement with respect to industrial methylated spirits (IMS)[5] in which Veolia recovers the solvent waste and returns it as pharmaceutical grade solvent entirely within the GSK site. Another example[6] of "cradle to cradle" thinking is provided by carpet manufacturers Desso who have redesigned their product for subsequent disassembly and reuse. Today, more than 60% of Desso's carpet tile range contains Econyl yarn made from 100% recycled content.

Closed-loop models are closely related and sometimes equivalent to 'whole life cycle' and 'circular economy'[7] approaches to design, materials and business models. The application of such approaches starts by focusing on what is being delivered to the customer and how can it be achieved more efficiently. As with CMS the customer's and supplier's business models become aligned potentially leading to a much stronger relationship. The 'circular-economy' concept has gained particular traction in recent years[8] and is championed by the Ellen MacArthur Foundation[9] amongst others. More sectors and major businesses are moving towards closed-loop approaches in order to internalize major risk, protect against resource supply disruption, reduce environmental impact and develop a better value proposition for customers. The benefits of this model are therefore broad and not only environmental in character.

For chemistry-using industries this approach means not only taking responsibility for minimising the impacts of the substances produced and sold from 'cradle-to-grave', i.e. from raw material sourcing right through to the end of product life, but also taking back the product at the end of its life and restoring it to a condition where it can be reused.

The approach ranges from extending the lifespan of a product (repair and remanufacture) to a providing a service based on the effect a substance delivers rather than the substance itself. The latter is typically achieved by full recycling of the material with ownership retained by the provider. As with CMS the efficiencies are derived by the producer (and hence expert) managing the substances with the benefits of customer understanding and 'lock-in' as well as some control of resources. Extending the productive use of a material in a given application generally reduces its overall energy intensity. The strategy is particularly important for materials with a high embodied energy but relatively low 'in use' impact. Essentially – as with CMS and chemical leasing – the producer focuses on selling what the

[5] http://www.guardian.co.uk/sustainable-business/best-practice-exchange/veolia-closing-loop-chemical-waste
[6] http://www.desso.com/Desso/Business-Carpets/bc_en/bc_news/bc_news_archive/bc_news_archive-News_archive_2012/Desso_Wins_Guardian_Sustainable_Business_Award_for_Waste_and_Recycling_.html
[7] http://www.wrap.org.uk/content/wrap-and-circular-economy
[8] www.green-alliance.org.uk/reinventing_the_wheel
[9] www.thecirculareconomy.org

substance(s) does more than what it is. This focus on customer benefits is essentially a service model.

Industrial Sector Users Closed loop models work very well business-to-business but can be harder to employ along complicated supply chains or in business-to-consumer provision. Remanufacturing has been employed very successfully by companies such as Caterpillar, Xerox and Ricoh. For these companies, highly valuable end products are designed to be easily deconstructed, refurbished and upgraded and are provided with warranties 'as new' despite many components having already been used in previous 'products'.

Some industrial sectors have been disrupted by the adoption of circular economy models by leading businesses. For example the flooring sector has raced to keep up with the likes of Interface FLOR and Shaw developing closed-loop models and selling carpet tiles as a service: they install and maintain the flooring and at the end-of-life remove and recycle every molecule, all as efficiently as possible.

5 Opportunities, drivers and barriers to the further expansion of service based business models in chemical using industries.

Service based business models can clearly be beneficial but may not be universally applicable. Their application seems to require careful tailoring to the industry, business, product and customer, and then an increasingly thorough and holistic re-design of a business's processes as you proceed from CMS to chemical leasing to closed-loop. As with all business models there can be both advantages and disadvantages to their use – as we discuss below – and further expansion of these models will depend upon pursuing the advantages without succumbing to the disadvantages, and upon the existence of strong driving forces for change from both industry and government.

