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Competing on Information: An Exploration of Concepts

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Competing on Information: An Exploration of Concepts

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Abstract

In the literature for strategic management a number of authors have explained in which ways information and communication technology (ICT) is being deployed in the strategy of the firm. In management books and articles in management journals a variety of cases have been described how specific firms deploy ICT but increasingly information, in their strategy. A number of authors have proposed conceptual frameworks for new strategies enabled by the deployment of ICT, but less so due to the changing nature of information and the exploitation of information. Both for educational purposes and for transferring insights gained from leading firms to other firms in a reliable and comprehensive way a conceptual framework is needed to understand new strategies, especially those based on competing on information and information superiority. This paper explores the different concept of information in relation to a strategic deployment of information. The strategic deployment of ICT can be explained in the concepts of industrial organization as the underlying theory of strategy. The strategic deployment of information partly fits into traditional concepts, but also questions traditional concept of strategy. Also the lower costs of information and communication make corporate strategy and some aspects of business strategy converge, whereas other aspects of business strategy converge with operations. The higher transparency in markets due to lower costs of information and communication forces firms to shift their strategies from the conduct level to the structure level to create and maintain market power. Especially information overload and mediation of goods and services create strategies outside the scope of traditional strategies. The increased role of information in marketing, sales and the customer value proposition and the increased volatility in consumer preferences require firms to create some form of information superiority, that is the capability to acquire, record, store, retrieve, interpret information and turn this into product and price differentiation and adjusted customer value propositions. The attempt to understand the various roles of information in firm's strategies reveals that the field of strategy lacks a coherent theory.

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1. Introduction

1.1. Which roles information plays in the firm's competitive strategy?

The decreasing costs of information and communication, the ubiquitous nature of digital technology, the Internet and the intensive use by consumers, businesses, governments and other institutions of interconnected digital devices are fundamentally changing markets, strategies, business models and organizations. There is no lack of publications on the opportunities, threats and sometimes dilemma's related to all these changes. Many are the publications on e-commerce, new (e)business models, implications for management and organization and also the field of industrial organization produces insightful analysis of how markets change by structure, working and efficiency as the result of the decreasing costs of information. The Internet and especially the social media are changing the balance of power between suppliers and consumers. The decreasing costs of information make markets more transparent forcing firms to create market power in new ways in order to be profitable.

Virtual all firms have a presence on the Internet in some or other way, many relate with their suppliers, customers and those with a general interest in the firm, using the Internet, including social media. Digital technology has transformed industries like airline reservations, book selling, the music industry. Many other industries, also those with non-information goods, are in a process of being transformed by the Internet and the increasing roles of information. Virtual no business or industry remains untouched, even not traditional industries and firms, by digital technology the Internet and the declining costs of information and communication.

At the same time many firms are wrestling with their IT-costs, with the quality of information in their organization, finding it difficult to calculate a business case for their IT investments whilst at the same time suffering poor quality of information and insufficient capacity to process information. In 2000 Evans & Wurster mentioned that one-third of the cost of health care in the United States—then some \$ 350 billion—consisted of the costs of capturing, storing, processing, and retrieving information (Evans & Wurster 2000:9). There are no signs this is different today. In 2003 Brynjolfsson & Hitt reported a significant contribution of computerization to productivity and output growth, be it that this appeared to be codependent on complementary

investments in organization capital. From as early as the eighties various cases are reported how firm deploy ICT not only to create efficiencies and operations that can be scaled up in an efficient way to achieve growth, but for strategic reasons. ICT is being used to increase or defend market share by creating switching costs and to create other forms of market power for sustainable profit. The combination of digital technology, the Internet and the emergence of information goods opens up new opportunities for pricing tactics. The Internet itself, through ecommerce opens up new opportunities for distribution and entering new markets or enlarging existing markets. The Internet changes search behavior of consumers as well that of professional purchasers, especially reducing or eliminating the information asymmetry between supplier and consumer. The information on specific consumer preferences and need for specific information has become for a number of firms a key resource in their production function. Which makes information a strategic issue.

It seems to be the case that whereas initially ICT was deployed in a strategic way, now it is information itself being deployed so, apart from the fact that information is changing the strategic environment of the firm. Therefore in this paper a sharp distinction is being made between information technology and information. Information technology serves to capture, record, store, retrieve and communicate *data*. Information is a different phenomenon, which certainly is supported by data processing technologies, but information also requires organization and purpose and creating and processing information is a human and a social event.

These developments raise the question which roles information plays or should play in the competitive strategy of the firm.

