

---

## **E-fulfilling the e-supply chain of digital print**

---

### **Savvas Papagiannidis\***

University of Newcastle upon Tyne  
NE1 7RU, Newcastle upon Tyne  
Fax: ++44 191 2226838  
E-mail: Savvas.Papagiannidis@ncl.ac.uk  
\*Corresponding author

### **Michael Bourlakis**

University of Newcastle upon Tyne  
NE1 7RU, Newcastle upon Tyne  
Fax: ++44 191 2226720  
E-mail: M.A.Bourlakis@ncl.ac.uk

### **Feng Li**

University of Newcastle upon Tyne  
NE1 7RU, Newcastle upon Tyne  
Fax: ++44 191 2226131  
E-mail: Feng.Li@ncl.ac.uk

**Abstract:** This paper employs a qualitative case study methodology aiming to shed light on the integration process between the supply chain and the information technology operations of a business network in the UK digital print sector. That integration process, combined with the simultaneous and parallel transformation of the supply chain management operations in order to distribute and print material online, via numerous partners and distributors, results in the emergence of a fourth party digital print logistics network. The unique characteristics of the network are related to the fast response to on-print customer demand and to the ability to print material in numerous locations; hence, it is gradually becoming a demand-chain digital print logistics network. It also illustrates a new business model and a new way of working, enabled by the internet and related technologies, that were not financially viable in the past.

**Keywords:** Supply Chain Management (SCM); Information Technology (IT); 4th party logistics network; UK.

**Reference** to this paper should be made as follows: Papagiannidis, S., Bourlakis, M. and Li, F. (2008) 'E-fulfilling the e-supply chain of digital print', *Int. J. Information Technology and Management*, Vol. 7, No. 1, pp.98–112.

**Biographical notes:** Dr. Savvas Papagiannidis graduated from the Physics Department of the University of Newcastle upon Tyne. Upon completion of his PhD, he joined the eBusiness Group at the Business School, in the same University. He started a number of eBusiness ventures and also worked as a freelance internet developer. His research interests include management of internet and emerging technologies, high-technology-related entrepreneurship and e-business models.

Dr. Michael Bourlakis is currently a Lecturer in Marketing based in the Centre for Rural Economy (CRE) in the School of Agriculture, Food and Rural Development at University of Newcastle upon Tyne (UK). He has more than ten years experience dealing with marketing, distribution channels and supply chain management. He graduated in Business Administration at the Athens University of Economics and Business (Greece) and obtained both his MBA and PhD degrees from the University of Edinburgh (UK). He worked as a Research Associate at the Management Centre, University of Leicester (UK) and at the Oxford Institute of Retail Management, Templeton College, University of Oxford (UK). He has published in various logistics, supply chain management and marketing journals.

Professor Feng Li is Chair of E-Business Development at the University of Newcastle upon Tyne Business School. His research has focused on the interactions between information systems on the one hand, and strategic and organisational innovations on the other. A particular focus of his current research is on the internet and e-business, and emerging strategies, business models and organisational designs in the new economy. He has worked closely with companies in banking, telecommunications, car manufacturing and electronics industries through research, consultancy and executive management programmes. His recent works on internet banking and on telecom pricing models and value networks have been extensively reported by the media.

---

## **1 Introduction**

Logistics and Supply Chain Management (SCM) have gained major importance over the past decades, representing key strategic functions for firms (see for example, Bourlakis, 1998 for retail firms). In the same vein, Information Technology (IT) has increased its role, and its simultaneous functional integration and interaction with SCM has become an absolute necessity, resulting in heightened operational results for the firms involved (see Bourlakis and Bourlakis, 2006).

The current paper illustrates this interaction between IT and SCM by focusing on the case of the e-supply chain of a digital print software house, that of Gaia Fulfilment. The paper starts with a discussion of the digital print industry in order to provide the reader with the background information needed to put the rest of the paper into an industry context. It then discusses the connection between SCM and IT and how this underpins the creation of an appropriate SCM network. This is followed by an analysis of the cases under examination. The last sections provide a discussion on future trends and concluding remarks.

## **2 The digital print industry**

Since the earliest print presses there has been a strong relationship between the unit price and the overall volume of a print job. Once the print volume reaches a certain scale, the unit price decreases rapidly as the volume increases. However, with the development of the modern colour digital presses, this relationship has been broken, with printers now able to deliver profitable full colour, short-run printing at economic costs. Leading vendors today are actively promoting short-run variable documents, but this depends on

successfully resolving two key issues: significant overall volume consisting of multiple jobs and low transaction costs. It is possible with mass marketing and web front-ends to build sufficient print volume, but unless the transaction cost is minimised, the print will not be profitable. The traditional print markets focus on service and low price, based on few high-volume prints. To achieve profitability in short-run printing, there needs to be little human intervention when it comes to printing, finishing, distribution and invoicing, which should be fully automated.

