

KNOWLEDGE AND INFORMATION FLOWS IN SUPPLY CHAINS: A STUDY ON PHARMACEUTICAL COMPANIES

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Abstract

Goods, information, financial and technology resources flow through supply chains, and pharmaceutical companies face a very specific challenge: ethical drugs must be prescribed by physicians to be bought or used by final consumers. That gives a unique design to their supply chains. This paper aims to understand how the supply chains of pharmaceutical companies are configured. It especially explores knowledge and information flows between those companies and physicians. Those companies have developed specialized units to manage their relationship with physicians. It is not a typical producer – distributor commercial relationship, since physicians work under strong professional regulations and code of ethics. It draws upon a qualitative field research: physician and customer relationship managers from four large multinational pharmaceutical companies were interviewed and their units' procedures were examined.

Key words: supply chain management, information flow, knowledge flow, health care.

1. INTRODUCTION

Undisputedly, supply chain has become a major source of competitive advantage to companies. It is a very broad concept, which, as evolving, has received a number of different denominations [1]. Most of the current knowledge on supply chain management (SCM) comes from "narrow functional silos such as purchasing, logistics, IT and marketing" [2] (p. 703). For instance, following one of the more restricted views, a logistics perspective, SCM is concerned on the activities to deliver products and services to the market. Thus supply chain can be conceptualized as a group of organizations that build connections and establish material and informational flows in order to deliver goods and/or services, and SCM is the planning and control of those flows and the related logistics activities, both within each organization and between organizations [1]. In that view, activities like demand creation are not considered as part of the SCM but as a marketing function: demand is given and fulfilling that demand is a supply chain function.

There are however attempts to develop broader views. Min and Mentzer [3] for instance argue that every firm function, including logistics and marketing, promotion and sales is part of the SCM. Cigolini et al. [4] point that a more encompassing perspective of SCM deals with the co-ordination of the organizations related to the delivery of goods and services. Thus the latter view acknowledges that the SCM should be not only a cross functional enterprise, undertaken by different functions within the organization, but also a inter-firm coordinated and integrated effort.

This paper follows the second concept, and specifically explores the role of technological information within an important SCM effort: demand creation. Discussion on information flows in supply chains is usually restricted to the study of order information, as for instance in the analysis of the bullwhip effect (e.g. [5]). But in many situations, supply chains are an important channel companies possess to bring technological information to the market and also to receive feedback from other companies and customers. Moreover, in some supply chains, technological knowledge and information flows are critical to demand creation. Despite that fact, research on SCM has given scant attention to this phenomenon. For

instance, Chen and Paulraj [1], Min and Mentzer [3], Tracey et al. [6] and Burgess et al. [2] did not include any construct about technology-related information flow among those selected for their studies.

That may due to the fact that technological information, in many cases, flows alongside commercial (order) information, giving hazy boundaries to each other. It is usual, for instance, to find engineers in charge of sales, performing the so called 'technical sales' function, which includes both delivering technological information to help customers' decision making and also contracting and collecting order information. But in some specific industries, due of some peculiar features, the flow of technological information needs to be managed apart from order information, through an especially designed path within the supply chain. That is the case for instance of pharmaceutical companies: since customers do not have discretion over their purchasing decisions but depend on physicians prescriptions, pharmaceutical companies need to keep physicians well informed about technological developments embedded in their products in order to create ethical drugs demand. To manage that flow, they have to develop two paths in their outbound supply chain: the main path, where goods and order information flow to and from the market, and a secondary path, where technological information flows to create demand. This paper explores how those companies manage that technological information flow and how they organize and structure information channels. It thus highlights a neglected issue within the current supply chain discussion: knowledge and technological information flows and their role on demand creation.

2. KNOWLEDGE AND INFORMATION FLOWS IN SUPPLY CHAINS

Mentzer et al. [7] argue that, although supply chain *per se* does have a consensual definition, as "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances and/or information from a source to a customer" (pp.3), SCM in turn does not have such a convergence, but "there remains considerable confusion as to its meaning" (pp.2). Here, SCM is conceptualized from a very broad perspective, as the management of

material, informational, financial and technological flows, both within each organization and between organizations, aiming to bring value to stakeholders and clients [8]. Thus SCM should be a cross functional effort, starting from demand creation up to its fulfillment.