Many firms still manage their IT-investments based on total-costs-of-ownership, whereas firms like Wal-Mart and others make a return on their investments in IT-systems (Brynjolfsson & Hitt 2003). Why is it that many who have to make decisions on IT-architecture and software applications still do so on basis of the Business-IT-Alignment Paradigm (Henderson & Venkatraman 1993), whereas others use the digital technology and the Internet to transform their business, to reinvent their businesses and their organizations deploying ICT? In the Business-IT-Alignment Paradigm, which dates back to the seventies, ICT mainly is used to *mechanize* existing processes for reasons of efficiency and scalability.

This paper explores the hypothesis that there is an economy of two velocities, the advanced firms like Wal-Mart and IBM, typical Internet firms like Google on one hand and on the other hand

many firms wrestling with their organization, ICT and market position. It is hypothesized that this economy of two velocities is due to the lack of understanding of the true nature of information and of its changing roles in business, the economy and in society. Most people have an intuitive understanding of these changing roles of information, not in the least because virtual all working in business use laptops, the Internet, a variety of digital devices and social media. However, when thinking about how to use information, what new opportunities are to be considered, it seems that many let themselves be guided by concepts from an era in which information was of a different role and nature. The question is to be asked is, given that all concepts in business have limited validity and are based on non-stable assumptions, which of the familiar business concepts, and in which degree, are affected by the declining costs of information.

An example is the unit-organization (formal: M-form). This organization form according to e.g. Williamson (Roberts 2004; Williamson 1985) is the most successful organization form of the twentieth century. In hindsight it appears that this organization form was an answer, when it was introduced in the first quarter of the twentieth century by DuPont and General Motors, to the then high costs of information and communication (Stinchcombe 1990). And indeed, since the costs of information and communications are coming down, through the vehicles of e.g. shared service centers and corporate account management the unit-organization is in a process of being abandoned. If organizational concepts are being changed due to the declining costs of information and communication, is it to be expected that strategy, be it corporate strategy or business strategy is being changed in a comparable way?

A number of authors have addressed how firms pursue new and different strategies based on ICT, digital technology, the Internet and cheap and abundant information, e.g. Evans & Walker in their *Blown to Bits* (2000), Tapscott *et al.* in their *Digital Capital* (2000) and De Kuijper in her *Profit Power Economics*. As early as in 1985 Porter published his HBR article *How information gives you competitive advantage* (1985) and more recent is his *Strategy and the Internet* (2001). Despite an unremitting flow of publications on e-business and their strategies, no systematic conceptualization exists on the roles of information with respect to the development of firm strategies. Tapscott has proposed a B-Web Typology (Tapscott, Ticoll, & Lowy 2000:28) like Evans & Schmalensee have proposed a typology of catalysts in two sided (digital) markets (Evans & Schmalensee 2007:7) and Weill & Vitale a typology for e-business models (Weill & Vitale 2001).

The question is to be raised why not simply published examples are sufficient to transfer knowledge to non-leading firms on how to deploy ICT and information in their strategies. After all,

in the twentieth century an important factor in economic growth was the mimicking of strategies, organization forms and operational processes of innovating, successful firms. This could be successful, probably until somewhere in the eighties because economic models or business models were not very differentiated and resources exploited mainly were physical resources. Also, apart from experimenting a limited number of alternative organization forms, e.g. the unit form or M-form, competitive innovation concentrated itself on products and processes, not as is presently developing, business models, including revenue models. So most likely in today's economy mimicking what is visible at the surface might be a risk without a deeper understanding of what economic principles are underlying a successful business model. Also, when the application of ICT an information is innovating the concepts of strategy itself, a deeper understanding of their theoretical foundations is needed (Grant 2008). Therefore it will be necessary to attempt the published examples of firms deploying ICT and information in their strategies, to understand at a deeper, theoretical level. It is assumed that the main theory underlying strategic management is industrial economics or industrial organization (Besanko, Dranove, Shanley, & Schaefer 2004), to which should be added the resource based view of the firm (Collis & Montgomery 1997; Penrose 2009).

1.2 Competing on information defined

Following Porter (Porter 1985) competing on information can be defined as using information (as an explicit and major factor) to create and maintain a defendable profitable position in the market. This applies as well to traditional goods and services, e.g. real estate, production equipment, consumer goods, as to information goods. Porter (2001) suggests that the Internet and digital technology do not really change the idea of competitive advantage. Defined in an abstract way, the new technologies don't. But the Internet and digital technologies meanwhile do change industries fundamentally, change consumer markets, power relations etc. To achieve and maintain a competitive advantage in the information economy requires quite different tactics, capabilities and resources as was the case in the industrial economy.