The printing press, as we know it today, was invented by Johann Gutenberg in the 15th century, an event that has been named number one among the Top 100 Greatest Events of the Millennium by *LIFE Magazine*. The introduction of digital presses may not have resulted in changes of the same social magnitude as those that followed the original introduction of the printing presses, but it has undoubtedly fuelled a fundamental transformation of the printing industry itself. Changes have not occurred seamlessly, though. So far, they have been very slow and have encountered resistance at every step. Digital presses are not traditional but improved print presses. They are devices that require different thinking and attitudes when worked with. In order for them to fully deliver their promised value, a cultural evolution within the print industry will be needed.

Digital presses transformed the economics of print, allowing an array of printing tasks to be fulfilled viably. As a result, new business opportunities and models hit the markets. Coupled with the parallel introduction of the internet as a mainstream communication medium, the introduction of digital presses improved a number of existing applications and created many more. First of all, digital presses allow short-run jobs to take place. Traditionally, the minimum quantity has been set high, in order to compensate for the high setup costs that each job incurred. With such a pricing model, customers were encouraged to print more than they needed, as re-ordering would have meant paying the set-up costs once more. These extra documents had to be stored, managed and often became obsolete by the time they were to be used. To compensate for this, customers sometimes deliberately removed information from the documents that could render them obsolete too quickly, *e.g.*, dates or prices.

Digital presses, on the other hand, do not require set-up: they print each document separately. This implies that each document can be personalised and customised without actually making any difference to the print process at all. Also, as documents do not require any drying time, they could reach potential markets much faster than documents that were printed using traditional lithographic processes. Moreover, printing-on-demand meant that no storage was required any more and wastage was kept to a minimum, resulting in reduced operating costs and environment friendly printing applications.

### **3 SCM and IT: the interconnective network**

SCM aims to reduce costs, risk and lead times and to maximise value (Christopher, 1998). Key trends in SCM include the outsourcing of activities (Alexander and Young, 1996), the creation of long-term and sustainable relationships with suppliers (Lamming, 1993), the implementation of lean/agile methods (Naylor *et al.*, 1999) and systems integration (Christopher, 1998); actually, the last trend has emerged as a critical issue for most firms. Focusing on the integration of IT and SCM operations, Fitzgerald and Willcocks (1994) note that firms employ numerous SCM information systems resulting in a major increase in the availability of information within the chain. Similarly, Ciborra

and Olson (1989) stressed that IT minimises the transaction-related costs of coordination among firms through a standardisation of tasks. Recently, the use of the internet has become very popular as it maximises the dissemination of information among the SCM participants (Quarrie and Hobbs, 1997). This in fact is giving rise to new business models and new ways of working that were not possible – or not financially viable – in the past. New business models, though, cannot create value by themselves. In order for companies “to translate the new strategies and business models into real benefits, it is essential that they redesign their structures, processes and inter-organisational relations to reflect these changes and capitalise on the emerging opportunities” (Li, 2007).

From the above discussion, it becomes evident that the use of IT within the SCM operations has undergone an evolutionary process. Part of that evolution, focusing on the integrative role and importance of the IT systems within the retail firm’s SCM strategy formulation, has been examined by Bourlakis and Bourlakis (2006) based on the work carried out by Lucas and Turner (1987). Table 1 extends that work by indicating the evolution of the IT systems integration within a firm’s generic SCM operations.