But which business functions should be encompassed by SCM, and to what extent, is still under debate. For instance, a survey conducted among the members of the Council of Supply Chain Management Professionals (CSCMP) reached a mixed conclusion: although demand creation was regarded as part of SCM, there is still doubt on to what extent marketing and sales should be included in SCM [9]. Thus, the final wording the CSCMP has chosen as SCM definition did not include the expression "demand creation". Despite current fine grain terminology and definitions do not still clearly include generating demand as part of SCM, the integration and coordination between marketing and logistics is increasingly being recognized as an important organizational capability [10] [11]. Thus, the SCM debate should include, either as a central or peripheral issue, how demand is created.

The management of material and informational flows is the most usual concern in SCM research texts. Regarding material flows, discussions revolve around issues like purchasing, remanufacturing, recycling, transportation and stock replenishment processes along the chain. Research on information flow is usually focused on information about demand and its propagation along the chain, studying for instance the bullwhip effect [12] [13], quick response and e-commerce. Managing financial flows in turn, although present in some studies, like in the research on supply chain coordination with contracts [14] [15], has received much less attention.

But in order to understand how demand is created, SCM should deal with one more flow: besides goods and services, order information and financial flows, it has to pay attention to technological knowledge and information flows. To date, knowledge flows in SCM has mainly been studied in product development, or taking a broader perspective, as sets of integrated competences to deliver products and services. Here a different focus is taken, looking at the role of technological knowledge and information flows on creating demand. Customers have to be made aware about new developments to be familiar with and to consume them. Further, they have to fully understand new features, applications and limitations of new products and services, otherwise they may be improperly utilized or consumed, causing complaints and poor product image. Products in that situation are doomed to fail. This is particularly critical in highly specialized and technology-driven markets, where products and services have high technology content and consumers are very knowledgeable and demanding. In those situations, there must be a SCM specific effort to ensure that proper technological information flows to the market.

This paper explores how companies within an industry where the management of technology knowledge and information is critical on demand creation: the health care industry, and more specifically, pharmaceutical companies. Using a field data from four large companies, this paper explores how they build specific channels to ensure that the market, or to be more precise, the decision makers, fully understand the features of new products.

3. KNOWLEDGE AND INFORMATION FLOWS IN HEALTH CARE SUPPLY CHAIN

Health care is the largest sector of the US economy [16] with total expenditures approaching 15% of the GDP,

making the US one of the countries with the highest expenditures in health care in the world [17]. As for Brazil, total expenditures in health care, including government, private companies and individuals, reaches about 8,2% of the GNP [18].

The health care value chain has been already studied by some researchers. For instance, Burns et al. [19] argue that the US health care value chain is composed by five main elements: 1) purchasers: the government, employers, individuals and employer coalitions; 2) fiscal intermediaries: insurers, HMO's and pharmacy benefit management companies, 3) providers: hospitals, physicians, integrated delivery networks and pharmacies; 4) product intermediaries: wholesalers, mail order distributors and group purchasing organizations; and finally 5) producers: pharmaceutical and biotechnology manufacturers, medical device makers, medical suppliers and information technology firms.

The health care chain possesses some particular features. Among them, Porter and Teisberg [20] list: its high complexity, the problem related to the fact that the customer, in this case the patient, does not fully understand the medical practice, its highly customized nature and the fact that most of the costs are paid by insurance companies or the government. Specifically related to pharmaceutical companies, Northrup [21] remembers that in those companies, unlike industrial enterprises where the bulk of the resources are spent to build the tangible infrastructure, most of the financial resources are applied in intangibles such as intellectual capital (R&D) and marketing investments like communication to health care providers and patients.