Competing on information needs to be distinguished from two related areas of competition. The first is competing with information technology. Originally information technology was deployed to mechanize with digital computers especially the recording and processing of transactions, allowing the financial industry to develop large scale payments systems. Also through computer

systems for materials resource planning (MRP II) firms achieved efficiencies in resource planning, materials management, and coordination with suppliers. Combined with the advances of (digital) telecommunications firms got access to low wage countries whilst maintaining an efficient coordination of their overall supply chain (Pavitt & Steinmueller 2002) .

Second, competing on information needs to be distinguished from competing in the information industry or competing for the information industry, as this has been documented e.g. by Brock (2003) in his *The Second Information Revolution*, Chandler & Cortadas' *A Nation Transformed by Information: How Information Has Shaped the United States from Colonial Times to the Present* and Wu's *The Master Switch* (Wu 2010).

In section 2 of the paper the traditional roles of information in competition are explained, in section 3 the changing nature of information is explained, including Arrow's information based view of the firm, in section 4 new strategies due to the vanishing costs of information, information good and the increasing interactivity are explained. In section 5 is it explained what it requires in the organization to achieve information superiority as needed for competing on information. In section six seven levels of competing are proposed.

2. The role of information in traditional strategy

To understand the changing role of information in competition we need to understand and to appreciate the role of information in traditional competition. The role of information in competition, or specific information asymmetry or limited information, always has been acknowledged in the field of industrial organization. It has always been acknowledged that the law of supply and demand and the law of a single price do not hold in markets with limited information (Carlton & Perloff 2000:421). Also in welfare economics asymmetric information or imperfect information plays an important role (Nelson & Winter 1982:358-365). Information asymmetry by some is seen as a source of market imperfection and those are looking for removing this asymmetry to have perfect markets. But: "The strategizing firm, looking out for entrepreneurial opportunities, lives with the bounded nature of its knowledge of the economic system and turns 'information

asymmetry' into a source of entrepreneurial discovery and entrepreneurial action" (Mathews 2006:29).

To understand what roles information traditionally has played in firm's strategies and how these roles develop and transform over time, we need some analytic scheme in which to plot various phenomena in the economy with respect to the role of information. We will propose such an analytic scheme but we have to be aware that such a scheme itself may be invalidated or be short sighted to capture new developments. True learning is the acknowledgement that new phenomena do not fit into existing schemes of thinking and that these schemes need to be redefined. "The critical limitation of theory-based approaches to strategy/policy teaching is that, despite the advances of the past two decades, our level of theoretical and empirical knowledge remains limited. The danger is that we restrict the scope of our strategy just to those phenomena and influences where we have well-developed theories to guide us." (Grant 2008)

We need to make a distinction between types of strategy (e.g. portfolio strategy, low cost strategy) and levels of strategy (e.g. conduct level, corporate level). With respect to levels of strategy a matrix will be used comprised of the levels in the SCP-paradigm of industrial organization and distinction between corporate strategy, business strategy and functional strategies from the field of strategic management (Johnson, Scholes, & Whittington 2005; Wit & Meyer 1998). The SCP-paradigm (Carlton & Perloff 2000:4; Linstead 2004:7; Lipczynski & Wilson 2001:7; Waldman & Jensen 2001:7) is not without criticism or problems (Lipczynski & Wilson:171-179). Nevertheless with care it can be used to explore the use of information in competition of firms. Therefore to develop a comprehensive understanding how ICT, respectively information is deployed in strategies, a matrix will be used as in Table 1.

To table 1 a different dimension of alternative strategies can be distinguished; that of models of strategy. The five forces model, the core competences model, the dynamic capabilities model, the game model and the competing on the edge model constitute a different dimension which is not completely independent from, nor overlaps with the dimensions in table 1.

Another dimension to plot the role of information or the impact of its growth, could be that of strategic thinking, strategic analysis, strategy conceptualization, strategic planning and strategy implementation. For practical situations this may be helpful, but in each of those phases, the concepts and levels as depicted in table 1 need to be used.

As we will see a distinction needs to be made between the deployment of ICT in strategy and that of information. A first question should be if and to what extent ICT respectively

information is being deployed to perform various existing alternative strategies at various levels, respectively in what way ICT either strengthens or weakens those strategies, fundamentally changes those strategies or creates new strategies.