**Table 1** The evolution of IT integration within SCM operations

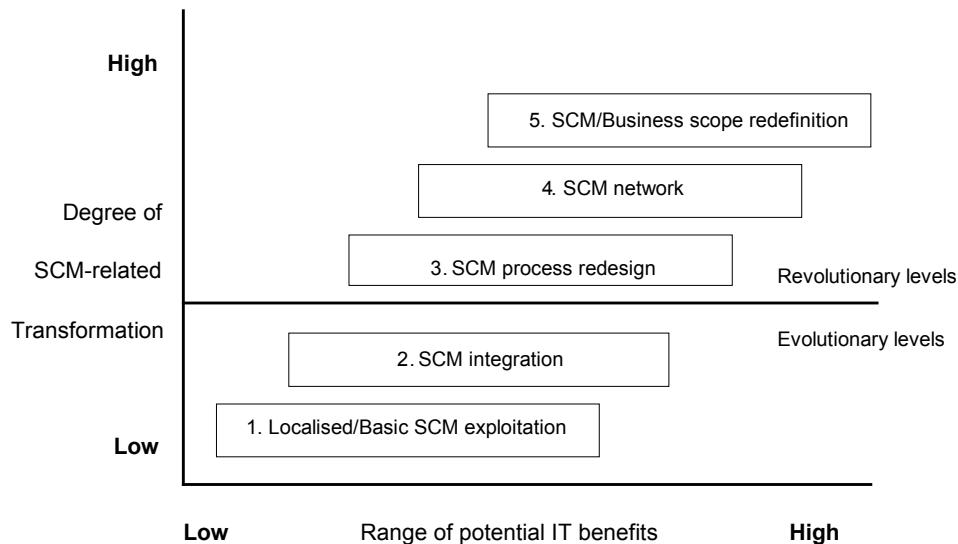
<i>Level of IT systems’ integration within SCM operations</i>	<i>Primary objective</i>	<i>Secondary effect</i>	<i>Examples of level of IT system’s integration within SCM operations</i>
1st Level – Independent IT systems	Increase operational efficiency for few SCM activities	Provision and dissemination of managerial information	Warehouse control systems
2nd Level – Policy support IT Systems	Aid the SCM planning process and key SCM activities	Better understanding of SCM problem dynamics	SCM planning applications ( <i>e.g.</i> , activity-based costing systems dealing with SCM-related activities)
3rd Level – Fully integrated IT systems	To open new SCM-supported strategic options and to provide the company with a competitive advantage	To change the SCM decision-making process; strategic SCM-related alternatives considered	Web, internet technology

Note: Table 1 is based on Lucas and Turner (1987); Bourlakis and Bourlakis (2006).

Hence, for the first level of integration, independent IT systems support the firm in enhancing operational and supply chain efficiency, whilst, at the second level of integration, policy support systems aid, primarily, the SCM planning process and key SCM activities. At the third level of integration, IT is fully incorporated within the firm’s SCM operations and, subsequently, it provides the firm with a unique competitive advantage. At this stage, IT provides the management of the company with the opportunity to define a plethora of SCM-supported options available for further exploitation. Apart from the above, IT has a critical role in the evolution of a business structure helped by the fact that the cost of IT has been decreasing in the past. Venkatraman (1991) notes a hierarchy of five levels of business evolutionary

reconfigurations where firms consider the range of potential benefits emanating from using IT. In Figure 1, we redevelop these reconfigurations considering the degree of SCM-related transformation.

**Figure 1** The five stages of an SCM-related transformation stemming from IT benefits



Source: Adopted from Venkatraman (1991)

Specifically, the first stage in Figure 1 involves employing IT for solving a basic SCM business problem. The second stage intends to aid specific SCM operations and, as a result, the internal SCM processes along with the other business operations are improved. These two stages are seen as evolutionary, requiring small and gradual changes in the current SCM operations. However, the other three stages (Figure 1) are viewed as revolutionary, demanding major changes in the nature of the SCM operations and processes. Following this integration of their IT systems, many firms join stage three ('SCM process redesign'). Here, the launching of a key IT system could transform a firm to operate in a unique manner. For example, the use of the internet has enabled firms to, *inter alia*, improve information dissemination and their communications with their SCM partners. The fourth stage ('SCM network') reconfigures the scope and tasks of the firm's SCM network, encompassing the SCM tasks within and outside the SCM boundaries of a firm, and the subsequent redesign of this 'virtual business network' through IT capabilities. The final stage ('SCM – business scope redefinition') is where the firm will manage its SCM operations via an IT network and will outsource most of its SCM operations. Stages three, four and five are deemed to be revolutionary ones. Moreover, we could reasonably suggest that the network theory can be fully incorporated and considered in our analysis. This theory emphasises that a firm's network consists of many interdependent relations (Johanson and Mattsson, 1987) and its operations, including the SCM and IT ones, are based on a web of external and internal activities between firms (Thorelli, 1986). Bowersox *et al.* (1992) illustrate key benefits, such as cost reduction and synergy, considering that these networks permit firms to focus on activities that perform

more efficiently. They also create a competitive advantage through the leverage of key capabilities and quick response to market changes. Similarly, the network can be viewed as part of the evolution of an inter-firm relationship (Table 2).