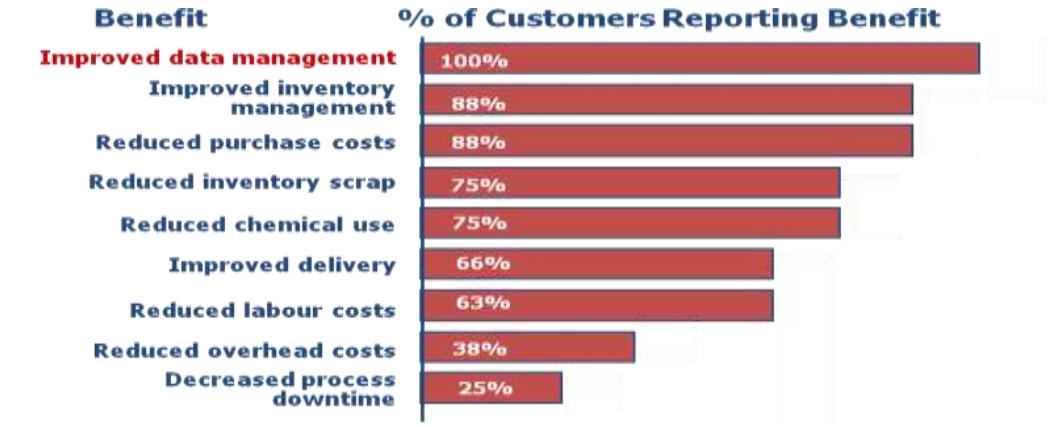
One of the key inhibitors in further exploitation of business service models in the chemicals sector results from the conservative attitudes of parts of the sector. Although these models can lead to significant reductions in costs and improvements in sustainability, they often require radical changes to business operations which present a new range of risks.

5.1 CHEMICAL MANAGEMENT SERVICES

There is increasing evidence (see figures below) that the chemical management services model has many advantages. Results from the industrial application of CMS to date indicate that this model lowers total chemical costs, and both suppliers and users achieve bottom line benefits via reduced chemical use, costs, and waste.

Other advantages include:

- Improved understanding of how and why chemicals are used
- Reduced emissions
- Reduced exposure to liabilities
- Reduced accidents
- Enhanced reputation due to reduced waste production
- Improved logistics
- Suppliers can handle some legal obligations relating to the import and management of substances reducing the specialist resource needed



Source: *CMS Industry Report 2004*, Chemical Strategies Partnership

Chemical Management Services can transform the relationship between provider and customer from 'more is more' to 'less is more' thus leading to increased efficiency for both parties. The model is also compatible with many emerging business management trends: it allows a focus on strengthening a company's core business, outsourcing support functions, and building strategic alliances with suppliers.

The increasing complexity of chemicals regulation is a major driver to the further extension of the chemical management services model. Instead of the user needing to provide expert resources to understand and comply with increasingly complex regulations this can be handled by the service provider. For example the REACH regulation in the European Community increases the need to track and understand the application of chemicals for downstream users.

The chief barriers to introducing this model are:

- Small companies can find this business model hard to establish.
- Some chemicals/applications are better suited to the model than others.
- Confidentiality aspects and trust.
- User is more remote from the primary manufacturer which can inhibit information flow when the service provider is not the manufacturer.
- Poor transparency over costs – not truly understanding or being able to come to agreement over the 'hidden costs'.
- Internal company structures – i.e. poor links between procurement divisions and other divisions.

4.2 CHEMICAL LEASING

The basic principle underlying chemical leasing has been understood for decades but until recently the model has only seen practical applications in a small number of areas. Recent pilot studies in Austria have shown the advantages of the Chemical Leasing model to include the following:

- Because most chemical leasing agreements see suppliers sending staff to the end user's site to manage the service, this allows end users to focus on core skills and to reduce liability and risk whilst increasing legal compliance and worker safety.
- Improved product quality can be achieved.
- A competitive edge can be gained when tendering for new business.
- Client relationships are improved
- Innovation is stimulated. As Old technology can be replaced with more efficient, better designed equipment that may not have been economical under the old business model.

