E-SOURCING: IMPACT ON RESILIENCE OF THE CHEMICAL INDUSTRY

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Abstract

Resilience is described by Begon et al. (1966) as the degree to which an ecosystem will return to its original position after an exogenous shock had occurred and the velocity of this adaptation. The introduction of electronic markets as a method of strategic sourcing in the period between 1999 and 2002 can be now seen as a dynamic turning point for the chemical industry. This paper describes the evolution of the electronic markets, using two framework models for analysis. The aim of this paper is to examine how the chemical industry adapted and became resilient to sourcing shocks. We find that this adaption occurred through market design, user sophistication and asset specificity.

Keywords: strategic sourcing, chemical industry, standards, market design.

1 INTRODUCTION

Biologists distinguish between two basic concepts of stability (Begon et al., 1996, p. 838). The term 'resistance' circumscribes the ability of a community to fend off external disturbances and invasions into the ecosystem. 'Resilience' describes the degree to which an ecosystem will return to its original position after an exogenous shock had occurred and the velocity of this adaptation. It stands out that in environments that are relatively stable, with few exogenous shocks, ecosystems rely on resistance. However, in rapidly changing environments, ecosystems foster high reproduction rates and species become specialized to be able to quickly and elastically adapt to new conditions (Gothlich and Wenzek, 2004).

This can also be seen in business by adaptation of electronic marketplaces for specific vertical industries. The business ecosystem scenario can be seen with rapid reproduction (initial high numbers of entrants), evolution of the market need, and then sophistication of the surviving marketplaces to become specialized to the needs of buyers and sellers. This creates higher probability of efficient adaptation in case of exogenous shocks and therewith resilience can be achieved.

This paper examines the chemical industry and its electronic markets, with the aim of highlighting what factors create a successful marketplace ecosystem and how efficient adaptation of electronic markets creates resilience in the chemical industry. We first describe the role of strategic sourcing for buyers and sellers, and also review two theoretical frameworks for electronic markets examining success as a derivative of market design. We then examine the adoption and adaptation of electronic markets for the chemical industry, looking at elements of the theoretical frameworks to see how market dynamics have created resilience in the industry.

2 DRIVERS FOR SOURCING

Strategic sourcing is a buying process that includes definition of product and service requirements, identification of qualified suppliers, negotiation of pricing, service, delivery and payment terms, and supplier selection (Aberdeen Group, 2001). One approach is to do this with electronic tools to aid in information discovery. Electronic markets that use these e-sourcing tools create value by aggregating buyers and sellers, creating marketplace liquidity (spatial or temporal) and reducing transaction costs

(Kaplan and Sawhney 2000). However, buyers face a challenge in switching from existing supply relationships to these marketplaces because adoption of such marketplaces imperils their relationships with existing suppliers and may create problems for purchasing goods with some types of characteristics.

Because of the historically high failure rate of electronic markets, this research examines specific factors that might be crucial for resilience in e-sourcing success. Through a literature review of previous research, an exploratory research model is developed to specify the success factors. Case study examples are used to assess the validity of the research model and illustrate the economic effects that could be experienced by both the industry itself, and by buyers and sellers, focusing on the conditions under which electronic markets are likely to fail or are likely to be a success in e-sourcing opportunities.

3 THEORETICAL FRAMEWORKS

The effectiveness of these electronic markets depends on how critical processes are designed. We therefore examine two different frameworks that look at design of market processes. Using the work of a number of researchers and an examination of the Dutch Flower Auction, Ribbers et al. (2002) classify electronic market success as a derivative of market design as shown in Figure 1.