Table 1. A matrix to identify levels of strategy for the firm

	Grand Strategy	Corporate Strategy	Business Strategy	Functional Strategy
	External control Market power Relationship with governments, legislators (public affairs) Reputation with the public	Corporate Finance Portfolio strategy (market entry, exit) Internationalization Parenting value (synergies) Mergers & Acquisitions	Product positioning (defending market position) Branding/marketing Market(share) growth Pricing Distribution Profit model / business model innovation Value chain	Human resources Organization strategy Finance / accounting Information Marketing / distribution Manufacturing Logistics
Basic Conditions <i>Demand Conditions:</i> Price elasticity Substitutes Market growth Type of good Method of Purchase Lumpiness of order Seasonality Location <i>Supply Conditions</i> Technology Raw Materials Unionization Product durability Location Scale economies Scope economies				
Market Structure Industry concentration (suppliers, customers) Numbers of buyers and sellers Type of rivalry Barriers to entry and exit Distribution structure Contestability of markets Standards Product differentiation Vertical integration Diversification Cost structures	Competing <i>for</i> markets	Finance strategy Resource strategies		
Conduct Pricing strategies Advertising Product strategies Research & development Production investment Collusion Mergers Legal strategies			Competing <i>in</i> markets	Efficiency Creating new options
Performance Production efficiency Allocative efficiency Equity Product and service quality Technical progress Profits				

2.1. Imperfect information

The traditional rule in industrial organization is that with imperfect consumer information about price, perfect competition is impossible. Information asymmetry between supplier and customer and limited information on prices, product quality and availability in traditional markets was induced by high costs of information, and especially high costs of communication, limited speed of communication and limited capacity of communication channels. The introduction of the railway system in combination with the telegraph system in the United States in the nineteenth century create large markets and thus increased the size of firms (Chandler 1962). The railway system lowered the costs of transportation, and the telegraph made possible the communication of prices and available quantity of goods over a long distance at the speed of light. But in hindsight both still were limited in especially capacity of information transported.

This limitation of information, communication and transportation made it possible to segment markets by geography and by distribution channel, also because most goods were physical goods with volume, mass and weight and therefore carried transportation costs. The latter implied that the four flows in a transaction, the information flow, the value flow, the goods flow and the title flow, occurred at the same time and at the same place. Be it that the introduction of e.g. catalogues for non-food retail goods by Sears, separated the information flow from the other three flows.

Also for non-physical goods information asymmetry played an important role. Financial markets (and most other trading markets) are not efficient because of imperfect availability of information. Competitive advantage in the financial industry therefore was dependent on superior access to information (Grant 2002:242).

2.2. Advertising as information

With respect to the information flow between supplier and customer the main techniques deployed in the traditional economy was market research and marketing/advertising. Market research was conducted by specialized agencies through a variety of techniques, like demographic analysis, surveys, consumer panels etc. The acquisition of information on consumer preferences, to discover reservation prices of consumers, over the years increased by frequency and intensity as markets shifted from product push to consumer pull, also due to a growing overcapacity in production. The increase of wealth, education, demographic changes, the role of the media culture implied a differentiation in consumer tastes on which suppliers needed increasingly detailed

information to feed their competitive strategies expressed in product (differentiation, positioning), placing of products, pricing and promotion (Belleflamme & Peitz:107).

In marketing and advertising a distinction used to be made between informative advertising and persuasive advertising (Lipczynski & Wilson:199). Informative advertising informs the consumer on product quality, usually in terms of use value, availability and price (Stigler 1961). Persuasive advertising is aimed at changing the preference and price elasticity of the consumer by expressing a product or service not so much in use value, but more in social values like hedonistic values and other non-price attributes. Both types of advertising are a one-way flow of information from the supplier to the consumer. Advertising, especially persuasive advertising, can be used to incur entry barriers, as e.g. in the case of Kellogg Cornflakes in the eighties of the twentieth century. A new entry to gain attention from the customer for a competing product may need to invest such a high sum in advertising that this is prohibitive.

Be it not so explicit under the label of information, information always has played an important role in competition to maintain intransparent markets, segmented markets, to limit information available to consumers, by have privileged information on consumer preferences and to manipulate consumer preferences.

2.3. First application of ICT in competition

Understandably with the emergence of computers and lowering costs of communication firms have sought to deploy those technologies to lower the costs of information in their competitive strategies, respectively to use computer technology deliberately in their strategy. As early as in 1970 United Airlines and American Airlines installed the computer based airline reservation systems Apollo and SABRE. American Airlines used SABRE, by offering its services to other parties, to create itself a competitive advantage in its industry, by coding the system such that its offerings were displayed with priority (which in a later period per force was removed). American Hospital Suppliers extended its computer system into the organization of its customers, hospitals, by placing computer terminals in the hospitals, thus saving hospitals costs on ordering and inventory management, but increasing in this way also switching costs (Porter & Millar 1985).