The health care supply chain can be conceptualized as composed by six main actors: (a) Health product suppliers: manufacturing companies, including pharmaceutical and biotech companies, equipment suppliers and health-related product suppliers; (b) Health service suppliers: service providers, hospitals, clinics and professionals, diagnostic service providers, prevention and rehabilitation services providers; (c) Health product distributors: gross distributors and retail companies, like drug distributors, pharmacies and drugstores, non prescription drug retailers, and hospitals, clinics and health care companies; (d) Financial dealers: financial companies, including insurance companies and medicare companies; (e) Institutional clients: those that buy products and services from the above companies – the government, private companies and individuals and (f) Consumers: those that are the final users of the health products and services.

Many authors stress the main role R&D play in the pharmaceutical (e.g.: [16] [21]) and biotech industries (e.g.: [22] [23]). Only 2 or 3% of the research projects end up as commercial products and the development phase can take up 10 to 15 years. Therefore developing and selling pharmaceuticals is characterized by high sunk costs and risk and long payback time [21]. Also, since patents are deposited when new molecules are developed, and the further development and trials can take up to 10 years, there is usually a short window to pharmaceutical companies to explore the market as a monopoly, setting premium prices to pay for their high development costs. Thus, they cannot afford to be ineffective in communicating new developments and products to the market.

Azoulay [24] argues that drug advertising may perform an important informative function. In fact, US pharmaceutical companies have been aggressively investing in direct-to-consumer (DTC) advertising since 1977, when drug advertising regulations were relaxed [16]. However, that is

not true for the Brazilian pharmaceutical industry, where, advertising prescription drugs to final customers is forbidden, it is only allowed in specialized journals and magazines aimed to physicians, pharmacists and dentists. Control over advertising prescription drugs is enforced by the Federal government through Anvisa [25], the Brazilian equivalent to the US Food and Drug Administration (FDA). Therefore, there are legal constraints to the pharmaceutical information flow which limits the knowledge flow between pharmaceutical companies and consumers, which make physicians even more critical to demand creation.

4. FIELD RESEARCH

To understand how pharmaceutical companies manage technological information flow, a qualitative study was designed. One of the authors has been in contact with several professionals working in pharmaceutical industries for at least three years, and has been discussing issues related to the supply chain management in those industries. That was the first approach to the problem, and was instrumental to give a first understanding of the problem, to delimit the study and to guide the data collection. Four professionals from four different companies were selected for interviewing, according to their relevance to the study. Interviews were conducted between December 2006 to March 2007, lasted from 1h00 to 1h30 and were fully tape recorded. Interviews were later transcribed verbatim and analyzed. Also during interviews documents were collected that helped the analysis.

4.1. Company A

Company A is a large North American pharmaceutical company, with offices around the World. It produces ethical and non-prescription medicines and, like other large pharmaceutical companies, invests heavily on R&D. Its research focuses are on small molecules and biotech. To manage its contact with physicians, company A starts at the pre-launch stage, when the medicine is still in its final clinical trials (phase III trials, to be later explained). During the pre-launch stage, the sales team is formed, composed by sales representatives, usually professionals with a business management or a marketing background. It is important to note that to pharmaceutical companies, each product line (a group of related drugs) is usually a business unit, with its own marketing and sales force. Besides the Marketing and Sales team, each product line has a Physician Relations Manager (PRM). The PRM, a physician himself, is in charge of visiting main clients, like hospitals purchasing departments, physicians, pharmacists and nurses, to discuss about specific characteristics of company A's product. As a physician, the PRM is regarded by his clients, his peers, as a valid discussant, and thus, able to argue using proper language, arguments and within professional norms. Another very important role of the PRM is to identify Key Opinion Leaders (KOL's), professionals with high credibility, who are regarded by their peers as authorities within the field. They are usually professors from the best Med schools and chief physicians from the most respected hospitals. The PRM pays special attention to keep the KOL's well informed about company A new product. After the pre-launch phase, if the drug successfully completes the final trials, is made available to the market through a launch phase. Then a new phase is put into action, the continuous marketing effort, where the sales force and the PRM keep their routine of visiting clients and KOL's. The effectiveness of those communication efforts is very hard to measure and usually

the only quantitative measure that is followed are the drug total sales.

