Archives of Business Research – Vol. 10, No. 1
Publication Date: January 25, 2022
DOI:10.14738/abr.101.11535.
Kin Bee, T. (2022). Electronic Business-to-Business Marketplace Transformation in the Chemical Industry: Will the Second Wave Succeed Where the First has Failed? Archives of Business Research, 10(01). 12-42.

Electronic Business-to-Business Marketplace Transformation in the Chemical Industry: Will the Second Wave Succeed Where the First has Failed?

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ABSTRACT

The global chemical sales are expected to be worth over €6,000 bn by 2030 and this offers a very significant market size for businesses to be transacted electronically. It is generally believed that the first wave of the electronic business-to-business marketplace featured very strongly into the chemical industry sometime in the late 1990's, but in just over a few years many of these electronic marketplaces started to close down or being merged with others, and later on they too disappeared from the chemical industry. Many of them had failed to sustain themselves in the marketplace and survived. From 2005 onwards, it became apparent that the second wave of electronic marketplaces started to enter the chemical industry again. Electronic marketplaces were being set up by chemical manufacturers and distributors, with many of them even setting up multiple web storefronts, to promote their products. This research will look into the chemical distribution market size, supply chain activities, as well as the various electronic marketplaces present in the chemical industry. The Author will investigate into the reasons why the first wave of chemical electronic marketplaces did not manage to sustain themselves in the market and the possible reasons for their failure. The types of electronic marketplaces during the second wave were investigated in great detail. What are the differences in the types of electronic platforms in the second wave and will they stand a chance to survive this time round, when many of them have failed in the first wave? This research will attempt to investigate the possible strategies through the digital marketplace, by both chemical manufacturers and distributors, in their effort to capture greater market share.

Key words: Electronic Business-to-Business Marketplace, e-Marketplace, e-Platforms, Digital Chemical Industry

INTRODUCTION

This research was prompted by the huge wave of Electronic Business-to-Business Marketplace (e-B2B MP) entering the chemical industry in the late 1990's, and also in the 2015's, by both chemical manufacturers and distributors. Some historical perspectives will be discussed on the development of the e-B2B MP in the past, what happened to them, and what is new now being introduced into the same market space.

The journey of the e-B2B MP, or also called by electronic commerce, platform, and exchanges, began in the late 1990's when the market was being swept away by the utopian enthusiasm that e-B2B MP will take over the whole industry, and any companies not conducting their

business electronically are going to be totally irrelevant in the future. The Author has lived through those days when everyone, particularly the management consultants, fueling the fever pitch that electronic commerce was the way to go, and they have the answer for everyone. Guess what, the company the Author was working for at that time, rejected all the hypes and today they are still very much alive. However, it cannot be said of the many e-B2B companies and consultants, which did not survive the dotcom era.

In this research, the late 1990's to 2010, is taken to be the first wave of e-B2B MP entering the chemical industry. Some historical perspective of the different types of e-B2B MP will be discussed. From 2010 onwards till today, the Author has labelled it as the second wave of e-B2B MP entering the chemical industry. It can be observed that e-B2B MP business models are metamorphosing into cloud-based strategy with many chemical companies jumping on to the bandwagon. More and more electronic exchange platforms, using Software-as-a-Service (SaaS) approach, which supposedly makes it easier and cheaper for businesses to migrate to ready-made electronic platforms.

This research will investigate the e-B2B MP that are being specifically used in the chemical industry, by both chemical manufacturers and distributors, and to evaluate the value propositions they are offering to the customers. Will they be more successful in the second wave as against the failure of the first wave? This research will attempt to provide some answers to the research questions, i.e., what happened in the first wave? Why did it fail? What is new in the second wave? and, Will it succeed this time?

GLOBAL CHEMICAL INDUSTRY MARKET SIZE

The global chemical sales are valued at about €3,700 billion (bn) in 2019 (Bee, 2021), and by 2030, the forecasted world chemical sales are expected to be worth around €6,050 bn. The commodity and specialty chemicals sales are estimated to be worth about €3,630 bn and €2,420 bn, respectively by 2030 (Bee, 2021). All these sales are potentially available for transactions through the e-B2B MP. This is a very sizeable potential business volume with millions of customers and, is seemingly waiting for the efficient e-B2B MP to capture the business. The e-B2B MP are generally thought to be more suitable for transacting commodity chemicals, rather than specialty chemicals, and even then, by 2030, there is a market size potential of at least €4,000 bn that are available for transactions electronically.

From the total chemical sales, a portion of it is transacted through chemical distributors, and Bee (2021) estimated that by 2020, the global chemical distribution market size will be worth about €276 bn and, is expected to grow further to €440 bn by 2030. Chemical distributors are intermediaries, who gets their chemical products from the manufacturers, and sell them to industrial users. The details of what the chemical distributors do in the supply chain will be discussed more in the later section. At this point, it suffice to say that if e-B2B MP are as efficient as what the theories makes it out to be, then all these chemical distribution sales volumes of about €300 bn, could in theory be transacted through the e-B2B MP. Can this be a reality? The disintermediation of chemical distributors is not in the scope of this research, and anyone wanting to study this in greater detail can refer to Tay and Chelliah (2011). Theoretically, the potential business that can be transacted through e-B2B MP are without any doubt available to be transacted electronically, if the e-B2B MP business model, are sufficiently efficient and frictionless, thus reducing transaction costs, disintermediate the chemical distributors, and

URL: http://dx.doi.org/10.14738/abr.101.11535

allow the manufacturers to supply directly to the industrial customers. However, this remains in theory only for the time being.

CHEMICAL INDUSTRY SUPPLY CHAIN

After the chemical products are being produced, they had to be shipped out of the factory to the customers' destination, whether directly by the manufacturers themselves or through an intermediary. There are many activities happening throughout the chemical distribution supply chain before the physical product reaches the customer's destination, promptly, accurately, and arriving at the customer's destination with all the necessary paperwork. Tay and Chelliah (2011) provided exhaustive details on the supply chain activities, and this is shown in brief in Figure 1. Basically, the supply chain activities are split into four segments, namely "*Matching of Buyers and Sellers*", "*Facilitation Transactions*", "*Institutional Infrastructure*" and "*E-Commerce Capability*".

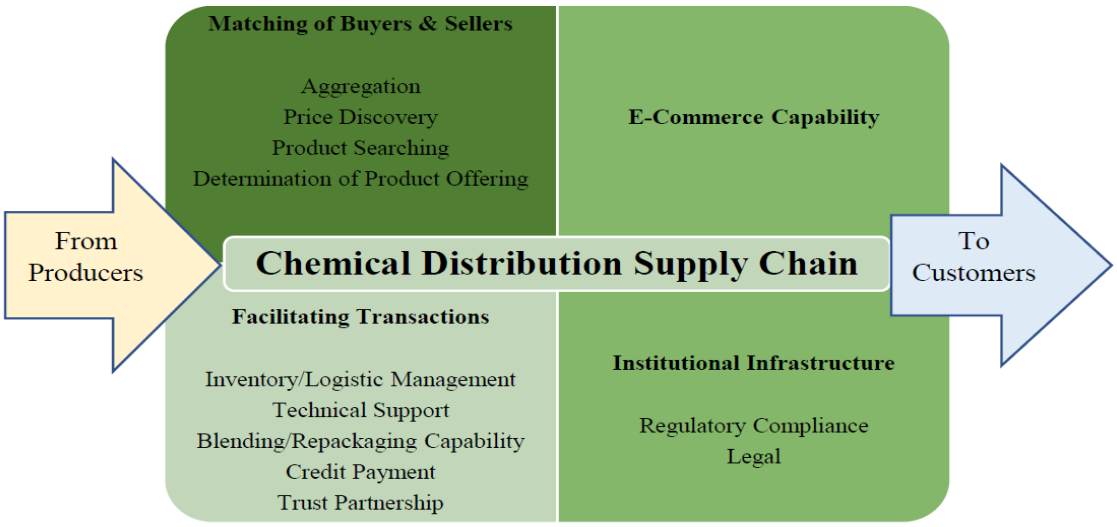


Figure 1: Chemical Distribution Supply Chain
Source: Extracted from Tay and Chelliah (2011)

The "*Matching of Buyers and Sellers*" are predominantly before-sales activities where salespeople had to go out to market the products and to conclude the sales. Customers will be searching for the right product and upon finding the suitable supplier, the price discovery process, as well as determination of the offering will take place. The word "*suppliers*" is used here because this can be either chemical manufacturer or distributor. Often the suppliers had to provide the service of product aggregation so that customers can buy multiple products from them as a one-stop shop. The ability to aggregate buyers and sellers are claimed to be one of the key benefits of e-B2B MP. It has been argued that e-B2B MP are well suited to perform the task of aggregation of buyers, and sellers and buyers could benefit from the lower cost of transactions (Fingar et al., 2000). Distributors have a distinct advantage over chemical manufacturer because the manufacturer would be unable to aggregate the product offerings because they only sell what they produce, whereas distributor can combine products from different manufacturers to offer to customers.

Up to this stage, only paperwork is being handled and there is no transferring of physical product yet. Once the orders are confirmed, and if the customers are overseas, then the supplier

would have to provide the "*Institutional Infrastructure*" services like export documentations and advise customers if there are any specific rules and regulations on handling and storage requirements. Documents like product datasheet, certificate of origin, test analysis certificate and material safety data sheet had to be provided to the customers. To complete the paperwork loop, the customers expect the suppliers to provide the "*Facilitation of Transactions*" services, like local warehousing and deliveries, provide credit terms and provide technical advice to them.