2.4. Information technology and industry structure

The computer technology and the decreasing costs of communication also changed the structure of industries. The music industry has been changed dramatically, as has the distribution of books, the sales of holidays, second hand cars. Total Quality Management produced a better specification of processes (including measurement of sub-process performance), industry standards for components and interfaces shifted from proprietary to open standards, ICT improved market efficiency, resulting in a deverticalization of firms, supporting a low cost strategy. This deverticalization created an industry of parts and component suppliers, which in a number of cases resulted in lower entry barriers. In the nineties the Dutch market for mortgages, a profitable market, was known for its high entry barriers for foreign mortgage firms. The establishment of a specialized firm for mortgage administration, to which original vertical integrated mortgage firms (mostly banks) outsourced back office processes, created an opening, deftly used, for foreign entry to the Dutch mortgage market.

Companies like Wal-Mart, Cisco and Dell, like many others use Web based information systems to reduce the costs of coordination between the company and its customers and the company and its suppliers (Hill & Jones 2010:123). With respect to the suppliers they do so to increase their bargaining power, resulting in lower prices from their suppliers. Walmart was one of the first retailers to make *strategic investments* in the complementary, co-specialized combination of distribution centers and information systems, which lowered the costs of managing inventory (Hill & Jones 2010:7).

2.5. Information technology and disintermediation

Dell often is referred to as the case in which Web based information technology is used to change the structure of its industry by eliminating the distribution: Dell's direct selling model. It also is often depicted as a paradigm example of a new business model induced by Web based information technology. Disintermediation is an essential element in Dell's business model, but perhaps more is the tactics of mix-match flexibility through the deployment of modular products (the PC's open architecture) and a well defined customer interface. Other examples of new business models based on the Internet are Amazon, eBay etc. (Tapscott, Ticoll, & Lowy 2000). ING Direct is an example from the financial industry of a successful Web-based strategy (although at the level of its parent this case is not without problems).

2.6. Information technology and pricing tactics

The Internet also has changed the pricing tactics of firms. In first-degree pricing discrimination suppliers aim for setting different prices for individual customers, “market of one” based on personalized products (Dell), known customer behavior (price elasticity) or experimentation, in order to capture as much as possible of the consumer surplus (Varian, Farrell, & Shapiro 2004:13). Suppliers that have detailed information on the preferences of their customers can offer more personalized services to the customer that will be valued by the customer and thus will be able to charge more. But this model of competition not only assumes full information by the suppliers with respect to their customer, it also assumes that the supplier is able to differentiate its offerings without incurring costs. The fashion retailer Zara is a case in which a manufacturing strategy based on information technology is being used to enable a fast response to changes in consumer tastes (Hill & Jones 2010:85). A specific form of pricing differentiation is to be found with airline carriers. Most of them have developed pricing differentiation based on the number of days ticket are offered before departure and on basis of demand for tickets expressed in the rate of sales of tickets for a specific flight relative to the date of departure. We might label this time-demand based pricing differentiation (Piga & Filippi 2002).

The internet is also used to increase the old competition tactics of second-degree price discrimination. In this model the supplier has knowledge on the distribution of consumer tastes, e.g. based on income brackets, life style, or other demographic attributes, but has imperfect information about this distribution. This imperfection is addressed by offering a range of product versions, differing in functional quality and corresponding prices and then let the customer choose. A tactic first experimented, with success, by Alfred Sloan at General Motors (Sloan 1962/1986).

Especially information goods (software, stock prices, baseball scores, newspapers, movies, web pages etc.) lend themselves to low cost versioning (Picot, Reichwald, & Wigand 2008:303; Shapiro & Varian 1999:3).

2.7. Information technology and industry consolidation

The Internet and information technology also is used to consolidate a fragmented industry, e.g. in the case of eBay (auctions) and amazon.com (bookselling) by deploying a cost-leadership model in combination with a first-mover strategy near monopolizing the attention in their markets

to their websites (Hill & Jones 2010:180; Shapiro & Varian 1999:177). Another example of consolidation is in distribution of both used cars and new cars in the USA. Because buyers feel better informed on available cars, their quality and prices, buyers are prepared to travel over larger distances to close a deal. Subsequently car distributors could save costs by thinning the grid of showrooms and create larger, more efficient showrooms with a higher quality of customer offerings and services (Pine & Gilmore 1999).