4.2. Company B

Company B is a large European pharmaceutical company, one of the leading enterprises in the industry. Most of the effort company B undertakes to communicate with physicians is similar to the efforts of company A. In fact, it seems that pharmaceutical companies develop very similar market efforts: each product line is a business unit with its own sales force and market strategy. As company A, company B also has a PRM, a physician who manages the communication efforts with physicians. Unlike company A, company B's PRM had a more active role in managing drug clinical trials performed within the country. However, as performing both activities started to be an excessive load, company B has recently split the duties in two different functions, and the PRM will be responsible for only physician communication.

Likewise company A, company B starts its marketing efforts during the final drug clinical trials (phase III trials), starting the pre-launch phase, forming the sales team and developing all communication materials. Again, the PRM central role is to identify and keep in close touch with the KOL's, who act as true gatekeepers to physicians. To company B, KOL's are well-known physicians, usually with several published research papers, chief doctors at well-respected private and public hospitals and chief doctors at large hospitals with high purchasing volumes. The relationship with KOL's includes supporting them to attend professional conferences and workshops, and research funding. But all funding is delivered within legal regulations and strict ethical norms, since company B is very concerned about its public image. In fact, company B has developed its own Marketing and Sales Ethic Code, which regulates all relationship between company B and physicians. Again likewise company A, company B develops a continuous marketing strategy after the drug launching, and measures the effectiveness of its efforts by the drug total sales.

4.3. Company C

Company C is a large North American pharmaceutical company, one of the leading enterprises in the global industry. Company C classifies its products according to two dimensions: position in the product life cycle (innovative and regular drugs) and market (niche or general application drugs). Innovative drugs are those still in the first phases of their life cycles (i.e., launch, market growth and the first stage of maturity). Regular drugs in turn are those within the last phases of their life cycles (final stage of maturity and phasing-out). Regular drugs are managed as consumer products, may suffer competition from generic drugs and the manufacturing of some of them may be even outsourced. As for markets, niche drugs are those developed to specific applications, like oncology or low volume markets, and those developed to the institutional market (hospitals). General application drugs are those used for instance in cardiovascular or neurological diseases.

Marketing and new product managers are in charge of all communication efforts of each drug. They are organized according to each product life cycle position and market. PRM's support those managers, especially during the drug launch phase and in all relationship with physicians, where they assume a leading role. A central task in physician

relationship efforts are, as in companies A and B, the identification of KOL's.

Physician relationship is managed in a very similar way as in Companies A and B, where conferences play an important role. Also, Company C keeps a technological information survey service, which sends periodical reports to PRM's, who in turn contact KOL's. Those reports also are used when other physicians ask questions to Company C.

Communication during the pre-launch, launch and continuous marketing phases are similar to Companies A and B. Additionally, Company C stressed the role of academic and research literature even before the pre-launch phase, which can be compared to a subliminal pre-launch effort.

During the initial stages of an innovative drug life cycle, Company C also uses an Advisory Board: a group of researchers and physicians, who periodically discuss issues related to that drug. An Advisory Board for a cholesterol reduction drug may be composed by cardiologists and physicians who research on the fields like hypertension and hyperlipemia.

Company C also stressed the importance of the pharmacovigilance process, which tracks drug side effects. Although this process is present since the drug development stage, it is during the commercial phase that it becomes critical, since there is no control over drug administration: during clinical trials, pharmaceutical companies strictly control how medication is given to patients, but after its commercial launch, they no longer have that control, which stays within the physician-patient relationship.

4.4. Company D

Company D is a large European pharmaceutical company. The Sales and Marketing department is organized according to families of drugs. This organizational structure is similar to what was found in Companies A, B and C. Sales managers (one to each drug family) are in charge of drug information flows. PRM's help sales managers, especially during the launch phase and the communication process with physicians.

Following a new marketing effort, Company D has been adopting a market segmentation approach. To Company D, clients are everyone or every company and organization that keep any relationship, even non commercial ones, with it. Therefore, market segments include regular clients (physicians, nurses, hospitals and clinics, drug distributors, drug stores, the government), as well as other stakeholders like the regulatory agency (ANVISA), health care related NGO's, etc. Company D's goal is to achieve a holistic perspective, or as they say, "a 360° view of the client", that crosses all functional departments. The implementation of a CRM system is considered as a corner stone to reach that goal, since it makes possible to centralize and coordinate all client-related information.