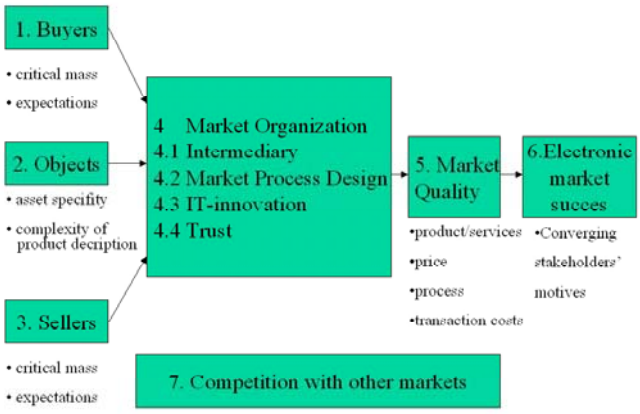

Figure 1. Electronic market framework (From Ribbers et al. 2002)

The first element, buyers, are characterised by their number, by the expectations with which they enter the market (such as the kind of products and services they expect e.g. standardized or customer specific), and their buying behaviour (e.g. their bidding strategies). Buyers affect success as buyer participation has to meet conditions of critical mass; the motives of the buyers will determine the required performance measures of that market.

The second element, objects (exchanged products) have certain characteristics. Asset specificity and complexity of product description are proposed as factors affecting the possibility of a product to be traded through an electronic market (Malone et al., 1987). Analogous to buyers, sellers can be characterised by their number, the expectations with which they enter the market, and their strategies. Critical mass and sellers' expectations affect the success of the market.

Market organization refers to the structure of key market processes, such as price discovery, information exchange, and logistics. Basically it refers to how and by whom different tasks are carried out and coordinated. The key issues in relation to market organization are intermediaries, market process design, IT innovation, and trust.

The second framework we examine is that of Kambil and Van Heck (1998), which specified a generalisable model of exchange processes for effective market process design. As shown in Figure 2, the framework distinguishes five trade processes (search, valuation, logistics, payments and settlements, authentication) and five trade context processes (communication and computing, product representation, legitimisation, influence, and dispute resolution).

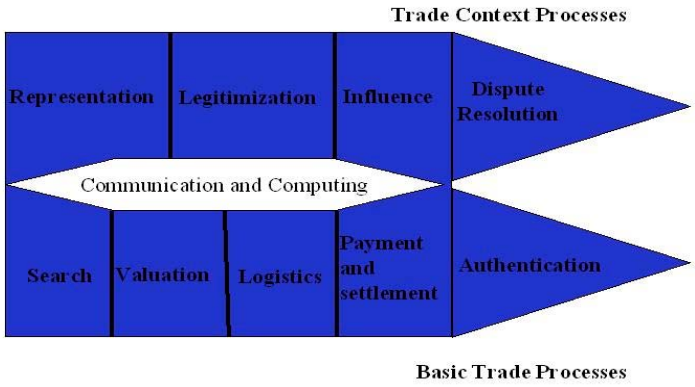

Figure 2. Market Process Design (From Kambil and Van Heck, 1998)

IT innovation proposes that trading processes will be affected by increasing bandwidth and ICT convergence, facilitating electronic communication, electronic coordination, and electronic brokerage (Malone et al., 1987). In addition, the trust element suggests that buyers and sellers may be confronted with opportunistic behaviours of their counterparts. Trust can be defined as the belief, or willingness to believe, that one party can rely on the fairness, goodness, strength, and the ability of the other party (e.g. the seller, the buyer) (Fukuyama, 1995).

Market quality refers to effectiveness and efficiency of trading on that market. The literature provides some measures. For example, Clemons and Weber (1990) characterize financial markets in terms of liquidity, volatility, and transparency. Liquidity is an important attribute of a financial market's attractiveness. It measures the investor's ability to liquidate a position – that is, to convert a security into cash or cash back into a security, without delay, and without the transaction having an excessive effect on the price at which the security is bought and sold. Schwartz (1998) measures a market's attractiveness in terms of liquidity, accessibility, transaction costs, accurate price discovery, and adequate information about products, transactions, and quotes. Apparently, specific measures depend on the type of market.

While competition with other markets is an important element, the literature shows that most researchers view markets as single isolated markets (Rothkopf and Harstad, 1994). Recent work from Ribbers et al. (2002) and O'Reilly and Finnegan (2002) both propose that the success of electronic markets depends on two categories of factors: (I) the motives of (potential) participants, and (II) the level of effectiveness and efficiency of the market – expressed in terms of motives of participants.