The chief barriers to introducing this model appear to be:

- Persuading customers to abandon production methods and operations which have functioned well in the past although they may not have considered wider environmental and resource issues.
- The significant investment in time and effort that it requires
- The requirement that suppliers assume more responsibility
- Buyers' concerns about being dependent on one supplier
- The difficulty foreseen in creating a relationship of trust between the user and the supplier

However it is worth noting that despite these same barriers, many of the businesses that took part in the Austrian pilot studies say that although the process was challenging, they would implement it again.

4.3 CLOSED-LOOP MODELS

These can require a radical change to the customers business which in turn can involve significant redesign and re-engineering of the product to ensure that it can be returned into the value change when its initial purpose has been fulfilled.

The advantages of closed-loop business models:

- Savings can be made on net material use.
- Resource supply risks and price volatility can be mitigated.
- Innovation is driven by this model – particularly because of its emphasis on re-design.
- Increased resilience is achieved.
- Customer loyalty and interaction is increased.
- Warranty costs can be reduced.

The chief barriers to introducing this model depend on the approach which to some extent will compete with each other i.e. increased repair and remanufacture can compete to some extent with recycling and vice versa.

For repair and remanufacture these include:

- In general the embodied value must be higher than the costs of repair, upgrade or component regeneration.
- The approach is limited by consumer demand for 'new' products,
- Consumer perceptions that the product is of a lower quality,
- Manufacturers concern about 'black markets' evolving for their 'obsolete' products when they shift to service-based closed-loop model but others do not.

For recycling led approaches these include:

- Chemically bound or physically incorporated materials can be hard or impossible to isolate.
- Collection and concentration of the material in sufficient quantities.
- Consistency and quality of supply of subsequent 'waste' streams.

6 Conclusion

The chemical industry and the many companies that have used its products have developed over time using a linear business model in which raw materials are used to create valuable substances which are then, in turn, used to produce other products further down the value chain(s). In the case of bulk chemicals the manufacturer's profits are based on the volume of material sold. Speciality chemicals can be sold at higher margins due to the intellectual content of the material, but once again profitability rises as sales volume increases. Thus the business incentive is to grow sales in order to generate maximum returns. However this is in opposition to the drive for resource efficiency and sustainability where the aim is to minimise resource use whilst maximising added value.

Service-based models, as described in this guide have the potential to resolve this problem. They can extend the business incentive for improved resource efficiency to the product itself and its delivery, leading to enhanced product durability and a reduction in waste. Selling the 'service' rather than the 'substance' incentivises both the supplier and the buyer to minimise the consumption of the substance commensurate with delivering the required value to the end product.

The maximum efficiency is likely to be delivered using 'closed loop' systems where, at least theoretically no waste is produced because the substance is continually recycled back into the production process at the end of its useful life. However introduction of such systems is likely to be slow due to the need for fundamental redesign of the product itself.

Nevertheless considerable savings in cost and resources along the whole value chain are possible by introducing both Chemical Management Services and Chemical Leasing approaches.

Appendix: Further Case Studies and Examples

1 Chemical Management Services

1.1 Chemical Management Services at Raytheon

Raytheon is one of the world's leading diversified technology companies, specializing in defence and government electronics, space, information technology, technical services, business aviation and special mission aircraft. Raytheon had more than 80,000 employees and $20 billion in revenues in 2004. Raytheon were interested in contracting out the management of their chemicals driven by an interest in reducing costs, a desire to outsource areas that were not included in core competencies, and the need for better data management for environmental reporting.

Technical solution Raytheon entered into a comprehensive, far-reaching partnership with a chemical management service (CMS) provider, Haas TCM. The contract covered chemical management for all chemicals and gases including procurement, inventory, delivery, disposal, and data management. Additionally, the contract included incentives for shared savings, due to reduced chemical use and purchase costs and improved process efficiency. The program has resulted in elevated performance and savings for the company by reducing chemical usage and streamlining chemical management throughout the chemical lifecycle.