**Table 2** Features of transaction exchange and strategic network for firms involved

<i>Transaction exchange</i>	<i>Strategic network/network</i>
Shorter term	Longer term
Multiple suppliers, who are played off against one another for concessions	Fewer suppliers (maybe even one) who are treated as valued partners
Price dominates	Value-added services dominate
Little dedicated investment from supplier	Specialised investment can be high for both partners
Little information sharing	Much sharing of every kind of information
Firms are independent	Firms are interdependent
Formal, infrequent communication	Frequent, formal and informal communication
Little interaction between respective functional areas	Many functional areas may interact across the partners

*Source:* Bowersox *et al.* (1992)

Relevant work has been developed by Gattorna (1998), who pioneered the concept of the fourth party logistics network. In his thinking, this network is a channel integrator and becomes the interface between firms, normally the buyer of a SCM service and the supplier of that service, such as the third party logistics firms and IT suppliers. Such an integrator is typically an autonomous firm whose role is to provide supply chain services to numerous clients. The fourth party logistics network is supported by the latest IT developments, and primarily by the internet, which assists the coordination among the SCM members. Gattorna (1998) provides a number of examples of the industrial applicability of the fourth party logistics network, including the UK pharmaceutical and beverage manufacturing sectors, whilst Bourlakis and Bourlakis (2005) conceptualise its possible applicability to food retailing. Gattorna (1998) also notes some of the key attributes required for its suitability in an industry including, *inter alia*, small industry concentration and low margins – attributes that are pertinent to Gaia and the print industry. Linking the above with the previous analysis, we could argue that the fourth party logistics network presents an alternative fifth stage of the stages proposed in Figure 1.

#### 4 Methodology

For the purpose of empirical examination, we followed a qualitative case study methodology to generate an in-depth understanding of the basis of contextual and detailed data (Silverman, 1994; Yin, 1984). This paper is based primarily on the empirical data collected from two closely linked case studies. Primary data was provided by the IT director of Gaia Fulfilment. He made available information about Gaia's operations and the characteristics of the orders fulfilled, while collaborating with one of

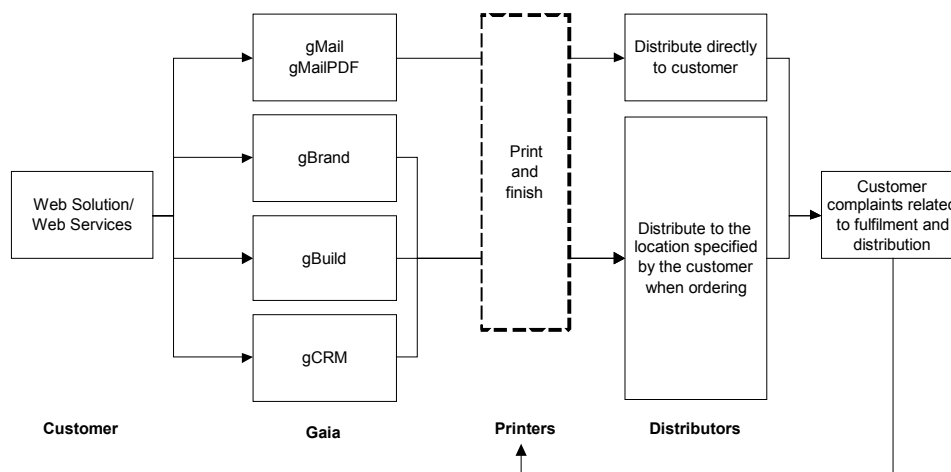
the authors, who worked as a freelance developer for the company. This close involvement allowed the participant author to observe closely not only the interactions within Gaia itself but also the external relationships that Gaia had with its partners and customers. Subsequently, the material was analysed and written up as case studies, which were then verified by the two companies. The cases were considered jointly and subsequently were subjected to comparative analysis, where underlying similarities and systematic associations were sought out with regard to the issues under examination (Ragin, 1987).

## 5 The case of Gaia Fulfilment

In this section we will examine the arrangement of the print network of Gaia Fulfilment, namely, the relationships and interactions among Gaia, its customers and its print partners.

Gaia Fulfilment is a software house, based in the northeast of England, specialising in collateral fulfilment (Papagiannidis and Li, 2005), *i.e.*, applications that deliver short-run print on-demand via the web. The software enables end users to compose and order print, which will be automatically generated at the printers' end, allowing them to handle high-volume, short-run printing. Gaia's print partners are required to adopt the software before they join their print network. Gaia's services cover a wide range of B2C and B2B products, which include a range of designs such as stationery, mailers, business cards, brochures, calendars and many others. They also offer a number of products for businesses (see Figure 2), such as direct mailing and branded document fulfilment. Gaia has recently merged with a company providing data and marketing services, with the hope that such a move will enable it to provide more holistic marketing products to its customers.

**Figure 2** Gaia's 4th party digital print logistics network



## **6 Print network**

Apart from developing printing solutions, Gaia has established a printing network that services a number of national and international clients. Gaia effectively runs and integrates a fourth party digital print logistics network with numerous print partners around the UK. This allows for a significant print capability that both grows organically and maintains an economy of scale, allowing access of the end customer to assets worth millions of pounds.