4 RESEARCH QUESTION AND OBJECTIVES

We have defined the scope of the research as examining how a business ecosystem scenario creates resilience by creating a higher probability of efficient adaptation in case of exogenous shocks. The research question posed is: *What factors of adaptation contribute to the resilience of these electronic markets?*

To address this, we first focus on a particular industry, in this case the chemical industry, and the effects the electronic markets might bring for its participants. The difference between markets and hierarchies to source goods is also discussed in order to provide additional insights on the different dimensions of electronic markets. We then examine three electronic markets, using both the frameworks previously discussed, to examine market design, market processes and resilience. Given that the research focuses on the historical aspects of these markets, research was primarily done via content analysis and secondary published materials.

5 STRATEGIC SOURCING IN THE CHEMICAL INDUSTRY

The chemical industry was an early adopter of e-commerce tools and one that continues to refine their uses. Many chemicals are commodities with low margins, so cutting the cost of transactions was not only attractive, but also essential. Additionally, many chemical companies sell their goods to other chemical companies that make finished chemicals. This environment lends itself to easier adoption (Vinas, 2005)

With the chemical industry's rapid recovery in recent years, producers are now forced to tightly control supply flow to the very customers they worked so hard to attract and retain during the long industry slump (SAP, 2005). The industry's traditional challenges remain: strict quality control measures and governmental regulations, intense time-to-market pressures and complex production and supply chain processes spanning multiple countries. The increasingly global nature of chemicals operations requires companies to share information across internal and external supply chains, from headquarters and local sales offices to distribution centers and plants, as well as from customers back to suppliers.

In terms of a business ecosystem, the current drivers for strategic sourcing via electronic markets is demand-driven, creating a system of technologies and processes that senses and reacts to real-time demand signals across a supply network of customers, suppliers, and employees (AMR Research, 2005).

5.1 The Players

ChemConnect was founded in 1995 as a bulletin board site, and has since then established itself as a leader in helping companies optimize their purchasing and sales processes for chemical feedstocks, chemicals, plastics, and related products through the use of e-commerce (Angwin, 2004).

ChemConnect is now the biggest online exchange for chemical trading, with volume of USD $8.8 billion in 2002, the latest figure available. One key to ChemConnect's survival was speed. It was first to market, launching an Internet bulletin board in 1995. It was also the fastest and best fund-raiser among its dozens of competitors — bringing in $105 million by the time the stock-market bubble burst in 2000, compared with $50 million for its chief competitor, CheMatch.com.

More than a dozen chemical exchanges had emerged by 2000, led by CheMatch.com, which had lined up support from DuPont Co., while ChemConnect had backing from Dow Chemical Co. Founder and Chairman John Beasley launched himself into a frenzy of fund-raising, flying around the world to meet with chemical companies. In the spring of 2000, he raised $72 million from 38 of them. To keep the exchange neutral, he limited each company to, at most, a 5% stake. The company has since moved from its San Francisco offices to more modest quarters in Houston and its staff has shrunk to 60 from about 190 during the boom era (Angwin, 2004).

Elemica is a global electronic network developed by 22 of leading chemical companies. It offers solutions focused on improving supply chain inefficiencies through browser-based and Enterprise Resource Planning (ERP) connectivity. Elemica is one of the longest surviving industry consortia investments from the dot-com era, largely because it has steadfastly avoided competing with its founder members, or offering services that further commoditized the relationship between customers and suppliers, such as RFx/auction services. Elemica has stayed true to its original mandate to improve

transactional efficiency between trading partners within and outside the Chemical industry, and continues to make gains in adoption of its *Connect Once Connect All* vision. While Elemica has consistently grown the number of trading pairs and transaction volume, including a rapid ramp-up of logistics transactions since its acquisition of Optimum Logistics, it is not yet a self-sustaining Enterprise Service Provider (ESP), and remains dependent on founder members for funding. (AMR, 2005)

Omnexus, the Consortium Trading Exchange (CTX) for the Plastics industry, failed to garner the adoption that it needed to keep running. Omnexus COO Michael Walsh cited sluggish e-commerce adoption rates in the decision to close down Omnexus. Omnexus shareholders decided to discontinue funding, and asked for an orderly wind-up of the company by the end of 2003. In December, SpecialChem, which sells business development services to the Polymer and Additives, Adhesives and Sealants, and Paints and Coatings industries, bought the complementary e-marketing services of Omnexus, and the brand name. On June 1st, 2004, based on users' feedback and extensive evaluation of the needs of the plastics industry, SpecialChem launched the new Omnexus, with integrated services for the entire plastics and rubber industry (Omnexus, 2005).