Benefits

- Streamlined Operations (~20,000 chemicals, 1000 waste profiles)
  - Automated ordering, chemical gate-keeping, consolidated sourcing
  - On-line MSDS and EHS data for reporting
  - Chemical use and waste generation tracking
  - Procurement and inventory management

- Improved Service and Quality
  - On-time delivery rose from a base of 82% to an average of 91% in the first 5 months
  - Scrap rate reduced by over 80%

- Reduced Costs
  - Payback of the program in the first 6 months
  - 10-20% net savings in the first 2 years
  - Expected savings over the 5 year contract is 30-40%

1.2 Chemical Management for Aerospace manufacturer

As a division of Hamilton Sundstrand (a United Technologies Company), Claverham manufactures actuation systems for aircraft. This process requires the use of machining coolants for manufacturing, adhesives and sealants for assembly, hydraulic oils for testing processes, and paints applied to units in the treatment facilities. The Claverham facility was experiencing problems with inventory stock-outs. In addition, gathering constituent stock data for REACH compliance was a challenge.

Technical solution Claverham decided to deploy chemical management services (CMS) as a strategy to improve inventory management, information management, and to save costs. During Phase I of the program, the CMS provider (HassTCM) took over sourcing and supplying of chemicals to the point of use. They deployed barcode scanning equipment to securely trace chemical movement to sites, ensure appropriate min/max levels are kept, and minimise shelf-life expiration. During Phase II, services were expanded to include management of the parts wash service. In the first year of the CMS program, Claverham

realised a 28% reduction in costs and improved inventory and data management. Scrap rates have been reduced significantly.

The chemicals involved included:

Bulk wet & dry chemicals used by the Treatments Processing facility
Bulk fluids: machine coolant, hydraulic oils
Assembly consumables: sealants, adhesives
Aerospace specified paints

Claverham are now looking to complete a cradle-to-grave approach by exploring opportunities for including hazardous waste management in the program.

Benefits

- Reduced unit price costs 8% at start-up
- Reduced direct program costs by 28%
- Chemical gate-keeping process in place
- Reduced stock holdings and stock-outs
- Easy access to data for REACH compliance
- Reduced scrap rates
- Reduced machine downtime due to better information / visibility

2 Chemical leasing

2.1 Chemical leasing of powder coatings

Powder coatings are a sustainable way to apply colour and a protective covering to finished objects. The method is more sustainable than coating in situ and does not involve solvents or VOCs. The powder is sprayed onto the substrate surface (sometimes pre-treated) with virtually all the excess powder recycled. The coating is electrically charged as it is sprayed onto the surface to be coated and then baked in an oven, where the powder particles melt and fuse into a smooth coating. The result is a uniform, durable, high quality environmentally safe and attractive finish. Given the efficiency of the approach powder coating lends itself well to chemical leasing. This is a business model where the customer pays for the benefits obtained from the chemical, not for the substance itself. Supplier success is not linked with product turnover and chemical consumption becomes a cost rather than a revenue factor thus requiring the use of chemicals to be optimised.

Technical solution In a chemical leasing business model, AkzoNobel Egypt is providing the coating powder, managing and supervising the powder coating process of domestic appliances at ABBs ARAB plant in Eqypt. Furthermore, AkzoNobel Egypt is providing a certain number of coated m^2 per month against a fixed price. The offered service is including know-how transfer and improvement of the quality of the final product, in addition to capacity building of the ABB ARAB technical staff.