Print partners could supply print on-demand independently from each other or they may join forces, if a specific job requires this. As the relevant supply chain infrastructure is already in place, this can be achieved simply by creating a new account in the system and assigning it to the print partner that has the required capacity or finishing capabilities.

Harnessing the capacity and capability of professional printing devices through the internet is a great leap for SMEs, who now have cost-effective applications at their disposal. For example, marketing campaigns can be personalised and fulfilled within hours of the order being placed. In the past, such campaigns would have been fulfilled manually with someone spending hours or even days folding letters and placing them in envelopes. Even in cases where mailing house services were to be used, this often took days to arrange. With collateral fulfilment solutions, like the solutions Gaia offers, mailings can be arranged on demand and are often fulfilled within 24 hours. For the customer ordering, there is no difference between ordering one document or 1000 documents. In fact, there is almost no difference for the printers either. The printing devices undertake all the printing and folding before inserting the letters into the envelopes. Still, this is often the part of the supply chain that raises the most issues. Printers, used to traditional practices that required them to oversee every single step of the printing and finishing process, tend to interfere with the jobs, which leads to delays and additional, often hidden, costs.

It is worth noting that mapping the existing processes on a technology that operates based on fundamentally different assumptions and rules can only result in inefficiency and ineffectiveness. Digital print requires no-touch processes if it is to deliver the promised benefits of cost-efficient short-run print. Gaia solutions are often offered through a reseller channel (the Customer Relationship Management – CRM chain) creating numerous opportunities for independent vendors to tap into existing and new markets. Resellers are provided, among others, with total autonomy to set prices and content, selection of print partner, ready to go off-the-shelf templates and a suite of online tools to set up customer sites and monitor sales.

Actually, all accounts are considered to be ‘reseller’ account, with even Gaia itself having its own reseller account in the system. The difference is, of course, in the level of involvement in the order process and the level of engagement with the customer. As a result, in the customer web of Gaia’s print network, one could distinguish three main pools of customers: Gaia’s own customers, its print partner’s customers, and resellers’ customers. The above chain structure increases the inherent complexity and further supports our view for considering Gaia as the prime member of that fourth party digital print logistics network arrangement.

In terms of IT use, and although it is up to each organisation and reseller to decide how they engage and support their customers, the default option is to deliver CRM functions through a common website that is offered as an integral part of the online solutions. Customer enquiries are logged in a central database and first dealt with centrally before being acted upon or forwarded appropriately.

To reduce the cost of engagement with a customer, a fine balance must be struck between empowering the users and not allowing them to feel abandoned. This is achieved by giving the customer easy access both to a well-documented help file and an easy to use support request tool. The support request tool asks the user to describe the nature of the issue, for instance, print quality or delivery issues. It also allows the user to indicate the urgency of the issue. The Gaia support team responds quickly to these notices, usually within one hour, either resolving the problem or at least informing the user that the issue is being investigated.

The process of dealing with each support call is first to identify the nature of the call. There are three categories:

- 1 Quality – The Gaia support team checks the additional description of the problem, as some quality issues may be poor print: colour variations, creased paper, wrong paper type; or they may have to do with a composition issue: corrupt images, text overflow or font issues. If the issue is print-related, then the call is forwarded onto to the printer, who will generally reprint, otherwise the Gaia support team will resolve the issue and again order a reprint.
- 2 Delivery – The most common issue is failed delivery. Primarily, this is the case because the process is not controlled by Gaia or the partner. Delivery issues are passed straight to the print partners, who generally reprint and re-distribute. Most print partners actually maintain an audit trail for deliveries and have digital signatures demonstrating proof of print.
- 3 Technical – These issues are relatively rare, as the software is mature. These issues occur most regularly with new users who experience problems. These are usually resolved by educating the user. Other technical problems are related to the web infrastructure, *i.e.*, connectivity, bandwidth and firewalls. These issues are rarely deemed to be significant and are therefore referred to the regular technical meetings, where they are discussed and a plan of action is implemented.

Generally, when it comes to failed or defective orders, it is easier to simply re-supply the user free of charge, because of the orders' low cost. If, however, a customer persists with the same problem, a more robust approach is taken and the customer will be asked to re-order; examples might be where deliveries are being received by a company (as proven by a digital signature), but the internal distribution is not effective; another example might be where a customer uploads corrupt or incorrect images.

The customer support management is based on an organic process that constantly evolves as more active customers and print partners join the network. As relationships mature they start forging links among themselves. For example, customers may be given the contact details of the print partners in order to reach them directly.