Turban et al. (2006) describes the market, be it electronic or otherwise, as having four main functions and these are reflected in the framework of Tay and Chelliah (2011) as presented in Figure 1. Tay and Chelliah (2011) found that "*Trust Partnership*" between suppliers, distributors and customers are of paramount importance to the transactions. Customers feel confident to buy from the local stockiest, or distributors, because they have developed the trust relationship and, if any problem arises from the orders, they have somebody locally who can handle the matter for them. Often manufacturers are not able to provide the door-to-door service to the customers as they are unable to reach down to every customer's location for the last-mile delivery. Having local stocks and just-in-time deliveries are also of great importance to the customers.

With the advancement of digitalization technology, more and more of the manual administration process like sending physical paper documents, shipping documents, provide latest shipping status, shipment tracking can be provided through the internet. This is more of an enterprise resource planning capability within the company, but it must not be mixed up with e-B2B MP transactions. Today, more and more of the sales and marketing process are even being supplemented, and complemented, through e-B2B MP digital devices. So, e-B2B MP capability is becoming more and more of a necessity to reach out to all the customers and potential customers. Many domestic home product type consumers are quite happily buying through the internet websites without so much thinking whether the websites could be trusted. Internet sales fraud thus are increasing due to many ill-intentioned people exploiting the trusting nature of the consumers. However, is this the case for commercial buyers where the purchasing officers have the onus to determine the authenticity of the websites they are ordering from? Thus, security of transactions becomes a very important factor to convince customers to buy on-line and the same goes for industrial product purchasers.

There are two school of thoughts on e-B2B MP as regards to the chemical distribution supply chain. One school of thought is predicting that digitalization will replace almost all the physical supply chain activities, thus disintermediating the physical distribution channel partners. Perhaps it is why many of the chemical manufacturers and chemical distributors are embarking on installing web storefronts on multiple e-B2B MP. The other school of thought is that e-B2B MP will just be a supplementary service tool to reach out to the digitally inclined customers and the physical infrastructure will remain intact. Time will tell where the reality lies.

ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE IN THE CHEMICAL INDUSTRY

This topic of Electronic Business-to Business Marketplace (e-B2B MP) is not new, and they have been referred to by many different names. This section will attempt to clarify the terminologies being commonly used and the author will adopt a common name for the purpose of this research to be used throughout this research. The author will also categorize the different e-

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B2B MP encountered in the market and to highlight some of the more prominent electronic marketplaces in the chemical industry. The author will touch briefly on the butterfly business model to exemplify a perfect scenario which e-B2B MP may aspire to be.

ELECTRONIC BUSINESS-TO-BUSINESS TERMINOLOGIES

Any time you read an article on e-B2B MP, there are also many other terms being used quite interchangeably to describe what are basically the same thing. Terms like Electronic Market (e-M), Electronic Marketplace (e-MP), Internet-Based Electronic Marketplace, Electronic Hubs (e-Hubs), Virtual Marketplace (v-MP), Electronic Exchange (e-Exchange), and Electronic Commerce (e-Commerce) are very often being used interchangeably. These terms will be described briefly on the pertinent similarities to gather a common understanding on its definition.

Electronic B2B (e-B2B) can be described as the use of web-based technologies to buy, sell, or exchange products and the exchange of information between two or more companies. There is the more popular e-Business-to-Consumers (e-B2C) business model which is out of scope of this research and will not be covered in this research. B2B transactions can take place directly between companies or through a third party, for example an intermediary who is also a company, who helps to match buyers and sellers (IBM, 2001). E-B2B encompasses all electronically based exchanges, including internal business processes within an organization and interfaced with external stakeholders (Rodgers et al., 2002). It also includes electronically mediated information exchanges with suppliers, employees, and regulatory authorities as well.

Bakos (1991, p. 296) defines an e-Market system as an "*inter-organizational information system that allows the participating buyers and sellers to exchange information about prices and product offerings*" which sounded like e-Market is just an information system. Segev et al. (1999) describes an e-MP as where buyers and sellers meet virtually to exchange services between buyers and sellers. e-MP have also been referred to as electronic procurement solutions (Segev et al., 1999), intermediaries (Dai & Kauffman, 2002a), and digital marketplaces (Raisch, 2001). Fath and Sarvary (2002, p. 78) goes even further to state that the e-MP is where "*participants can reduce transaction costs and reach new customers*". Popovic (2002) sees e-MP as a virtual online market where buyers, suppliers, distributors, and sellers find and exchange information, conduct trade, and collaborate with each other via an aggregation of electronic information portals, trading exchanges and collaboration tools. e- MP are also defined as information systems (Strader & Shaw, 1997), digital marketplaces (Laudon & Traver, 2002), and online markets (Turban & King, 2003). Grieger (2003) consider e-MP to be a central marketspace that possesses the unique feature of virtually bringing multiple buyers and sellers together to exchange information, goods and/or services. Ruijter (2004) describes e-MP as where buyers and sellers can meet to negotiate for products they wanted to buy and sell at competitive pricings electronically. In summary, e-MP is an internet-based (or web-based) solution, facilitating the linkage between business partners in buying and selling of products electronically (White & Daniel, 2004). The term *e-hub* is also being used as a synonym for e-MP (Daniel et al., 2003).

E-Exchange, e-B2B Exchange, e-Hub, and Electronic Platform (e-Platform) are also words being used in the e-B2B world. A straightforward definition of an e-Exchange is a trading platform in which order entry and forwarding, matching of buy and sell orders, and price determination

are performed by a computer (Deutsche Boerse, 2021). An e-Exchange should have electronic capability in order that both buyers' and sellers' desire can be transacted and, in the process create values for its users. In spot-purchases, the buyer's search cost become important and the relationship between buyers and suppliers is limited. e-Exchange are suitable to facilitate spot trading but must be able to attract large number of sellers and buyers to transact electronically in order to achieve sustainability.

In the earlier days, e-Commerce was frequently referred to as the electronic exchange of products, services, or information between businesses (Zwass, 1996). Wigand (1997) define e-Commerce as the seamless application of information and communication technology along the entire value chain of business processes electronically. Bontis and De Castro (2000, p. 365) summarize e-Commerce simply as "*the buying and selling of goods and services via electronic means*". This definition spells out clearly the commerce part which is buying and selling. Fingar et al. (2000, p. 47) defined e-Commerce as an "*infrastructure for extending a company's inward-focused, unique business processes to customers, trade partners, suppliers and distributors…*". They elaborated that e-Commerce includes buying, procurement, pricing, selling, fulfillment, shipping, payment processing, product promotions/marketing, customer support and business intelligence to understand customer profiles. Vicnair (2001) provided a more pro-business definition of e-Commerce by saying they connect critical business systems electronically between customers, employees, suppliers, and distributors and improve time to market, access to a broader base of customers and suppliers, improve efficiency, and reduce costs. In fact, there were many references that considered e-Commerce as a subset of e-business (Chaffey, 2002; Rodgers et al., 2002).

Today, the term "*Digitalization*" is being used more and more in association with e-business. Gartner (2021) describes digitalization as the "*use of digital technologies to change a business model and provide new revenue and value-producing opportunities*". Deloitte (2017) defines Digitalization in the chemical industry as the usage of data to boost "*Operational Excellence*", "*Profitable Growth*" and/or "*Commercial Excellence*". Operational excellence is where Artificial Intelligence (AI) is used to substitute standardize and repetitive processes. The introduction of new products, services, and business models should improve profitability growth. Commercial Excellence is to improve the connectivity and capture the customer interface. Principals sees digitalization as a main source of organic business growth with or without distributors. Principals can either strengthen the distributor relationships via joint platforms and/or they reduce the dependency from distributors. Digitalization is the innovative application of digital technologies which may include cloud-based AI and data analytics. Digital technology does not fundamentally add anything new to the electronic activities which was earlier described in e-B2B MP except that the system is now cloud-based.

The expression "e-B2B Marketplace" is the combination of e-B2B and e-Marketplace, and the web-based functionalities include exchange and platform capabilities, and so the e-B2B MP ecosystem for these web-based business activities do sufficiently encapsulate the essence of all the activities discussed above. To simplify the description in this research, and to avoid using too many different terms to mean what is essentially the same thing, the expression "e-B2B Marketplace" (e-B2B MP) is chosen as an all-encompassing expression to represent all the other terminologies (electronic exchanges, commerce, and platform) discussed earlier from here on in this research.

URL: http://dx.doi.org/10.14738/abr.101.11535

CATEGORIZATION OF ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE

During the first wave of e-B2B MP entering the chemical industry, there was an explosion of many different types of e-B2B MP being set up. The e-B2B MP offered a wide range of advanced services online, from auctions, contract management, providing industry information to sophisticated logistic solutions by integrating the activities of buyers and sellers. e-B2B MP are generally classified by industry specialization, ownership type, open or membership participation, and type of functions the e-B2B MP can perform.

From literature review, there appears to be many very broad definitions and descriptions on how the e-B2B MP are being categorized. However, four categorization models, which are relevant to e-B2B MP in the chemical industry, are selected for illustration here, and are as shown in Figure 2.