The communication process is very similar to that used by Companies A, B and C (pre-launch, launch and continuous marketing phases). Advisory Boards are adopted during pre-launch and launch phases. Relationship with physicians is kept by visits, letters, email marketing and a magazine aimed to physicians, which is very well known among them. Giving financial support to attend conferences and to deliver lectures about its new products is also Company D's practice, especially during pre-launch and launch phases. Additionally, Company D's keeps also an information delivery program directed to patients.

Physicians enroll their patients in the program, which delivers information on correct use of drugs and other issues related to their use (proper diet, preventive actions, etc).

Physician communication efforts effectiveness is assessed by sales representatives' visits and through market research (conducted by Company D or by independent market research firms).

5. DISCUSSION

Cases reveal a similar communication pattern between pharmaceutical companies and physicians, which happens in parallel with the development, commercialization and product monitoring phases. It is worth noting that the product development process of pharmaceutical companies is very peculiar. Northrup [21] identifies three phases: (1) discovery, composed by target identification, target validation, lead generation and lead optimization; (2) development, composed by preclinical development, phase I, phase II, phase III and submit; (3) product commercialization, composed by global launch and global optimization. Pisano [23] presents a similar process, composed by seven steps: target identification, target validation, lead generation, lead optimization, preclinical development, phase I, phase II and phase III tests, and regulatory approval. During the interviews, PMR's also mentioned phase IIIb phase IV tests, which include post-launch clinical trials. Phases IIIb and IV can be used for additional safety studies or to validate new therapeutic applications for the drug. Figure 1 depicts typical R&D, product commercialization and product monitoring (or pharmacovigilance) processes in pharmaceutical companies, including the communication (or marketing) steps adopted by companies A, B, C and D.

All researched companies organize their development, marketing and sales departments by drug families. Sales managers are in charge of drug's information flows. PMR's support sales managers, especially during the pre-launch and launch phases, and also in supporting the communication process with physicians.

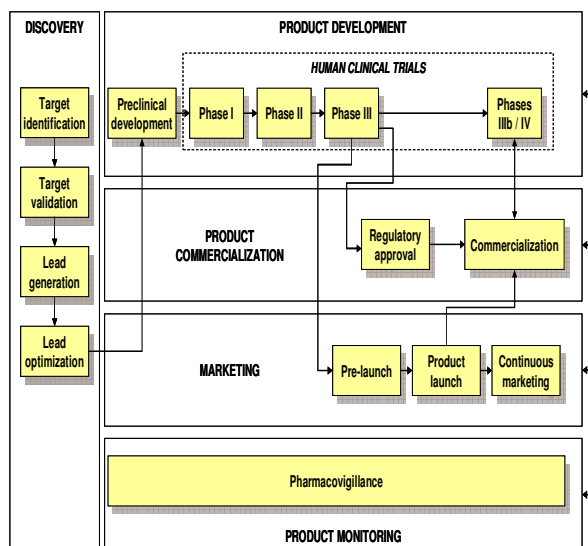


Figure 1: Discovery, R&D, product commercialization, marketing and product monitoring processes in pharmaceutical companies

The main channels pharmaceutical companies use to keep technological information flows to physicians are: the Advisory Board during the pre-launch and launch phases,

close contact with KOL's, by sending research papers to receive feedback, funding to lecture or just to participate in conferences. Also, as a broader approach, they produce and distribute magazines and use email-marketing aimed to physicians. Also the sales representatives' periodic visits to physicians help to keep them well informed.

In the ethical drugs market, keep good relationship with physicians is crucial, since they are the agents who create drug demand. Figure 2 depicts the demand creation path and the material flow path (for the sake of simplicity, distribution channels are reduced only to the large drugstores chains). Sell-in represents the product inflow to drugstores, and sell-out the product outflow to patients. Drugstore inventories account for the difference between sell-in and sell-out, and the ratio sell-in/sell-out for the effectiveness of inventory management. But in the case of ethical drugs, there is another key indicator: the ratio prescription/sell-out, which accounts for the proportion of the demand generated by physicians that is actually converted into sales to patients. A ratio under 100% may happen because the prescribed drug is not found by the patient at the drugstore due to, for instance, stocking-out. Thus, the effectiveness of the effort to manage knowledge and information flows to physicians depends on the effectiveness of the logistic processes. In the pharmaceutical business, knowledge and information flows, logistic processes (including order information and material flows management) and financial flow are intimately connected.