2.8. Information technology and costs of organization

ICT, through e-mail and intranet helps to reduce coordination costs within an organization, both with respect to imposed coordination and self-coordination. A completely centralized organization has high costs due to poor information due to lack of co-location of decision rights and required information for that decision and lack of information processing capability, but it will have low costs due to inconsistent objectives. A completely decentralized organization has low costs due to lack of co-location of information and decision rights, but will have high costs due to inconsistent objectives and in the case of an organization with self-contained organized business units, high costs due to replication of identical generic processes like accounting and ICT (Jensen 1998:116). The decline of costs of information created in the nineties a tendency to centralize organizations especially with respect to functional departments. This conflicted with a growing need for market responsiveness and thus decentralized decision making with respect to resource allocation. A combination of lower costs of coordination due to ICT, improved specification of processes and their performance and L-type cost curves for services like ICT, financial accounting and such resulted in the deployment of shared service centers (Bangemann 2005; Strikwerda 2010).

The introduction of the shared service center afterwards turned out to be the first step of the deconstruction of the M-form, the most efficient organization form of the twentieth century. In hindsight the M-form, as conceived by Du Pont and further refined and deployed by Alfred Sloan at General Motors, turned out to be based on the high costs of information and communication and the slowness and limited capacity of the communication channels available in the first quart of the twentieth century (Stinchcombe 1990). Now these two restrictions, high costs of information and communication, and limitation in communication channels are lifted, new options for more efficient organization forms can be pursued.

Also the improved availability of information through the Internet and financial services in the market reduces the information asymmetry between shareholders and the executive board of a firm. Around 1990 this led to the requirements that executive boards demonstrated parenting value of a multi-business firm, that is the market value of the firm is more than the sum of the market values of its individual business as if stand alone businesses. Especially in firms with an unrelated portfolio this proved not to be the case hence a wave of break-ups and of down scoping of firms (Hoskisson & Hitt 1994).

2.9.Changes in the role of information in competition

So far it seems to be the case that information technology is used in competitive strategies based on well known insights from especially the field of industrial organization how to compete for profitability. We need to make a distinction between two categories of changes. The first is that forces that were relatively minor in the industrial economy turn out to be critical in the information economy. Second-order effects for industrial goods are often first-order effects for information goods (Varian, Farrell, & Shapiro 2004:3). Constant fixed costs and zero marginal costs are rarely observed for physical products, simply because it requires additional raw materials, energy and labor to produce an additional copy of the product. Information goods have as a base line constant fixed costs and zero marginal costs. Information is costly to *produce* but cheap to *reproduce*. The production of an information good involves *high fixed costs* but *low marginal costs* (Shapiro & Varian 1999:3).

Effects that were uncommon in the industrial economy—network effects, switching costs, and the like—are the norm in the information economy (Varian, Farrell, & Shapiro 2004:12). So the role of information in the economy is not new, at the contrary. What is new are the vanishing costs of information and of communication. This results in a number of effects in the economy (De Kuijper 2009:4):

1. Reduced search costs; manufacturers for knowledge, supplies, services, consumers for products and services
2. Global wage and price competition
3. Cheap and easy coordination of activities over distance, monitoring of people and processes over distances
4. The end of information asymmetries, between suppliers and customers, between investors and executives, within the organization of firms, etc.

5. Falling transaction costs, creating opportunities for deverticalization and outsourcing
6. Feasibility of intricate contracts and conditional deals between firms in a value network to absorb market uncertainties and risks

It is to be noted that the effects of the diminishing costs of information identified by De Kuijper are restricted to the conduct of firms. Other effects (e.g. consolidation), especially at the level of structure in the SCP-paradigm still need to be discussed.

The second category of changes that makes the information economy different from the industrial economy is that in the information economy information is an explicit production factor in the economy. Information always has played a role in the economy, in markets and in the working of firms. But compared to the traditional production factors like land, labor and capital, information implicitly was included in the residual factor in the neo-classical production function, including also technology and tacit knowledge. Information has been relatively late acknowledged as a production factor in economics (Picot, Reichwald, & Wigand 2008:67). Information used as a resource for the firm, in view of the resource based view (RBV) of the firm sets requirements to the firm for the acquisition of information as a resource, its ability to exploit information as a resource and to create a combination of scarcity, demand and appropriability to turn it into a valuable resource (Collis & Montgomery 1997). In recent studies and also national statistics, information capital is acknowledged, together with human capital and organization capital to constitute the intangible assets as being the basis of the value of the firm (Brynjolfsson, Hitt, & Yang 2002; van Ark, Hao, & Hulten 2009; van Rooijen-Horsten, van den Bergen, & Tanriseven 2008). To understand what roles information may play in the production function of the firm and its strategy and how this is to be accomplished, we first turn to the issue of the nature of information.