Benefits

- Saving in raw material by reduction in powder loss from 12% to 5%
- Cost reduction of coating process per m^3 from 3.8 per m^3 to 3.2 per m^3
- Forecast direct savings are around USD $68,000 per year
- Process optimisation and more efficient process (1 kg powder makes more that 6 m^3 rather than 5 m^3)
- Less maintenance cost (one time instead of two times per month)

- Less energy consumption by reduction of pressure of the powder guns
- Long term business relationship based on a regularly monitored contract
- Recycling of powder waste at AkzoNobel
- Compliance with environmental regulations related to waste management and workplace environment
- Enhancement of supply chain management and other environmental management systems
- Reduction of chemicals, raw materials, energy, emissions and waste.
- Capacity building of operation staff by sharing know-how
- High quality of final product ensured

2.2 Renting Ionic Liquids

Ionic liquids are seeing increasing use as solvents due to their low vapour pressure, high thermal stability and the ability to solvate many polar and non-polar molecules. They have been exploited for use in metal plating, gas compression and absorption cooling as well as for other chemical processes. Due to many having low toxicity and being non-volatile, they have potential as greener solvent alternatives. However they remain expensive due to the difficulty of manufacturing them.

Technical solution German company, IoLiTec, has begun renting ionic liquids to customers. Under this business model customers effectively rent two batches of liquids which can be cycled for continual use. When the performance of the batch in use begins to drop, the customer sends it back to IoLiTec for cleaning and switches to the spare. IoLiTec then use a proprietary process to clean and purify the ionic liquids for reuse.

Benefits

- Closed-loop approach
- Novel business model chemical leasing approach
- Reduction in unit cost to customer of up to 90%
- Develop ongoing relationship with customer

3 Closed Loop Models

3.1 Chlorinated Solvent Recycling

Chlorinated solvents are extremely efficient cleaning agents. Unfortunately, significant toxicological and environmental hazards have caused many companies to stop using them altogether. Could suppliers find a way of using them safely and responsibly for applications where they are the best choice?

Technical solution SafeChem, a subsidiary of Dow, has developed a handling system for chlorinated solvents that allows them to be used in closed loop degreasing systems. The Safe-Tainer system uses two dedicated double wall containers; one to hold fresh solvent and the other used solvent. The containers are connected to the cleaning equipment with zero dead volume, leak-free connections that prevent spills, leaks or vapour emissions during use. Used solvent is collected for recycling and incineration of any residues.

However, this is not just a safe container. It actually switches the business model from sale of a chemical to management of a chemical process throughout the lifecycle. SafeChem is fundamentally a service company.

Benefits Minimises solvent use and release to the environment. A trial in Austria showed a 60% reduction in solvent used by customers - virtually all of that solvent would have ended released into the environment or would have become a hazardous waste stream to be managed a service model which brings long-term customer relationships

3.2 Closed-loop recycling of uPVC windows

Increasing volumes of post-use PVC waste from early generation windows and doors are destined for landfill with associated environmental and cost implications. PVC is a long-life material that cannot rot in the ground.

Technical solution Plastics recycler Axion Recycling Ltd is the UK agent for Recovinyl, the PVC industrys recycling initiative, which has a network of over 30 accredited PVC recyclers in the UK.

Merritt Plastics, a Recovinyl recycler and high volume trade extrusion company, pays £80 per tonne for post-use PVC window and door frames from installers and waste companies to incentivise recycling.

This waste is then cleaned, separated, shredded and granulated to make a recyclable material ready for re-extrusion. Merritt uses a monthly average 120 to 150 tonnes of waste PVC manufacturing a wide range of new low-maintenance plastic building products.

Thus end-of-life PVC window and door frames enter the site and subsequently leave as new PVC window and door frames with up to 100% recycled content for re-use in the construction industry.

Benefits

- Reduced environmental impact; diverts waste from landfill
- Preserves natural resources for re-use in the UK; reduced use of virgin material
- New products contain up to 100% recycled content
- Cuts disposal costs for installers
- New revenue stream for installers and an incentive to recycle
- Traceability - Recovinyl recycled 40,000 tonnes of waste PVC-U in 2007