## 7 Integrating Gaia's system with its print partners and customers

Print partners that belong to Gaia's network are required to buy a licence that provides them with access to the network. The licence includes installation and support of the platform's technology, which is based on Lotus Domino. This has often caused problems when adding new print partners on the network as they lacked the necessary expertise. As a result, site calls had to be made, in order to address the issues, which required the company to commit resources that could have been invested in other activities. Still, Domino's replication facilities allowed for the seamless intelligent distribution of the files to be printed across the print partners. The print partners can then integrate the end output, *i.e.*, the PDF files to be printed, in their own print process. Modifications may be required in the print process in order to fulfil new types of orders, for example, those that have special finishing requirements.

When it comes to integrating with customers' systems, no significant integration attempt has been undertaken so far. In fact, in the only case where partial integration was undertaken, this involved a customer's system automatically uploading data on the Gaia server that was later used in the ordering process. As the users did not have to upload these files manually and the time required to place an order was shortened, the system's efficiency and effectiveness were improved.

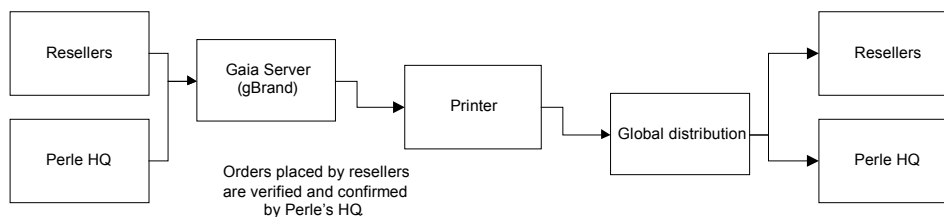
To address the challenge of integrating its system with print partners and customers, Gaia plans to use web services, which, as discussed later in this paper, will create a number of new opportunities.

## 8 Supply chain of digital print in action

Perle is a Canadian-based IT hardware manufacturer that runs a global supply chain with 93 delivery sites. Perle's challenges were to print brochures for many products, for many customers, in several different languages. Historically, this problem had been resolved by printing 5000 of each product brochure for each language, resulting in a good price per page. Each new product would then be shipped immediately in blocks of 50, with any remainder being stored. Once a product brochure ran out, another order of 5000 would be placed. In total, Perle supported 193 different documents.

In 2001, Perle migrated to a Gaia Fulfilment solution with all their product brochures deployed online, with the headquarters and each of their partners ordering on-demand using gBrand (see Figure 3). The fulfilment depends on who is ordering and for what purpose. For example, resellers' documents are delivered directly to the offices, while the headquarters could also order unbranded documents for general use.

**Figure 3** The supply chain of digital print: the Perle's case



The original method was relatively straightforward, with a single print run and one distribution effort typifying a Standard Supply Chain (SSC). However, the issues with this methodology were numerous and have been related in a previous paper (Papagiannidis and Li, 2005). The new method allowed the users to order short-run marketing materials on demand; we could argue that the latter method is similar to a Demand Chain (DC). This method, however, caused significant issues in producing profitable print for the print partner. These were:

a Transaction cost

Any transaction between two organisations has a tangible cost; in this case each print order had an associated invoice. In the SSC model, the cost of the invoice was proportionally small, when compared to a print and distribution cost of 5000 documents, but with the DC model, the order might only be for 30 documents and so was proportionally very large. The solution to this problem was to change the invoice from a per job basis, to one per month, with online reports detailing all activities. This allowed the cost of the invoice of the DC system to be commensurate to that of the SSC one.

b Print fulfilment

Another equally important issue is the cost of fulfilling each job. With the push method there is one large job, which enables the printers to cost-justify human interaction with the job, such as: telephone discussions with the customer, proofing and checking the job, and possibly altering the original artwork. This effort has a cost, but it can be absorbed into the job as a whole.

With the DC method, this type of activity cannot be cost-justified. It is therefore essential that the print process be reengineered to allow the minimum of human interaction. Gaia's IT capabilities achieved this by producing 'print-ready' files, which carried all the printing information in their name, allowing for the printer to submit these jobs into pre-configured folders for automatic printing. This information also carried any finishing requirement, such as folding, stitching or lamination. This process also required a change in the 'human' process, as it was no longer financially practical to intervene in the print process. Therefore, the customer was empowered to produce a preview of the print and responsibility moved to them for checking. We can therefore suggest that Gaia's revolutionary use of IT facilitated its business and SCM operations leading to a redesign (Stage 3), extension (Stage 4) and redefinition (Stage 5) of its SCM print network (see Figure 1).

c SCM and distribution

The final element of reengineering was that of SCM and distribution. With the SSC method, there would be a single distribution job with documents going to all 93 sites. Even with the SSC method, this was a difficult proposition, with packages being sent to many different countries with different charges. The DC method, however, meant that orders would come through either singly or in small batches, which in turn would increase the cost per order. This issue was compounded by the variable weight of each job and the requirement to feed individual distribution costs back to the reporting system.