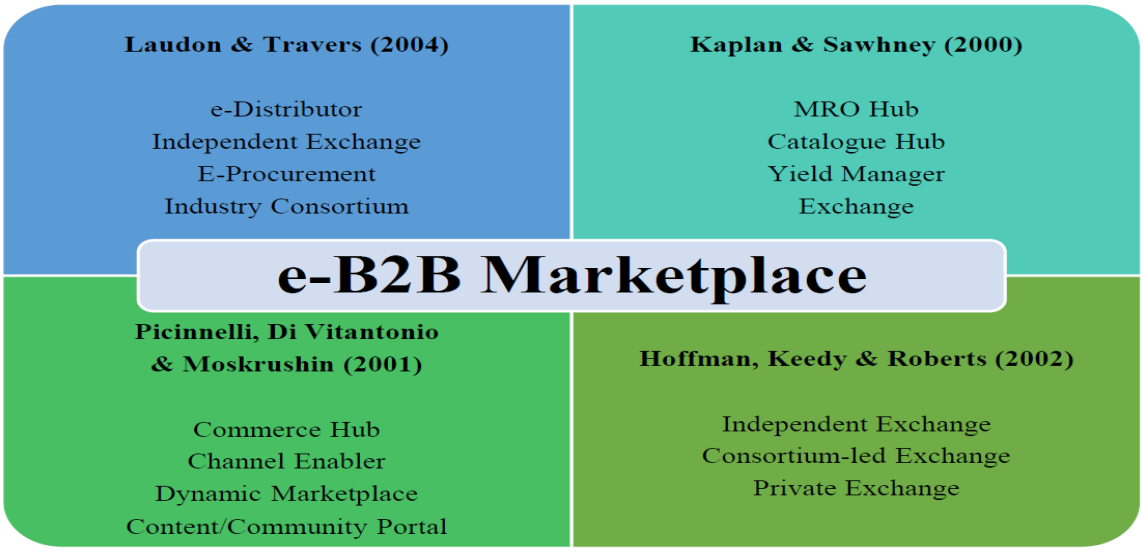


Figure 2: Categorization of Electronic Business-to-Business Marketplace
Source: Compiled from Kaplan & Sawhney (2000, p. 97); Piccinelli et al. (2001); Hoffman et al. (2002, p. 99); Laudon & Traver (2004).

Kaplan and Sawhney (2000) model categorized the governance structures of e-B2B MP in terms of manufacturing and operating goods (vertical versus horizontal) and spot purchasing against systematic purchasing. There were four segments, namely "*Maintenance, Repair and Overhaul (MRO) Hub*", "*Catalogue Hub*", "*Yield Manager*" and "*Exchange*". Other than MRO, all the other three categories are applicable to the chemical industry. The "*Exchange*" would add the most value in situations where there is a high degree of price and demand volatility (Kaplan & Sawhney, 2000) like for the commodity type chemicals. Piccinelli et al. (2001) model suggested four categories, namely, "*Channel Enabler*", "*Content/Community Portal*", "*Commerce Hub*" and "*Dynamic Marketplace*" as shown in Figure 2. "*Dynamic Marketplace*" is like an auction place where buyers and sellers can bid for products. All the four categories are suitable for the chemical industry to varying degree. Hoffman et al. (2002) model categorized it by the ownerships structure, namely, Private, Consortium-led, and independent model**.** All these three categories are applicable to the chemical industry. The four categories in Laudon and Traver (2004) model is a mixture, based on business functionalities and ownership (Figure 2). There are overlaps in many of the categories between these four models, but by and large, they are mostly applicable to the chemical industry. Twenty years has passed since these models were

being published and today the various components in these models are still very visible in the marketspace and nothing much has changed since then.

Regardless of the type of configurations and functionalities of the e-B2B MP, its main purpose is to electronically connect industrial buyers and sellers efficiently. Elemica, which is classified as a vertical e-B2B MP is one of the well-known one that was set up in the late 1990's and is still in existence today, but much of its original functionalities has changed and today they are connecting close community chemical manufacturers in their procurement activity. They are not meant to be an e-B2B MP in the strict sense of their functionalities. Alibaba is an independently owned e-B2B MP, but they are not specific to the chemical industry and is open to all sort of general products, with a strong emphasis on Chinese products. Such kind of general e-B2B MP is losing appeal for specific group of industrial customers, like for the chemical professionals, as these general types of e-B2B MP are pushing too much irrelevant information to them. Such general type of e-B2B MP tends to commoditize the products and they may well work for commodity type chemicals where customers are just looking for cheap bargains.

The Butterfly Model of Electronic Business-to-Business Marketplace

Kuttner (1998, cited in Brousseau 1999, p. 5) suggested that "*the internet is a nearly perfect market' …* where *"information is instantaneous and buyers can compare the offerings of sellers worldwide and the result is fierce price competition, dwindling product differentiation and vanishing brand loyalty*". Brousseau (1999, p. 5) further added that the internet is supposed to bring a " …*frictionless and intermediary-free economy*". Kaplan and Sawhney (2000, p. 97) agree that the web can bring "*…. together huge numbers of buyers and sellers and ….. web markets expand the choices available to buyers, give sellers access to new customers, and reduce transactions costs…*". "U*nquestionably the greatest force to impact market channel strategy …". "The availability of on-line channel option means that now virtually every firm, …., must include the internet as a channel for reaching out to its customers*" as posited by Rosenbloom (2007, p. 4). So, e-B2B MP were supposed to change completely the way business are conducted by disintermediation, transparency of information, increased efficiency, and increased sales (Cousins & Robey, 2005) as it is so efficient, and seemingly with no boundary. If anyone were to accept and believe these perspectives, then without any doubts everyone should migrate their business model towards e-B2B MP, but can this be really true? If they are really true, by now a perfect e-B2B MP business model would have emerged and would have dominated the market. There is no evidence in the market that this is happening and in fact there is no one e-B2B MP model that is even coming close to being perfect in the marketplace. Then, is the perfectness of e-B2B MP just a beautiful theoretical model and is just a myth?

Figure 3 shows the "Butterfly Model" (Perogianni, 2003, p. 7) which basically sum up the most perfect e-B2B MP model for the chemical industry, or any industry for that matter of fact. As long as there is internet connectivity, the buyers and sellers can reach out to anywhere in the world seamlessly without any physical boundary. If everyone were to subscribe to conduct their transactions electronically with each other, this would be the most ideal business model. Logic dictates that if this model is so efficient then it should thrive in the market but clearly this is not the situation for the chemical industry. In the consumer world, Amazon and Alibaba would appear to have achieve some kind of sustainability in the consumer market. The research will investigate into why so many of the chemical e-B2B MP were not able to sustain their presence in the market, even though in theory, there is a perfect business model available. Is

URL: http://dx.doi.org/10.14738/abr.101.11535

there any such type of e-B2B MP existing in the chemical market space? If not, will there be anyone able to introduce such a perfect model into the chemical industry? A literature review of the marketspace will reveal the reality.

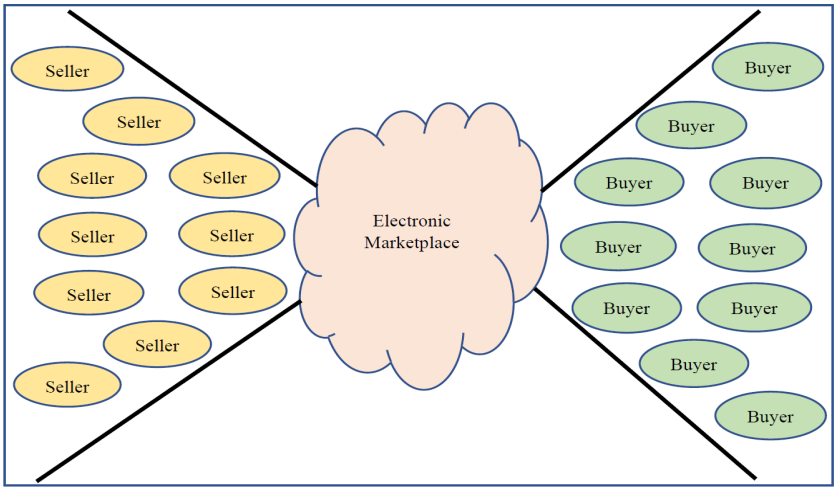


Figure 3: Butterfly Model
Source: Perogianni (2003, p. 7)

FIRST WAVE OF ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE

The Author has labelled the late 1990's to 2010 as the first wave of e-B2B MP in the chemical industry. Raisinghani and Hanebeck (2002) had suggested there are three waves to the evolution of the e-business. The first wave was the establishment of independent on-line exchanges for commodities products. The second wave was where consortium was formed to improve efficiencies and thus reducing costs to the buyers. The third wave was where e-Commerce platform allowed businesses to customize their business models. However, the Author viewed all these three waves as basically just a single wave of progression with various changing business models being introduced into the market as internet technologies evolve over the period of ten years. In the late 1990s, e-B2B MP was touted as the key driver of the new economy and promise to radically change the way customers sell or buy (Brunelli, 1999). Gurley (1997) claimed that the customers will force the manufacturers to move in the direction of e-Commerce and, manufacturers were increasingly eager to sell direct to the customers, especially on cost reduction. Are the industries able to adopt this web-based technology and are the technologies able to deliver what the theory has implied they could do for the chemical industry? Is the Butterfly business model an idealistic dream or can it be turned into reality where a super e-B2B MP can capture all the suppliers and buyers to trade on one single super ecosystem? From technology point of view, there is no reason why it cannot be achieved but is that what suppliers, customers, distributors want in the chemical industry? Here again it begs the question, why then is there no such super e-B2B MP emerging in the chemical industry in the past and also today? Perhaps the advantages and benefits of e-B2B MP are being way over-sold and the reality actually reflects this situation. Why then is the reality so far different out from the theory of the perfect e-B2B MP? The analysis of the failed first wave of e-B2B MP may be able to throw some light on why the reality is so far off from the theory.

Failures of the First Wave of Electronic Business-Business Marketplace

Over the ten years period of the first wave of e-B2B MP entering the chemical industry, it went from unlimited optimism to terrible disappointment as most e-B2B MP failed to deliver on the promises and expectations. What went wrong here and why did this business model not take off as expected? Many literatures have affirmed that e-B2B MP business model is the perfect model for buyers and sellers to conduct businesses frictionlessly and efficiently without any limitations at all. Then, why did they not succeed? What are the main causes for their failure?