2.9 A tentative summary of the effects of information on traditional strategies

A tentative conclusion could be that prior to the year 2000 the use of information in strategy mainly was through the deployment of ICT, be it that in addition to this there is the emergence of information goods and the growth of e-commerce and the Internet. The various uses of ICT and digital technology in terms of strategy reasonably can be plotted in the traditional schema of strategic

management as depicted in table 1. Table 2 provides an overview of how ICT and digital technology can be expressed in traditional concepts of strategic management.

Table 2. Overview of main effects of ICT on strategy < 2000

	Grand Strategy	Corporate Strategy	Business Strategy	Functional Strategy
	External control Market power Relationship with governments, legislators (public affairs) Reputation with the public	Corporate Finance Portfolio strategy (market entry, exit) Internationalization Parenting value (synergies) Mergers & Acquisitions	Product positioning (defend market position) Branding/marketing Market(share) growth Pricing Distribution Profit model / business model innovation Value chain	Human resources Organization strategy Finance / accounting Information Marketing / distribution Manufacturing Logistics
Basic Conditions <i>Demand Conditions:</i> Price elasticity Substitutes Market growth Type of good Method of Purchase Lumpiness of order Seasonality Location <i>Supply Conditions</i> Technology Raw Materials Unionization Product durability Location Scale economies Scope economies	<i>Various changes with respect to basic conditions</i>	Need to deploy shared service centers Opportunities and need to exploit synergies L-type cost structures	Larger markets through the Internet Information goods e-commerce de-spatialization of demand Higher diversity in scale economies Increase of scope economies	
Market Structure Industry concentration (suppliers, customers) Numbers of buyers and sellers Type of rivalry Barriers to entry and exit Distribution structure Contestability of markets Standards Product differentiation Vertical integration Diversification Cost structures	Convergence of industries, increased relatedness of industries Fight for standards Horizontal competing Markets becoming more contestable	Higher pressure on producing parenting value: higher homogeneity of portfolio's Higher degree of de-verticalization	Choice of being an integrator or module/niche player	Business Process Outsourcing
Conduct Pricing strategies Advertising Product strategies Research & development Production investment Collusion Mergers Legal strategies		Alliances for complementary products Patenting business processes	Pricing differentiation Product versioning	
Performance Production efficiency Allocative efficiency Equity Product and service quality Technical progress Profits				

3. The changing nature of information

3.1. Defining information: engineering versus semantic

What is information? It seems to be that the term ‘information’ is used in a wide variety of meanings, dependent of the science it is used for, physics, computer science, statistics, cybernetics, communication theory, linguistics, psychology, economics (Birchler & Bütler 2007:12). Many refer to the definition of information as given in the communication theory defined by Shannon in 1947. In Shannon’s definition information is a signal exchanged between two machines each with a finite and well structured set of states or messages. In this engineering or mathematical definition information has value if it reduces uncertainty. Economics uses elements of the engineering definition in e.g. structured decision support (decision trees, game theory). In the context of mathematical models for decision making it is possible to determine a value for (mathematical) information.

De Kuijper (2009:39) defines information as: “A useful input into decision making, especially decision making about commercial transactions. A piece of information, or input, is useful if it causes a difference in a commercial decision.” This definition is based on the theory of decision making, in which decision making is selecting the most valuable alternative of a number of available alternative courses. But entrepreneurship and thus competition is not about selecting a most valuable alternative from available courses, but to create new, innovative alternatives and destroying existing practices. The essence of entrepreneurship and competition is not induction nor is it deduction, it is abduction.

In economics the semantic aspects of information play a more important role (Birchler & Bütler 2007:15). This semantic definition of ‘information’ has itself a wide variety of meanings; varying from facts, hypothetical knowledge, accepted knowledge, fundamental knowledge, heuristics, algorithms, codes, to stories, values, interpretations, rumors, gossip, intelligence and communication. Lash (section 3.2) discerns within semantic information discursive information and disinformation. The different definitions of information might be summarized as in Figure 1.