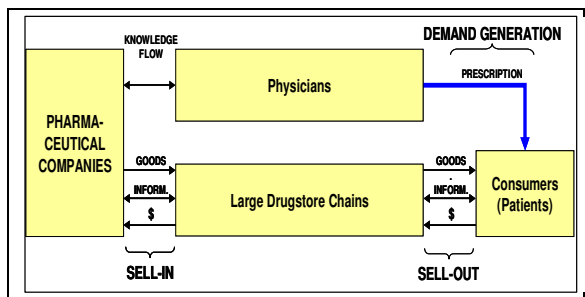


Figure 2: Sell-in, sell-out and demand generation in the pharmaceutical industry

6. CONCLUSION

Pharmaceutical companies have developed structured and controlled communication processes, since they are fundamental to their revenues. Communications processes to physicians are very similar and composed by three phases: pre-launch, product launch and continuous marketing. Those phases mirror the product development phases, they are connected to them, but are also regulated by legal constraints and federal regulations. Since regulations are different from country to country, it is thus expected that communication efforts also present differences from country to country. As already stated, there are legal restrictions on advertising of health products to final consumers in Brazil. Thus, knowledge and information flows are targeted to organizations like hospitals and clinics, and physicians, pharmacists and chief nurses. Among those, the Key Opinion Leaders (KOL's) are regarded as the most important ones.

The way those companies structure their supply chains clearly reinforces the importance of knowledge and information flows. Pharmaceutical companies supply chain is composed by the pharmaceutical companies, their suppliers to upstream, and to downstream, distributors,

retailers, institutional clients and customers. Figure 3 represents the supply chain and the four flows: drugs and services, demand information, financial resources and technological related information.

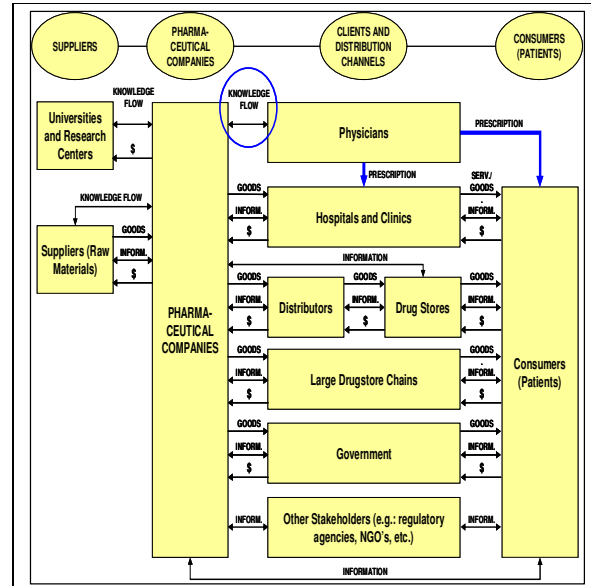


Figure 3: Example of a pharmaceutical supply chain of prescription drugs

Figure 3 emphasizes the role of pharmaceutical companies, thus secondary linkages are not represented. Also, it only depicts ethical drug flows. Non prescription drugs flow a different flow, akin to consumer goods. Figure 3 highlights how knowledge and information flows to physicians are central to manage ethical drug demand to final consumers. It depicts how physicians create ethical drugs demand by both prescribing them to their patients or those under their care in hospitals and clinics. There are some particular cases, as to one of Company B's products, where to physician is himself the client, since he owns the health care clinic that buys the drug to latter dispense it to his patients.

This research stresses the importance of a holistic perspective in supply chain management. It demonstrates the role of technological knowledge and information on demand creation. It also emphasizes the need to keep technological knowledge and information, order information, material and financial flows integrated and properly aligned. The effective integrated management of those four flows is directly related to the success in the pharmaceutical business, and especially in the ethical drug market.

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