Tay and Chelliah (2011) noted that there were fifty-six e-B2B MP active in the chemical industry in 2007. This includes e-B2B MP that are suitable for transactions as well as information portals. From 1999 to 2010, many e-B2B MP, examples Elemica, Chemcross, Chemhunter and Omnexus were specifically introduced into the chemical market. In a short time, many of them have ceased operation, or being merged, with another e-B2B MP, and examples are eGlobalchem, CC-Market and Chemplorer. From 2001 to 2002, Envera and Chematch merged into ChemConnect and HubWoo merged with Avisium to form CC-HubWoo. After 2003, lesser numbers of e-B2B MP were established and this signal that the e-B2B MP for the chemical industry have entered a mature phase already in a very short time span. Chemdex, at one point in time was valued at US$4 billion, but it too failed miserably in the dotcom bust (Moazed, 2020) and was closed in 2000. eGlobalchem closed in 2001, and e-Chemicals and Plasticnet in 2003. Omnexus was acquired by SpecialChem and Chematch was absorbed by Chemconnect in 2003. Other e-B2B MP like PolymerAdditives, Chemcross, Chemdeal, PlasticGrid, Onechem, ElastomerSolution, Trade-Ranger, Efolia and Chem-Singlesource, who entered in 2000's, have all disappeared from the chemical market. ChemConnect had a better run, but was finally acquired by Intercontinental Exchange USA in 2007, and so ceased to exist as an independent e-B2B MP in the chemical industry. Chemcross (2020) was founded in 2000 as an industry-owned consortium e-B2B MP and claimed to have memberships of 300 Asian companies along with 800 individuals (Sheridan, 2000). It had 60 shareholders from the major chemical companies in Asia like Hanwha Chemical, Nikko Petrochemicals, Samsung, Honam Petrochemical, Sinar Mas Group-AFP and Sinochem Pudong Trading (Sheridan, 2000). Chemcross claimed at that time that their exchange platform site, allow buyers and sellers to transact in a dynamic and flexible manner to optimize their online business potential (Sheridan, 2000). The Asian chemical market was then estimated to be worth approximately US$500 bn, making up 31% of the global market (Sheridan, 2000). ChemCross and CheMatch who are e-B2B MP, formed an alliance to leverage on the key stakeholders on each other's e-B2B MP (ChemEurope, 2001). Not much information is found on Chemcross after 2005, but a quick check on Bloomberg (2021) showed a company called Chemcross International was incorporated in 2009 in Korea, who is in the chemical business. There is nothing on how they are related to the original Chemcross of the 2000.

In theory, the e-B2B MP are perfect tools to reach out to the world, offers frictionless transactions and has no physical barriers, why then are so many e-B2B MP not successful? There is hardly any evidence that a physical chemical distributor has closed due to the onslaught of e-B2B MP, and this itself proved that e-B2B MP business model is flawed right from the start even though the theory was very sound. In Tay and Chelliah (2011), the results showed that chemical distributors will not be disintermediated by e-B2B MP anytime soon, and chemical distributors will still have a place in the market chemical supply chain network. Some key findings were that "*Trust*" was very important in the physical B2B market space and it takes

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many years to build up. There is no reason why trust will not apply in the case of e-B2B MP. Just because the supplier has an e-B2B web site, does not mean that all buyers are happy to jump on it and start transacting their businesses. With so many internet scams around, this has also caused many buyers to be extra careful in their dealings on transactions though the internet. Making repeated orders through the e-B2B MP web sites are fine for companies who already have established trust between themselves. However, during the initial stage of identifying suppliers, many buyers are exercising caution. Buyers are expecting on-time deliveries, and products delivered to them as and when they needed it, from the suppliers. How the orders are being processed are hardly something customers are too overly concern about. Perhaps all the glorified views extolling the virtues of e-B2B MP is just a passing fashion.

After the dotcom bust in Spring 2000, there were many thoughts arising as to why a seemingly perfect business model could collapse so fast. Dai and Kauffman (2002b, p. 1) claim that the progress of e-B2B MP has been hampered by "*unanticipated technological, organizational, economic, and legal challenges*". Some of the more notable reasons provided are failures in achieving critical mass, lack of trust, concerns on security issues, flawed exchange models, misalignment of the motives of buyers and sellers, and un-realistic expectation of owners. These factors will be discussed in greater detail below.

Inability to Gain Critical Mass

Th whole purpose of having e-B2B MP is to gain the network effect where it was supposed to bring in huge numbers of sellers and buyers so as to form a stable market (Kaplan & Sawhney, 2000). Unless the e-B2B MP can bring in the critical mass of buyers and sellers, the marketplace would not be financially viable. Larger firms who have better bargaining power are probably able to encourage their key suppliers and buyers to participate and use the e-B2B MP (Hadaya, 2006). Koch (2001) and Day et al. (2002) claimed that e-B2B MP failed to build up the critical mass of industry participants to join and use the marketplace. This is attributed to a lack of buyers' and sellers' participation (Ganesh et al., 2004), weak customers' loyalty, and weak mushroom growth (Razi et al., 2004). Fairchild et al. (2004) found that the value-added functionality of the e-B2B MP did not bring in the numbers either.

Lack of Trust

A crucial issue for the users of e-B2B MP is how to establish trust (Humphrey et al., 2003). Companies purchasing products on-line need assurances that the companies they are dealing with are genuine and reputable. Companies selling the products on-line also need to be confident that they will get paid by the buyers. Trust-enhancing processes to support the usage of e-B2B MP are very important and these were very weakly developed (Humphrey et al., 2003). For potential trading partners with no prior relationship with each other, the registration process required by the e-B2B MP providers were unlikely to generate trust between unrelated parties. If companies are to trade with unrelated parties, they must be confident about the reliability of the trading partner and the product information. The absence or weakness of the legal and institutional infrastructure does not give the level of confidence to the trading partners (Humphrey et al., 2003).

Trust is a key driver to ensure the success of the e-B2B MP. In the physical world, the local representative of the seller visits the customers often, and over time, they build up the relationship and trust between them. The customers had a local face that they can relate to as

to who they are buying from. The nurturing of interpersonal relationships, information sharing and being understanding and concerning about the buyers' needs are behaviours that would build up trust and relationship between the sellers and buyers. Trust thus plays a critical role in developing loyalty and commitment, which would then enhance the business (Doney et al., 2007). Eid et al. (2002) sees trust in these three areas, i.e., trust on the internet and the web sites, information provided and, the fulfillment of transactions. Companies spends a lot of time and effort in creating trust and this is a moving target which can shift position at any time (Ritter & Gemünden, 2003). So, it is logical to assume that the deeper the trust between the seller and buyer, the harder it is for anyone, including e-B2B MP, to just simply hijack the business between the parties. Gosain and Palmer (2004) suggested that e-B2B MP failed because they tried to commoditize the unique trust between buyers and sellers as if they are so easily replaceable or simply just ignore the existence of trust in the first place. Shook et al. (2004) also shared the view that the promoter of the e-B2B MP did not consider seriously the importance of trust and relationship in the sales process.

In Perogianni's (2003) Eurostat e-business survey, it was found that companies purchasing on-line continued to work with existing business partners, while a minority of the companies chose new suppliers. This study confirms that the lack of trust is one of the most important barriers on the take up rate of e-B2B MP. The few most important barriers for e-B2B MP transactions are uncertainties about contracts, delivery, guarantees, payments, and the perceived lack of trust by customers (Perogianni, 2003).

Concerns on Security Issues

Perogianni (2003) further confirms that the one of the most important trust barriers for the use of e-B2B MP for on-line purchasing are the uncertainties related to security issues on the confidentiality of sensitive data, the lack of clear information on the terms and conditions of the contract, to on-line payments and, to the settlement of disputes (Perogianni, 2003). There is the concern of buyers, and/or sellers, that sensitive information on prices and quantities may be exchanged in an uncontrolled manner, thus leading to anti-competitive agreements on prices which impact them negatively. The ownership of the e-B2B MP could potentially surface the issues on security, in particular SMEs, who may be forced by dominant enterprises to use specific e-B2B MP (Perogianni, 2003). The e-B2B MP owners may exclude certain participants from the more efficient e-marketplace, thus putting them at a competitive disadvantage.

Flawed Business Model

In the late 1990's, the internet technology was becoming more and more advanced and many e-B2B MP were set up by both private enterprises as well as, by consortium players, in the chemical industry. Anyone with some capital is able to set up a e-B2B MP, get together a handful of anchor trading companies willing to transact their business on the website, and the marketplace is created. There was little or minimum initial technology investment to be made before they were able to trade but there were concerns on switching costs after the company has set up shop on the e-B2B MP (Yoo et al., 2002). Suppliers were also concerned about the software and hardware requirements, and other unknown implementation costs, once they were on the e-B2B MP (Johnson & Johnson, 2005) and as a results users were concerned to switch to electronic transactions. They are worried that the little upfront costs initially were an enticement to get them to switch over the technology and, once they are on it already, the users may have to pay a high price if they so wanted to make a change to other technology. The lack

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of understanding on the web technology also resulted in users feeling insecure to embark on it resulting in the slower the adoption of the technologies (Dai & Kauffman, 2002a).

Many concerns arose from the issues of ownership of the e-B2B MP. Kaplan and Sawhney (2000) felt that neutral e-B2B MP are most likely to succeed in markets that are fragmented on both the buyer's and seller's sides. Stockdale and Standing (2002) added that a buyer might choose an independent e-B2B MP over a consortium-owned because it feared that crucial information may fall into the wrong hands. These concerns arise as the users felt that if the owners of the e-B2B MP were from interested party, like an industry player, their confidential information may be at risk and, resulting in conflict of interest on the transactions. Cousins & Robey (2005) expressed concerns of transparency, independent and neutrality where e-B2B MPs are not owned by neutral party.

However, there is another school of thought that failure of e-B2B MP arises because users are not familiar with the owner/s of the e-B2B MP. Fairchild et al. (2004) found that neutrality, as an absence of shared ownership, clearly contributed to the failure of e-B2B MP. Koch (2002) agrees that unless influential industry members are behind the e-B2B MP, users may not join in and trade on it. Ordanini (2006) agrees that for the e-B2B MP to be successful, it should be owned by established companies, within the field of business. Hadaya (2006) supports the participation of large firms in a consortium where he felt that large firms are less threatened to cooperate with their competitors by using the same e-B2B MP and utilizing their common pool of customers or suppliers. This is really a dilemma because whether e-B2B MP neutrally owned, or by consortium from industry players, all contributed reasons towards their own failure.