The solution to this problem was in two parts. The first was to ensure that all supply chain costs were pre-calculated by the solution. This was achieved by building a multiple dimension matrix of partners, distribution methods, weights and costs. The customer could then select their preferred distribution method that would generate a cost based on the weight. Each job would then have the distribution method passed as part of the printing code. This allowed all distribution costs to be seamlessly integrated into the existing reporting and invoicing system. The second part of the solution was to produce a delivery sheet for each order. This listed the delivery address, distribution method and the individual prints that made up the order. The solution allowed the printers an easy method to consolidate the elements of the job and, by placing the cover sheet in a windowed envelope, a simple addressing method.

## **9 Future trends**

### *9.1 Networked print*

Networked printing allows customers to substantially reduce costs and fulfilment times by using strategically located printers to direct printing requirements. This is similar to the Perle scenario, but instead of using just one printer, a series of them is used. Each time an order is received, the system selects the most appropriate printer to redirect the order to. For example, if one is based in Australia and wants to mail someone in the UK the order can be printed in the UK, or the location that is the closest to the UK, and have the letter sent out with a fraction of the cost of the international postage fee. In doing so, delivery time can be reduced from a few days to a next day delivery with no additional costs.

With an ever increasing number of digital print devices, even if networked print may only account for a small fraction of international deliveries, distributors should be aware of its potential implications. This is very similar to telecom operators, who found themselves threatened by the introduction of Voice over Internet Protocol (VoIP: transmission of voice and telephony services over the internet or other IP-based networks) services. Networked printing opens up new opportunities for the adoption of radically different operational models, making previously unprofitable activities financially viable. Many customers will continue to use conventional methods for their printing activities, but the possibilities opened up by networked printing could radically shake up the printing industry.

### *9.2 Service-oriented applications*

Web services provide a standard means, based on XML, of interoperating between different software applications, running on a variety of platforms and/or frameworks. Programmes providing simple services can interact with each other in order to deliver sophisticated value-added services (W3 Consortium, 2005).

In the future, Gaia plans to open up its technology via web services to other software developing houses, empowering their users to order print via a number of online applications and interfaces. This could attract external support for the technology that could potentially evolve into a platform on which many companies provide printing

solutions. Such a transformation, from a closed system to a platform that embraces collaboration and generates opportunities for companies adopting it, could potentially render Gaia's technology the *de facto* standard when it comes to fulfilling its fourth party digital print logistics network.

## 10 Concluding remarks

The internet, as a communication platform, is an integral part of delivering the benefits that the digital print technology promises. Equally important, the internet has a crucial role to play when it comes to coordinating the supply chain, by facilitating effective and efficient communication among the customers, the printers and the fourth party digital print logistics network, allowing for just-in-time approaches. Additionally, transforming an SSC to a DC poses a range of challenges. Our examination illustrated a few of these, such as the sequential levels of integration between IT and SCM required for firms involved in a fourth party logistics network and the IT/SCM network infrastructure and CRM tools developed by Gaia and Perle to guarantee the smooth and efficient functioning of that network. We also analysed the manner in which Gaia overcame these challenges, thrived on them and created a customer-friendly or even truly demand-led supply chain. That manner involved adopting a longer-term perspective, treating network print suppliers as valued partners and with firms involved in that network becoming interdependent but still working under a web of external and internal activities. Bowersox *et al.* (1992) proposed the above as key elements of the network theory (Table 2) and the current analysis has demonstrated the applicability of the network theory to Gaia and Perle. In fact, we have examined an extended concept of the network theory, *i.e.*, fourth party logistics network, to the supply chain and IT operations of the print industry and we report its full applicability.

Scaling up Gaia's technology and offering to provide a global service has a number of implications, *e.g.*, effective monitoring of the supply chain, integration of different systems in order to ensure accountability, management of complaints when jobs do not get processed smoothly and so on.

Reengineering the print fulfilment business has not been an easy task for Gaia. The print industry is extremely conservative. Many printers have based their business model on giving the end user the best service, by which the printers mean supporting each customer through the entire print process. Gaia's IT capabilities, however, increase the number of jobs and decrease the value of each, whilst empowering the users to manage their own print. Printers only embraced this concept when it was explained that the saving of resources during the print order could be focused on customer support pre and post print. In addition, Gaia, when possible, focused efforts on recruiting only the most dynamic and forward thinking of printers.