To facilitate our discussion on resiliency, we focus on the turning point which created the resilience of these marketplaces in the industry and changed the focus to more of a demand-driven integrated effort. As shown in Figure 4 below, the chemical industry evolved in its use of third party intermediaries to create an exchange mechanism from an internet, open information exchange to transactions and integrated services with more rich components for each party, leading to demand driven supply networks (DDSN). The turning point for the industry, as shown below, came around the year 2002 with consolidation of consortium trading exchanges (CTX) and the need for more tightly integrated ERP for chemical firms (SAP, 2005).

	Information	Facilitation	Transaction	Integration
Exchange Model	Websites & ITXs	ITX gives way to CTX	CTX competes with proprietary PTX	Standard Vendor PTXs and Exchange Services
ERP Integration	None	None	Proprietary PTX and CTX to ERP	Tightly coupled ERP and PTX
B2B Integration	None	Proprietary Apps and Trading Networks	Proprietary PTX to multiple CTXs	BPM of PTX and loosely coupled Exchange Services
Industry Standards	None	Cross-Industry Catalog	Multiple Industry Data and Process Standards	Cross-Industry Data & Process Mappings
Market Dynamics	Proliferation of exchanges	Expansion of scope of services	Consolidation of exchanges & services	Collaboration between exchanges
Participants	All	Fortune 1000 & Some SME Suppliers	Fortune 1000 only	Fortune 1000 & Broad SME Adoption
Key Services	Product Info	RFQ, Negotiation, Auctions	Automation of pre-negotiated transactions	End to end Supply Network Collaboration

Figure 3. Evolution of Exchange Service Providers (Source: SAP, 2005)

In the year 2000, consortium trading exchanges (CTXs) were seen as alternative that were pitted against third-party Independent Trading Exchange (ITXs). At that time, e-marketplaces, such as ChemConnect and CheMatch, existed as independent trading entities. This raised questions about ownership ties (Thayer, 2001) as many of the partners in Elemica, a consortium exchange (CTX), previously invested in ChemConnect, which was an ITX. Elemica had recently combined operations with the industry site ElastomerSolutions as well. There was a question then on what constituted independence. Can a marketplace still call itself independent after buyers or sellers take an equity position? The turning point discussed below shows that independence still requires support.

5.2 Toward the Turning Point – 2001-2002

The developments during this turning point exemplify the rapidly changing environment for chemical e-business during this period. The year 2001 was a critical one for the chemical e-marketplaces. Elemica, the chemical industry network backed by 22 major companies, had gone live over the summer. Meanwhile, its leading competitor, Envera, merged with ChemConnect, a third-party exchange (ITX). BASF, Dow Chemical, DSM, and Solvay Minerals had announced in 2001 that they had conducted the first transactions on Elemica. By connecting their enterprise resource planning (ERP) systems to Elemica, the companies routed their ongoing contractual business through the network. ERP connectivity, they said, was a critical component of their e-business strategies.

Although smaller than Elemica, Envera appeared to enjoy a first-mover advantage, launching transactions in October 2000. Thus, the 2001 announcement that it would merge with ChemConnect, an ITX dot-com, came as somewhat of a surprise. Operating as ChemConnect, the merged firm believes it will offer companies a broader solution--everything from supply-chain integration and contractual business to spot and commodity trading. At that time, the major players still left were third-party exchange CheMatch.com and polymer industry network Omnexus.

CheMatch was then acquired by ChemConnect in 2002, and at the end of 2003, Omnexus went under and its platform was acquired by Special Plastics, who relaunched the Omnexus brand the following year.