As web technology are readily available to the public, many of the web sites and their so called "*value-added functionalities*" are being standardized. This has caused a lack of differentiation between the various e-B2B MP (Razi et al., 2004). Many of the e-B2B MP are listing down all their uniqueness and functionalities as differentiators, but then all these web-based properties can be observed from many other web sites as well thus resulting in users not being able to discern between them anymore. One web site is just the same as the other except for the different visual artworks.

Misalignment of Motives between Buyers and Sellers

Right from the start, buyers and sellers had totally different motives for participating in the e-B2B MP. Buyers were looking for lower prices and sellers were looking for new sales, but price savings were beneficial for the buyers only, and not for the suppliers. Sellers are concerned with the pressures on prices, which is a vital motive for buyers (Tumolo, 2001). It was claimed that e-B2B MP might shift the bargaining power from suppliers to buyers. In the effort to increase the number of users, many e-B2B MP focus on attracting small and medium sized companies to be members of their marketplace. Ordanini (2006) did not agree with this strategy as he felt that only large companies are meaningful for the e-B2B MP as the deal sizes by large firms are big enough to reduce the aggregation costs. Porter (2001) postulated that e-B2B MP need to create sufficient entry barriers to prevent competitors entering the market, and that without sufficient entry barriers, the profitability of the e-B2B MP would not be able to sustain the business. With web technology able to make e-B2B MP so readily available, it has in fact lowered the entry barrier for anyone wanting to compete in this marketplace, thus driving down the profitability of the sellers.

Unrealistic Expectations of Owners

During the boom period of the late 1990's, an unsustainable number of competitors are attracted to enter the e-B2B MP because of the forecasts of extremely high growth and promises of exceptional returns (Minier, 2003). The e-B2B MP was already crowded and, yet still more and more participants kept joining in. Eventually, when the reality sets in the dotcom bust it caused more than 80% of the players to exit the market either through failure or acquisition (Minier, 2003). There was such hype and high expectations for B2B MP to revolutionize the way companies do business, but there was just no way they could deliver and meet those unrealistic expectations. By mid-2000, the bubble in the dotcom industry has burst and only viable companies with core competence have been able to survive (Kang, 2001). A plethora of e-B2B MP which lack offline background and customized service for specific industries couldn't attract sufficient investors' attention (Kang, 2001), and so they exited the market. E-B2B MP was supposed to be able to generate billions and billions of sales revenues and the expectations were very high. Finally, the investors of e-B2B MP realized that the business model was not as profitable as they initially thought because the income the e-B2B MP generate for the owners was only a small fraction of the sales revenues.

It was very clear that the first wave of e-B2B MP had failed in the 2000's. All the above reasons, or in combinations, resulted in the failure of the first wave of e-B2B MP in the 2000's in the chemical industry. Only a handful of the e-B2B MP survived, and many have those who survived, were used by the sellers themselves to transact their business on a controlled community basis.

Third Party Cloud based e-Business Platform Providers and Elemica

Before going into the specifics of what are the e-B2B MP entering the chemical industry in the second wave, let us spend a bit of time to review through the technology behind the cloud-based e-B2B MP and Elemica. The dominance of the cloud-based e-Commerce platform are the reason for the proliferations of e-B2B MP and their web storefront. Elemica is covered here purely for historical reason as they are one of the few survivals of the first wave, but they have since also changed their core approach towards e-B2B in the chemical industry.

Third Party Cloud based e-Business Platform Providers

Digitalization claimed to increase transactional efficiency and create instantly accessible information in real time along with multiple application (Chemanager, 2019). With the rapid developments of cloud-based software solution this has motivated the chemical manufacturers and distributors to introduce their own e-B2B MP web platform. The main purpose is to connect online buyers and sellers together. E-B2B MP platform owners can build their own portals and offers value-added services like marketing expertise, customized workflows, and lead generation (Agilis, 2019). The easy access to Software-as-a-Service (SaaS) cloud-based application tools allow company to configure their own electronic transaction capability, allows them to integrate channel partners, and offer to customers a seamless brand experience without any physical limitation (Agilis, 2019).

Agilis (2019), launched in 2017, is one such vertical provider of the SaaS application tools where they claimed their tools can bring all the key players in the chemical value chain, manufacturers, distributors, customers, and logistics partners together, through a single secure commerce platform. Agilis system is supposedly able to aggregate supply-and-demand data from e-B2B MP portals it develops for chemical producers and distributors (Demery, 2019).

URL: http://dx.doi.org/10.14738/abr.101.11535

Asellion (Covestro-Asellion, 2019) is another example of a SaaS application tools provider. Asellion is a wholly owned subsidiary of Covestro, a chemical manufacturer. The platform technology of Asellion is designed as a scalable and secure SaaS application tools. The platform was originally conceived to provide the electronic capability to Covestro in-house application. However, Covestro also intend to allow other chemical manufacturers and distributors to host their web storefront on their platform as well. However, to the market it is not sure how other chemical competitors will accept this invitation. Covestro is not the only chemical manufacturer taking this approach as there are also other chemical manufacturers offering their own e-B2B MP platform, to other chemical players as well. One wonders what the game plan is when chemical company starts to own e-commerce platform, as a business unit, instead of focusing on investment into other chemical manufacturing assets, which is supposedly their core business. Perhaps this could be a diversification strategy to move in new growth business areas or could it be just wishful thinking that other chemical manufacturers will jump on their bandwagon and create value on the competitor's new venture? This is certainly a very novel approach to create critical mass but with fierce strong competition out in the market, one wonders if a manufacturer would really want to help a fellow competitor to create the critical mass and sustain the competitor's e-B2B MP. Can this again be a flawed business model, just as in the first wave, and it is doomed to fail again?

Elemica

Elemica, founded in 2000, by twenty-two chemical companies, as an e-commerce hub linking buyers and sellers. They claimed to provide real-time value to buyers and sellers in the chemical industry by establishing a single, global, neutral network for secure information sharing within pre-established chemical trading partnerships (BASF 2021). They rely on cloud computing and SaaS application tools to link up supply chain systems for customer management, supplier management, logistics and sourcing management. It was claimed they transacted about US$600 bn worth of business annually (Rao, 2019). They serve as an electronic hub for the chemical industry and focuses on processing orders with more than 2,500 customers and suppliers (BASF, 2021). The company has significantly changed their business model since inception, migrating from being a e-B2B MP in the chemical industry, to focus on providing supply chain solutions centered on their digital network across all global manufacturing industries. (Globe News, 2020). Elemica was brought up here to emphasize that they are not the typical e-B2B MP this research is about as they are providing supply chain inventory management system for established partners through their system and so they should not be mixed up with the e-B2B MP that is in this research.

SECOND WAVE OF ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE

The first wave took about 10 years to come to an end before all the fuss and excitement was gone. Hardly any e-B2B MP of significance has managed to survive, and by and large, many of the chemical industry e-B2B MP has disappeared at the end of the first wave. From about 2015 onwards, a new wave of e-B2B MP seems to be entering the chemical market. What is the second wave of e-B2B MP offering this time that are different from the first wave and will they succeed this time? Both independent and consortium-led e-B2B MP are being started this time by chemical manufacturers, either by themselves or through a consortium and, also by distributors. Many of the bigger chemical manufacturers and distributors have also embarked on it. There are even cases where chemical manufacturers are setting up their own e-B2B MP, not only for their own purpose, but they are designing it for the purpose of hosting other

manufacturers and distributors e-B2B MP web storefront as well. The web storefront is basically a web interface, whether hosted by public or private electronic platform operators, for chemical players to link it to their own e-B2B MP offering products for sales. In the physical world, this would be equivalent to them placing their products in a high street shop, which they may or may not own, as an outreach to attract customers to buy their products.

The US chemical industry B2B e-commerce sales was valued at about US$25.0 bn in 2017 and increased to US$28.0 bn (Digital Commerce, 2020). This is a far cry from the potential of the chemical market size of €6,000 bn by 2030. The prize is out there for a perfect e-B2B MP to capture this business and no wonder so many chemical manufacturers, suppliers, and distributors are putting their bet on their e-B2B MP model to capture this business. A literature review of the e-B2B MP used by chemical players basically falls into two categories, namely independently owned and chemical players related owned. For the chemical players owned e-B2B MP, they can be sub-categorized into consortium and privately owned types. Figure 4 shows the types of e-B2B MP in the chemical industry identified in the second wave.

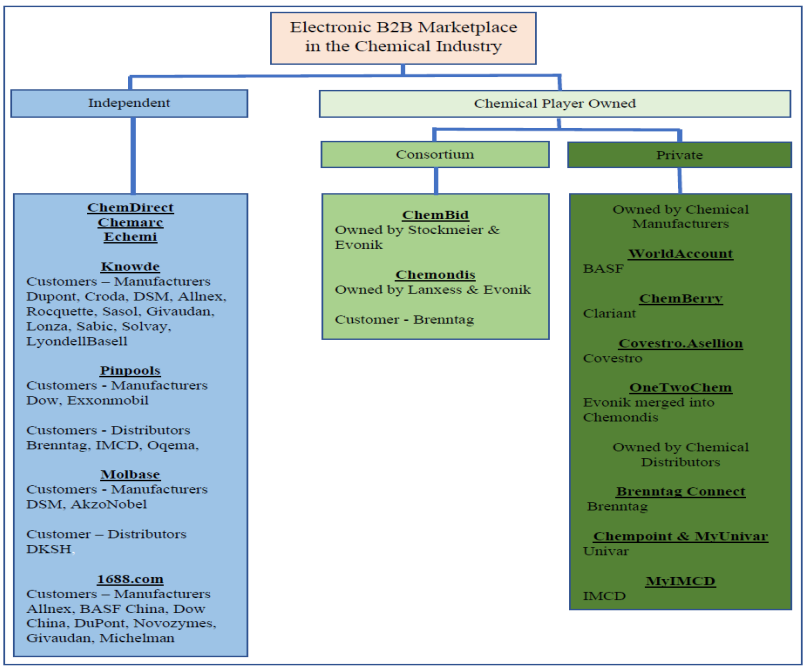


Figure 4: Electronic Business-to-Business Marketplace in the Chemical Industry
Source: Compiled by author for this research.

ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE OWNED BY INDEPENDENT PARTY

From a survey of the websites in the chemical industry, the independent type of e-B2B MP were set up by entrepreneurs and are available for whomever who wants to install their web storefront to reach out to the public. ChemDirect, Chemarc, Echemi, Knowde, Pinpools, Molbase and 1688.com are examples of such type of e-B2B MP. Over a short period of time, some of them seemingly were able to attract major global chemical manufacturers and distributors to set up web storefront with them. Knowde (2021) in their website claimed their marketplace "*interact with over 3,500 suppliers*" and they listed chemical manufacturers like Roquette, LyondellBasell, Sabic, Solvay, Croda, DSM, Allnex, Givaudan and Lonza on their web storefront. Knowde website

URL: http://dx.doi.org/10.14738/abr.101.11535

do not contains any product price, and this had to be requested from the suppliers. DuPont web storefront on Knowde features more than 1,300 products (Demery, 2020).

1688.com, belonging to the Alibaba group, was originally set up for China-based buyers and suppliers and, they claimed to have more than 10 million enterprise web storefronts, with 150 million users visiting the site per day (Demery, 2018). DowChina.1688.com was established to sell chemicals into China and Dow China sees that 1688.com portal can expand their online presence into China to diversify their sales and service channels. Demery (2018) speculated that Dow China sales will account for 40% of the company's global chemical sales. Dow China, like many other suppliers for example Michelman.1688.com, are using multiple e-B2B MP, in addition to 1688.com, to gain additional access into the China market (Demery, 2018). In 2018, BASF (2018) opens their flagship web storefront on 1688.com where it will supposedly enable BASF to serve small and medium enterprises in China. Allnex (2018), Novozymes (2019), and Givaudan (2021), announced their partnership with 1688.com too. Molbase (2021) is also a China-based chemical e-B2B MP which was launched in 2013 and, claimed to be a "*data-driven integrated service platform for chemical e-commerce*". Chemical suppliers can design and set up their web storefront, manage products and inventory, process orders and payments, build customer relationships and leverage analytics and reporting, on the platform. The e-B2B MP is also able to facilitate transactions with different value-added services including supply chain financial services, business intelligence services, logistic and warehousing services. Molbase (2021) claimed that by 2018, they had had built a nationwide supplier network, covering 376 cities in China with customers like DSM, AkzoNobel and DKSH, and they further claimed their platform have more than 100,000 buyers, 40,000 chemical suppliers and nine million chemical products. The common theme here is that many of the chemical manufacturers are setting up web storefront on China-based e-B2B MP to gain additional market share in the China market.

Chemarc (2021) claimed that their e-B2B MP, in addition to facilitating electronic transactions, also deliver analytics and data intelligence to the users. They allow users to integrate seamlessly with their enterprise ERP system. They advertised they can provide trade financing, discounting invoices and even raise financing for purchases. Pinpools (2021) is also one of the independent e-B2B MP in the chemical industry serving the European and China markets. They claimed to have 1,000+ companies, 70,000+ products, 300,000+ transactions including manufacturers and traders from over 50 countries on their platform. The customers are the likes of Brenntag, IMCD, Oqema, Dow and Exxonmobil. ChemDirect launched their 2.0 online e-B2B MP for on-demand, direct ship chemicals from vetted suppliers (Business Wire, 2021) where they claimed to reduce an average fulfillment time and up to 80% in cost savings. On the sell-side, they are able to provide digital sales and marketing solution with real-time market analytics which can then boost sales, expand markets, and build their brand presence. Suppliers are given a web storefront hosted by ChemDirect, at no cost, allowing buyers to shop directly and gain immediate access to marketing materials, accreditation certificates and frequently asked product questions (Business Wire, 2021).

Echemi (2021) was officially launched in October 2015 and advertised that they are dedicated to building a chemical product database with weekly updated price and multiple online discounts. Echemi claimed to have more than 10,000 suppliers and more than 70,000 international buyers where they concentrate on providing supply chain services, resource optimization, management efficiency. In summary, Echemi is a chemical supply chain service

company providing chemical raw materials supply, research and analysis, marketing, distribution, logistics and E-commerce. From this, it is not clear what is the revenue stream model for Echemi as they are not a full fledge e-B2B MP but would appears to be a hybrid e-B2B MP and also provide services as an information portal.

So far, all these independent e-B2B MP operators seems to be providing very similar electronic facilities to the chemical manufacturers, suppliers, and distributors without much differentiating factors between them. One wonder, how the manufacturers, suppliers and distributors decide which of the e-B2B MP to set up their web storefront. Or do these companies just set up web storefronts with as many of the e-B2B MP as possible and, hope to catch the customers that way? The low entry cost to set up a web storefront on e-B2B MP certainly is a great attraction for the sellers to sign on and, especially if there is low exit cost as well. However, the concern is that if more and more e-B2B MP are being set up, very soon the e-B2B MP business model will be commoditized, as everyone and anyone, can just sign on and tomorrow they have a web storefront space to market their products. With the commoditization of the e-B2B MP and web storefronts, this will inevitably lead many of the e-B2B MP being non-viable economically, just like what happened in the first wave. Is this likely to happen again in the second wave?

ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE OWNED BY CONSORTIUM CHEMICAL PLAYERS

ChemBid, founded in 2016, are jointly owned by Stockmeier, a chemical manufacturer and chemical distributor, together with Evonik, who is a significant chemical manufacturer. Evonik invested in Chembid, which they claimed to be a search engine and market intelligence platform for chemicals. They can provide a dashboard of market intelligence such as price trends and demand patterns by analyzing the search data with intelligent algorithms for the users (Evonik, 2021). It further claimed to have already over 50,000 users a month from more than 150 countries. Evonik had earlier invested in their own OneTwoChem e-B2B MP but then decided to discontinue their own platform and instead contribute their experiences and knowledge gained from the development and operation and fold it into Chembid (Evonik, 2021).

CheMondis (2021), founded in 2017, is owned by Lanxess and Evonik, where both are also significant chemical manufacturers themselves, and was intended to be an e-B2B MP for the chemical industry in Europe. They claimed to be active in 15 countries, and its number of buyers and sellers worldwide has increased from 200 to about 1,400 (Brohan, 2020). They further claimed to have signed up about 12% of the 22,000 chemical companies in the European Union. It claimed that in the past year, gross merchandise volume on the e-B2B MP grew to about US$200 million and the number of electronic transactions exceeded 5,000 with about 45,000 chemicals products for sale (Brohan, 2020). Brenntag, the world biggest chemical distributor, also decided to accelerate their digital sales and marketing into the chemical industry by participating through Chemondis for the German market (ASI, 2020). Brenntag view this as complementary strategy to their own Brenntag Connect e-commerce platform. Chemondis claimed to have 3,200 active companies and 50,000 products on their platform (MRC, 2020).

It is not apparent what is the strategy for Evonik to participate in two consortium 2-B2B MP, ChemBid and Chemondis, where both are hosting web storefront for their competitors as well. Whilst it may make sense for a chemical manufacturer to set up their own e-B2B MP and market

URL: http://dx.doi.org/10.14738/abr.101.11535

their products, but to participate in multiple e-B2B MP in the same market seems a very odd strategy. Of course, from a business perspective, the more e-B2B MP a company set up, the greater is their outreach to customers but this is true up to a certain extent. Not to forget, other chemical manufacturers are also able to do this, and the chemical industry may end up fully saturated with all kinds of e-B2B MP competing with a finite market size. This will inevitably end up with gross excess of e-B2B MP capacities and will mean that some of them have to exit the market when their business becomes non-viable to stay open for business.

ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE OWNED BY PRIVATE CHEMICAL PLAYER

Chempoint (2021), founded in 1999, was started by Univar as an "*e-distributor*" of chemical products and services with a focus on specialty and fine chemicals. It further claimed to be an e-business built by combining the best principals and approaches from the "dot-com" world with the industry knowledge and capabilities of the traditional chemical distribution industry. Univar (2018) too launched a Canadian e-B2B MP known as "*MyUnivar.com*". This platform offers a product catalog of over 10,000 industrial chemical and food ingredient products to new and existing customers for online purchase for the Canadian market. Not too sure what is Univar's strategy here as Chempoint can also provide the same services as MyUnivar.com. From the public viewpoint, both these e-B2B MP should be capable of offering the same services for customers as after all this is the distinct advantage of web technology as there is no boundary to where they can reach out to.

Chemberry, was launched in 2018, by Clariant (2021) who is a significant chemical manufacturer. They claimed to have indexed almost 40,000 beauty ingredients and users from across almost 5,000 brands and more than 1,000 suppliers. Clariant announced in 2021 that Chemberry will be spun-off from Clariant and will operate independently under the new name of Covalo (Clariant, 2021).

Covestro, a chemical manufacturer, through their Coverstro-Asellion.com (2019) set up their Covestro Direct Store, which is an e-B2B MP. It offers around 80 products for the high-performance plastics sector. Currently, Covestro Direct Store is the only supplier web storefront on the Asellion platform and Covestro hope that other companies may want to set up their web storefront on it as well. In 2018, Covestro opened a web storefront on covestrochina.1688.com. Just like what was commented earlier about Evonik participating in multiple e-B2B MP. What is the strategy of Coverstro as they owned their own e-B2B MP infrastructure, opening their own platform to other users, and yet they are signing up web storefronts on other independent e-B2B MP as well? Can this be a case of "just wanting to be everywhere" or is there a strategy behind it all?