Last but not least, the paper has illustrated the viable and successful application of the fourth party logistics network to the digital print industry; so far, that concept has been examined only in the automotive and the retail sectors. It can be reasonably suggested that there are many implications and lessons to be learned from the Gaia case study as similar applications can be developed for other industries. For example, printing online digital photographs via a fourth party logistics print network presents a viable business opportunity for a few UK multiple food retailers, such as Tesco and Asda, considering their intention to offer this service to their customers. The tourism, the car rental, the

insurance and even the banking and retailing sectors could also benefit. Of course, this also applies to big IT players. For example, Google and Amazon could offer their customers located in a specific country the ability to print large volumes of relevant promotional material (e.g., brochures and leaflets) and other documentation (e.g., books and magazines). Consequently, a local subsidiary/partner could print that material in a very quick, efficient and secure manner and satisfy unforeseen demand.

## References

- Alexander, A. and Young, D. (1996) 'Strategic outsourcing', *Long Range Planning*, Vol. 54, No. 1, pp.116–119.
- Bourlakis, M. (1998) 'Transaction costs, internationalisation and logistics: the case of European food retailing', *International Journal of Logistics: Research and Applications*, Vol. 1, No. 3, pp.251–264.
- Bourlakis, C. and Bourlakis, M. (2005) 'Information technology safeguards, logistics asset specificity and 4th party logistics network creation in the food retail chain', *Journal of Business and Industrial Marketing*, Vol. 20, Nos. 2–3, pp.88–98.
- Bourlakis, M. and Bourlakis, C. (2006) 'Integrating logistics and information technology strategies for sustainable competitive advantage', *Journal of Enterprise Information Management*, Vol. 19, No. 2, in press.
- Bowersox, D.J., Daugherty, P.J., Droge, C.L., Germain, R.N. and Rogers, D.S. (1992) *Logistical Excellence: It's not Business as Usual*, Digital Press.
- Christopher, M. (1998) 'Logistics and supply chain management: strategies for reducing cost and improving service', *Financial Times Prentice Hall*, London.
- Ciborra, C.C. and Olson, M.H. (1989) 'Encountering electronic work groups: a transaction costs perspective', *Office: Technology and People*, Vol. 4, No. 4, pp.277–290.
- Fitzgerald, G. and Willcocks, L. (1994) 'Outsourcing information technology: contracts and the client/vendor relationship', *Research and Discussion Paper 94/10*, Oxford Institute of Information Management, University of Oxford, Templeton College.
- Gattorna, J. (1998) 'Fourth party logistics: en route to breakthrough performance in the supply chain', in J. Gattorna (Ed.) *Strategic Supply Chain Alignment*, Gower.
- Johanson, J. and Mattsson, L.G. (1987) 'Interorganisational relations in industrial systems: a network approach compared with the transaction cost approach', *International Studies of Management and Organisation*, Vol. 17, No. 1, pp.34–48.
- Lamming, R. (1993) *Beyond Partnership: Strategies for Innovation and Lean Supply*, Prentice Hall, Hemel Hempstead.
- Li, F. (2007) *What is E-Business? How the Internet Transforms Organizations*, Blackwell Publishing, Malden, MA.
- Lucas, Jr., H.C. and Turner, J.A. (1987) 'A corporate strategy for the control of information processing', in S.E. Madnick (Ed.) *The Strategic Use of Information Technology*, Oxford: Oxford University Press.
- Naylor, J.B., Naim, M.M. and Berry, D. (1999) 'Leagility: integrating the lean and agile manufacturing paradigms in the total supply chain', *International Journal of Production Economics*, Vol. 62, No. 1, pp.107–118.
- Papagiannidis, S. and Li, F. (2005) 'Management and delivery of digital print via the web: a case study of Gaia fulfilment', *International Journal of Cases of Electronic Commerce*, Vol. 1, No. 1, pp.1–18.
- Quarrie, J. and Hobbs, S. (1997) 'Supply chain technology: improving retail efficiency and effectiveness', *Financial Times Retail and Consumer Publishing*, London.

- Ragin, C.C. (1987) *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*, Berkeley: University of California Press.
- Silverman, D. (1994) *Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction*, Sage Publications.
- Thorelli, H.B. (1986) 'Networks: between markets and hierarchies', *Strategic Management Journal*, Vol. 7, No. 1, pp.37–51.
- Venkatraman, N. (1991) 'Information technology induced business reconfiguration', in S.M. Morton (Ed.) *The Corporation of the 1990s*, Oxford: Oxford University Press.
- W3 Consortium (2005) *Web Services Activity Statement*, <http://www.w3.org/2002/ws/Activity>, (retrieved 30 January 2006).
- Yin, R.K. (1984) *Case Study Research: Design and Methods*, London: Sage Publications.