6 FINDINGS OF TWO FRAMEWORKS

We have discussed the migration of electronic markets in the chemical industry from information usage, to facilitation and transaction orientation, to today's more integrated structure with a demand based focus. We now examine these findings within the framework of the two models discussed earlier in the paper to see what elements of these models factored into the market adaptation which created resilience in this industry.

6.1 First model of Ribbers et al (2002)

Buyers/sellers: The initial users of the exchanges were a wide set of participants. This narrowed down to more specific participants as the markets gained more functionality. As the marketplaces matured to transaction orientation, the members found they did not need to join multiple markets, and member pressure helped define the specificity of each of the marketplaces. As the marketplaces provided services that were more integrated, the membership widened to other affiliated organizations in the industry who also saw benefit in membership.

Objects: Each market fulfills a different demand for different types of chemicals. ChemConnect focuses on specific chemicals such as NGLs, Omnexus now only addresses plastics and polymers, while Elemica has a much wider set of asset specific products. The degree of specialisation with asset specificity leads to more sophistication of marketplaces for resilience in areas such as product description, product search and supplier discovery.

Market organization and design: The exchange models used between participants changed over time. The initial use of ITXs evolved to more of a consortium (CTX) model as the required functionalities of a marketplace became more defined. As the value to participants changed over time, private trading exchanges (PTX) developed due to the specific needs of the some of the members. These are all adaptations to becoming resilient based on user sophistication and market dynamics.

Market quality: As a function of CIDX industry standards, the ability for search and valuation, for example, was improved. And the integration to both ERP and B2B exchanges assisted the development of these marketplaces.

The first model of Ribbers et al. (2002) puts into perspective the elements that make an electronic market: users, objects and market organization. The shift in participants from a wider group, to a more specific set of organizations, then expanding to a network of related organizations beyond the Fortune 1000 show how the market became more specific in its deliverables, then interested related parties who saw the value created for the market players. The objects defined in the markets became more unique to that particular market, in terms of asset specificity. And the design of the market changed to either be horizontal in nature (Elemica), specific to a subset of chemicals (ChemConnect), or more oriented towards a function such as sourcing news service (Omnexus).

6.2 Second model of Kambil and Van Heck (1998)

Basic Trade processes: The Elemica tracking and tracing modules, the automated Trading Center of ChemConnnect, and valuation and pricing of Omnexus are all unique functions within the basic trade processes to assist users in automating their sourcing efforts.

Trade Context processes: This is an area that connections to other organizations such as Citibank, or work with organizations for functions such as translation, for example, which all add value to the sourcing process. This area, however, is not as rich in functionality as the basic trade processes. Perhaps this is an area where more maturity is due to come.

The second model of Kambil and Van Heck (1998) allows us to examine how the processes of the market have evolved as the needs of the user matured. For example, as the users moved to more facilitation and specific transaction market needs, the ability and demand to catalog cross-industry and search grew in importance and the functionalities adapted to the demand.

7 RESLIENCE FINDINGS

So from these two models and this particular industry, we suggest the following factors may be factors in the adaptation of these markets in creating resilience:

- Evolution of functionality/ market design: As these markets progressed from information providing in a one-way flow to a more transaction oriented model, the markets became more specific and sophisticated in their functionality and design.
- Sophistication of user: As users became more interactive with these sites, their demands for functionality became more complex and integrated to other systems in use in their organizations. This created a need for standards and for specialisation in market objects to offer better tailored services to the user.
- Asset specificity of market: As the user grew more sophisticated in their needs, the detail required for the market objects increased, and therefore the objects covered in the market either became more specialized, or the market grew more horizontally oriented towards overall sourcing.

By examining this vertical industry with a business ecosystem scenario, we have shown that the rapid reproduction of electronic markets with their initial high numbers of entrants, the evolution of the market need to more asset specificity and increased sophistication, has led to the surviving marketplaces adding resilience to the chemical industry's ability to source product.

8 CONCLUSION

In examining the chemical industry's approach to strategic sourcing, we highlight the integrated aspects of the value chain and how technology usage plays a leading role in the production, information and logistical flows of the market. In today's rapidly changing global markets, resilience is key to survival, and by analyzing the components of that resilience, we provide an initial contribution to further research on supply chain flexibility and adaption.

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