Chemical distributors like Brenntag (2021) and IMCD (2021), also set up their own web based electronic trading platform called "*Brenntag Connect*" and "*MyIMCD*", respectively. Both claimed their online platform will allow customers to access them 24/7 wherever they are, find information, search for products and documents, request samples or quotes, place orders or stay in touch with your Sales Manager. There does not seem to be any differentiating features between what these distributors are offering to their customers. Perhaps this is more of an ERP system, integrating with the customers' order processing system, as well as customer relationship management and the e-B2B MP infrastructure are coupled to the system.

DISCUSSION ON THE CURRENT STATUS OF THE ELECTRONIC BUSINESS-TO-BUSINESS MARKETPLACE

There is clear evidence of the presence of the second wave of e-B2B MP entering the chemical market at great pace with many of them being set up since 2015. Both the independent and private type e-B2B MP are being introduced into the market concurrently. Are the e-B2B MP introduced this time round an improved version of what was being introduced during the first wave? Has digitalization been able to bring the benefits of frictionless transactions and cost efficiency to the users as promised? The Author will investigate this in more detail later.

With the introduction of the SaaS application tools into the e-B2B MP, this has spurred on the growth in the area of electronic infrastructure. It has lowered the entry barrier in terms of cost and technological expertise for companies wanting to set up their own e-B2B MP. Switching cost for web storefront from one platform operator to another is relatively low cost too. This technological capability at low cost has certainly led to the proliferation of the e-B2B MP. After all the companies are trying to reach out to as many of the customers as they can and the web-based e-B2B MP are ideal for this function with minimum set up costs.

From what is observable from the market, it is clear that manufacturers, suppliers, and distributors are all embarking on the digitalization journey and setting up as many e-B2B MP as possible to serve their existing customers as well as to those customers they have not reach out to yet. The choices of independent, consortium-led, and private e-B2B MP that are available for selection may pose a challenge to the companies wanting to set up their own e-B2B MP. The technological capabilities of the e-B2B MP are all basically the same as they have access to the same technology and application tools. If the companies have the financial resources, they can certainly sign on to more than one e-B2B MP, and it looks like that is exactly what many of the chemical companies are doing.

The fact that some chemical manufacturers are even investing into their own e-B2B MP, for use by themselves as well as making it available for other companies to set up their web storefronts are quite unexpected. After all, what is the strategy here? Is setting up e-B2B MP part of their diversification strategy and does it make sense for them to do so? How would other companies feel about setting up their web storefront on a competitor's owned platform? From the theory of competition, this strategy would not make much sense, as why would a company want to help another competitor to strengthen their e-B2B MP by giving them the business. It remains to be seen if competitors would come together to build up critical mass for another competitor, but the chances of this happening are not that high.

Earlier on, the entire chemical supply chain was being discussed, and the sales, and physical goods delivery activities, are not all electronic in nature. How are chemical manufacturers going to support the sales process where customers require them to keep local inventory and deliver as and when required? In many of the transactions, customers require the sales company to deliver the products directly to their storage facilities on call and provide credit payment terms to them as well. There is no possibility that chemical manufacturers are able to perform all these tasks required by their customers everywhere. Manufacturers can utilize electronic means to reach out to customers, but there is no way the manufacturers can provide the local facilitations for all the customers unless they have an office in the same locality as the customers. So, the last mile deliveries are still left to the existing supply chain channel to fulfill.

URL: http://dx.doi.org/10.14738/abr.101.11535

Are the newer e-B2B MP platforms able to address the issue of "*trust*" which was lacking in the first wave and was mentioned to be one of the main issues that causes it to fail in the first place? From the information unearthed in the literature review, the features of the web storefronts are still very much similar to what was being offered in the first wave albeit with improved electronic capabilities and there does not seem to be any additional feature that addresses this trust factor. How are the owners of the e-B2B MP storefronts intending to build up trust with the customers? Do the owners of the new e-B2B MP web storefronts actually think that trust is not that important to building customers' relationship and trust?

Figure 5 shows a simplistic representation of how the chemical manufacturers and distributors are reaching out to customers through the e-B2B MP and also through their web storefronts.

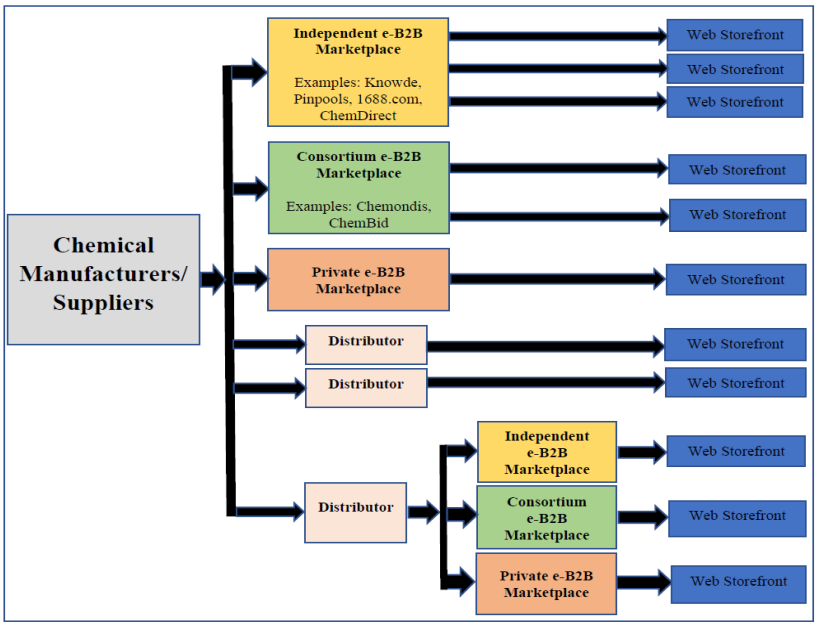


Figure 5: Chemical Manufacturers and Distributors Jockeying for Web Storefront Space
Source: By the Author for this Research

It is evident that manufacturers and distributors are attempting to cover all their options by setting up in as many web storefronts as possible, and on as many e-B2B MP as possible. It is also evident that some chemical manufacturers see the value in building up their own e-B2B MP, not only for themselves, but also sees it as an additional business avenue as an e-B2B MP operator, by attracting other manufacturers and suppliers to use it as well. The chemical manufacturers have the technological path now to reach out to all their customers and, also potential customers, by signing on to as many e-B2B MP themselves. One of the main issues here would be the costs versus benefits to be on every e-B2B MP.

Even though signing on with the different e-B2B MP platform may be relatively low cost but then the maintenance cost had to be factored in supporting all these different web storefronts. Low cost does not mean no cost and cost does add up in the longer run. The other main issue is whether customers, or potential customers, are going to be confused with all these different web storefronts set up by both the manufacturers and distributors. The added confusion can also be coming from distributors, who also have their own e-B2B MP, and advertising for the same products for sale in other private e-B2B MP. Will customers be checking on both these

web storefronts to get the most competitive quotations? Is this really the intention of the manufacturers and distributors for using the e-B2B MP model? No one seems to be winning if buyers were only using the different e-B2B MP just to compare the prices.

If any chemical distributors see their principals subscribing to multiple e-B2B MP, as well as setting up their own web storefront, as shown in Figure 5, they would be wondering when their relationships with their principals will be ending. Chemical distributors can potentially be disintermediated by their manufacturers. The manufacturers have the means to reach out to customers directly themselves thus by-passing their distributors and deal directly with the customers. This is a classic case of disintermediation. However, whether the customers want to deal directly with the manufacturers is another matter. The manufacturers may not be able, or unwilling, to fulfill the customers' demand on local inventory, door-to-door delivery, provide local technical services and providing local credit terms.

Perhaps the distributors see that the manufacturers are trying to approach their customers directly and, so out of no choice, they too set up their own web storefront on as many of the e-B2B MP as possible to compete for reach and exposure. Whether this is a winning strategy or, a strategy that is doomed to fail, remains to be seen. This situation is actually no different from what was happening during the first wave too. Most of the specialty chemical buyers have resolved to stick with the local distributors which finally led to the failure of the first wave of e-B2B MP onslaught.

WILL THE SECOND WAVE SUCCEED WHERE THE FIRST WAVE HAS FAILED?

From an academic point of view, this development of the second wave of e-B2B MP hitting the chemical market, is worth investigating into. The reasons for their failure in the first wave were very clear and now the second wave, offering pretty much the same suite of solutions, are hitting the chemical market again appealing to the same customers. The author will look at some of the reasons which resulted in the failure in the first wave to try to understand the market perspectives, ten to fifteen years later, after the first wave has ended.

Building up trust and the security issues are some of the key reasons attributed to the failure of e-B2B MP entering the chemical industry in the first wave. From what is observable, the e-B2B MP entering the second wave do not appear to be addressing both these issues as they are basically offering the same solutions as in the first wave. There were no observable features in the e-B2B MP in the second wave that particularly address these two issues. Perhaps the e-B2B MP operators/owners do not feel that trust and security are issues at all and so no attention was paid to address this.

Much was written about the flawed business model of the e-B2B MP in the first wave. Now, has anyone remedy this flaw for the second wave? It does not seem like it from the survey of the e-B2B MP entering the chemical market now. The ownership models are exactly the same, be it independent or consortium owned. These two ownership types are appearing in the second wave as well. For the second wave, the Author has observed that chemical manufacturers are not only setting up web storefront on independent e-B2B MP, but they are also developing their own e-B2B MP using the SaaS application tools. They are also opening up their own e-B2B MP to other competitors to set up web storefront with them as well. There were discussions that perhaps smaller and medium sized companies may feel less sensitive about being on e-B2B MP

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owned/operated by large companies. This arises from the notion that having large companies as part of the e-B2B MP ecosystem are beneficial to the business community as they can provide the critical volume to sustain it. With digital technology cloud-based computing system coupled with SaaS application tools, it has lowered the entry and switching cost tremendously and this may encourage more companies to set up web storefront in as many of the e-B2B MP as possible. The SaaS application tools seems to be the preferred tool to build the e-B2B MP and there are numerous choices in the market. So, no one need to stick to just one vendor as in the first wave where at that time subscribing to e-B2B MP were very expensive. The lower costs certainly are driving the proliferation of e-B2B MP. Of course, the downside is that if the systems are cheap, and e-B2B MP are plentiful, this will then dilute the transactional values of each of the e-B2B MP. This will lead to the unsustainability of the business model and may lead to some of the less frequented e-B2B MP to close down.

This then brings in the question of building up critical mass to sustain the business platforms. The butterfly model was the most idealistic model, where all suppliers and buyers are connected through a single cloud-based e-B2B MP. This is theoretical and probably can never happen as anti-monopolistic law will not allow it to happen. The next best scenario is just to have a few well-established e-B2B MP serving the whole chemical industry which will ensure sufficient critical mass in the chemical industry, and also ensuring there is no monopolistic practice in the market. This would be rational thinking but unfortunately the market often does not behave rationally. The chemical companies can see the proliferation of e-B2B MP in the market, but they will want to believe that they are the frontrunners, and they will be the one reaping the benefits. Imagine if everyone starts to think this way, in no time the chemical market will be flooded with all different types of e-B2B MP, and the over-population will then cause the business model to collapse as many of them will not be able to gain critical mass to survive. This scenario is now back to the first wave and looks like nothing has changed since then.

In the first wave, companies were overly excited by the potential revenues the e-B2B MP would bring to them and the expectations of owners were that this will manifest itself into income. It was apparent from the first wave that these two items are not mutually exclusive, and that income was the lifeblood of the company, and not the revenues. This has led to many unprofitable e-B2B MP in the first wave to close down. It is too early to tell whether the second wave will bring in the profits for the companies.

The misalignment of expectations of buyers and sellers is an age-old argument as whether e-B2B MP are actually beneficial to the buyers or the sellers. In the first wave, it became apparent that much of the benefit was on the buyers' side, as they can now compare the prices from the different offerings and find the cheapest price for the product, they are sourcing for. The sellers can benefit from the extended reach to the customers and hopefully gives them the incremental volume. The buyers can access the different e-B2B MP to compare the prices and if there is price differential for the same product, the buyers can take advantage of the situation and will arbitrage it. The buyers are happy to take this difference as a price reduction but someone along the supply chain would not be happy as they have left some money on the table for the buyers. Of course, the prices can be controlled by the seller, but however if there are many sellers of the same product, there is no way to control this outcome. Not only that but this will probably infringe on the anti-trust laws for the sellers to come together and set a market floor price.

In the second wave, the driving force for companies to move towards e-B2B MP is the cheap entry cost. The SaaS application tools for building the e-B2B MP, and the web storefronts are readily transferable. This acts as a huge motivation driving companies to open up multiple web storefronts in order to reach out to more customers. The philosophy here for the sellers is that the more customers they can reach out to, and as cheaply as they can, the better will be for them. The question here, are the sellers trying to disintermediate their distributors? This is a very valid question in the mind of the distributor, and can this be the reason why the distributors are also setting up web storefronts in multiple e-B2B MP to compete for the customers?

Trust was identified as a critical factor that was apparently missing in the first wave of e-B2B MP and so the number of buyers jumping on to e-B2B MP to conduct their businesses were not as much as expected. The closed type electronic platforms, like Elemica, seems to have gain sufficient buyers to be sustainable and so did survived through the first wave. However, many of the open type e-B2B MP did not survive through the first wave. Are the developers of the e-B2B MP and web storefronts in the second wave, able to generate the trust factor between the buyers and the sellers, and keep the e-B2B MP alive through the second wave? This remains to be seen but from the surface of it, the developers of the e-B2B MP do not seem to have any additional feature to specifically address the trust factor either.

For commodity chemicals, just as in the first wave, these products can be traded through the e-B2B MP in the second wave as well. As was discussed before, many buyers are using the available information on demand, supply, and prices, to press the sellers' price down only. The sellers do not in reality gain much economic benefits from the transactions. It can be seen that selling commodity type chemicals through e-B2B MP can be a viable proposition. The e-B2B MP are actually ideally suited to be an auction site for surplus chemical stocks for whoever that has the excess stocks, and want to get rid of it, can put it up for sale on such web storefront. They can reach out to many customers very cheaply and very fast. As the shelf life of the commodity chemicals may not be that sensitive to some users, expired stocks could also be sold through such e-B2B MP.

One of the key features of the e-B2B MP in the second wave is the possible inter-connectivity of the ERP systems between the buyers and sellers, which should in theory, streamline the procurement process, and make the connection seamlessly. However, what are the possibilities that buyer wants to allow the seller to be able to interact with their ERP system? Some global buyers are opening up their ERP system on a controlled basis for suppliers to view products which they supply to the customer, where the buyer wants the supplier to monitor their stock level, and to alert them when ordering are required. This could be in the form of an email sent to the buyer to alert them the stock level has fallen below the threshold quantity and the buyer should be looking to place new order to replenish the stock as part of the inventory management program. This would be as much as the buyer would allow the seller to do as it is inconceivable that the buyer would allow the seller unfettered access into their ERP system. There are some technical issues on this connectivity facilitation because this would entail both the supplier's and buyer's ERP system to be technically compatible for them to be able to communicate with each other.

URL: http://dx.doi.org/10.14738/abr.101.11535

CONCLUSION

The global chemical sales are valued at about €4,000 bn by 2019 and is projected to grow to about €6,000 bn by 2030. Potentially, all these sales could be transacted through e-B2B MP and certainly this has attracted many marketers to try to convert as much of these sales into electronic transactions. This has led to a proliferation of e-B2B MP in the first wave of e-Commerce into the chemical industry. The sizeable sales that are still available for conversion to electronic transactions are still out there and no doubt will attract even more e-B2B MP and web storefronts to reach out to all the customers. In reality, how much of these will be converted into electronic transactions remains to be seen.

In this research, the types of e-B2B MP were studied and categorized by what they do. The first wave of e-B2B MP introduced into the chemical industry started in the late 1990's and lasted till 2010. Over this period, many e-B2B MP that were set up, have also closed down, in just a few years. Not able to build up of critical mass, lack of trust, concerns on security issues, misalignment of motives between buyers and sellers, unrealistic expectations of owners, and flawed e-B2B MP business model were some of the most discussed factors that resulted in the failure of the first wave of e-B2B MP in the chemical industry.

The second wave of e-B2B MP entered the chemical industry in the 2015's and many e-B2B MP were being setup by chemical manufacturers and distributors. The introduction of SaaS application tools meant that the entry cost to own an e-B2B MP were low, and this encourages many chemical players to participate in the market. In some of the independent owned e-B2B MP, chemical companies can just set up their web storefront on these e-B2B MP and have internet capability to start to conduct electronic transactions. Many of the chemical players were setting up multiple e-B2B MP, as well as setting up web storefronts in the independent owned e-B2B MP. Some chemical players signed on with e-B2B MP providers like 1688.com just to reach out to their China customers. Some observations worth noting in the second wave. Chemical manufacturers are not only setting up their e-B2B MP for themselves, but they also intend to invite other chemical players to join in their e-B2B MP, like what Covestro intends to do through their Asellion platform. Different chemical companies are joining forces to set up their consortium e-B2B MP, and that is in addition to them setting up web storefronts in independent e-B2B MP as well.

From literature review and observations from the chemical market, the technical features of the e-B2B MP set up in the second wave are similar to what were previously introduced in the first wave in the 1990's. There does not seem to be any additional, or special feature, that addresses any of the deficiencies experienced in the first wave. What is observable is that a large number of independent e-B2B MP was set up and many of the chemical players were setting up web storefronts in more than one e-B2B MP, and this applies to even the chemical manufacturers. Chemical distributors are also following suit and are also setting up web storefronts in multiple e-B2B MP. It remains to be seen whether all these e-B2B MP in the chemical industry will survive through the second wave. The Author will speculate that the chances of failure is much more than success, and they will fail for much of the same reasons as in the first wave, which is lack of critical mass, lack of trust, security issues, misalignment of motives between buyers and sellers, unrealistic expectations of owners, and flawed e-B2B MP business model.

For the e-B2B MP to succeed, they must overcome the deficiencies encountered before and also must offer innovative and creative features to attract and retain their customers. The technical features of the modern e-B2B MP must be able to foster and build up trust between sellers and buyers for a start. The thought of using the e-B2B MP as an auction type business model is not likely to gain much momentum because it misaligns the intention of the sellers and getting the business by being the lowest price offeror is not their key intention in the first place. So, any e-B2B MP which list down prices of the sellers for buyers to make comparison will not serve the sellers' purpose. However, such auction type e-B2B MP can be used by sellers to get rid of their surplus, or expired, stocks which is a possibility which may gain some traction as sellers don't really care about the price they can sell and just want to get rid of it by incurring minimum cost. With the proliferation of so many e-B2B MP in the second wave this will dilute the revenues of each of them resulting in the electronic platforms not being able to gain critical mass to sustain themselves in the chemical market.

The jury is still out there as to whether all these e-B2B MP will survive in the second wave remains to be seen and it would be interesting to review the chemical market ten years down the road to see what has worked and what did not. Perhaps by then a more perfect e-B2B MP, which resembles the theoretical butterfly business model, may emerge to give customers a truly frictionless, efficient, and intermediary-free electronic platform to conduct their businesses.

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