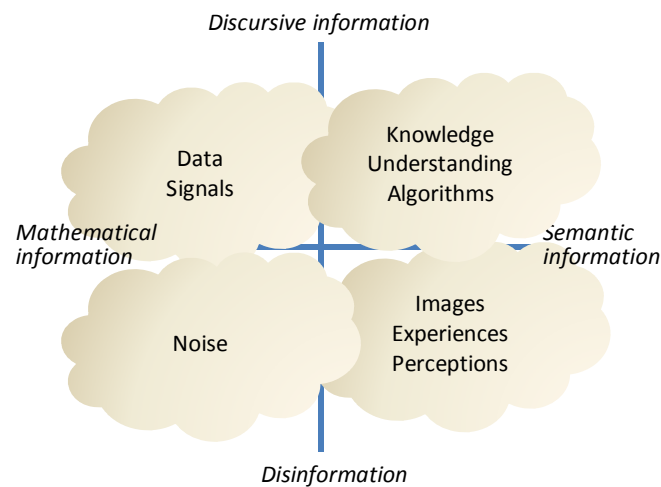


Figure 1. A summary of different types of information.

3.2 Discursive information and disinformation

Especially the semantic definition of information, because it includes such a diversity of meanings, needs a further understanding. Lash (2002:chapter 11) defines two types of information. The first type of information is about discursive or analytic knowledge. This type of knowledge is based on abstraction, on selection, on simplification, on complexity reduction. To deal with such type of information requires formal training in science, technology and or economy. This type of information is about codified knowledge that is easy transferable between individuals and groups. It assumes a Cartesian rationality, be it in manufacturing, computer programming, marketing, sales or in finance. The production of such type of information and thus knowledge marginalizes manual labor according to the law from cybernetics that the information intensive system always masters any system that is not information intensive, even if more intensive by matter or energy. This also explains that whereas in the industrial economy capitalization (market value) was based on physical assets, in the informational economy capitalization is based on intangible assets, *human capital*, *information capital* and *organization capital*, being a mix of complementary, co-specialized intangible resources, routines, skills and processes, not easily to be codified and difficult to imitate or to transfer.

In the industrial era firms exerted control over these intangible assets by ownership of physical assets, buildings, equipment, proprietary standards, and based on the fact that exploitation

of these intangible assets was through embedding of knowledge in discrete physical goods. Especially the latter implies that such exploitation of knowledge remains subject to the law of diminishing returns. Due to the digital technology and the emergence of information goods, knowledge increasingly can be exploited without being embedded in physical goods, opening up the possibility for increasing returns, e.g. in the case of Microsoft's Windows. Discursive knowledge and thus discursive information is universal, it is valid over large stretches of time and space. It has both use-value and exchange value.

Lash's second type of information is labeled *disinformation*. Disinformation is about the content in newspapers, on the Internet, in YouTube-movies. Disinformation is temporal, it is ephemeral, it is immediate, it has not past, no future, it has no space for reflection or reasoned argument; it is about *fait divers*. Disinformation is about lifestyles, design, about branded goods and about the mediation of goods and services (Lash & Lury 2007). This second type of information is about the information culture. This second type of information is about information overload, for which individuals and groups need frames (e.g. brands like Oprah Winfrey, software like iTunes) to find their way in this information overload. Whereas the first type of information is supposed in decision making, also by consumers, to maximize their utility, it is the second type of information that molds the perception of consumers, shapes their identities, orders their preferences, defines their social life; living by this disinformation is their consumption. This second type of information is being exploited by the media industry since the end of the nineteenth century. It was initially carried by the newspaper, the cheap printed novel, movies, radio, television and ultimately by the (mobile) internet. The digital technology has removed forcefully the limitation of channels, of media, of media capacity. It has removed, through the social media, the distinction between the journalist and the reader. The consumer of news also is the producer of news: the prosumer. Broadcasting now exists alongside narrow casting and point-to-point casting, all bidirectional. Whereas in the past broadcasting was monopolized by state owned institutions (e.g. the BBC) or private enterprises (USA), now individuals have the means for broadcasting as well.

Firms are wrestling with social media, denying firms the control over consumers by traditional marketing and advertising. In the traditional sales process the sales clerk had information superiority over the customer. Today, due to the Internet usually consumers are better informed on alternative products, product quality, prices, etc. as are sales staff. Social media comprises phenomena like Wikipedia, YouTube, Facebook, Second Life, Twitter, and LinkedIn. These media differ in social presence/media richness and in self-presentation and self-disclosure from the

traditional broadcast media. Dependent on these factors firms may engage in collaborative projects, blogs, content communities, social networking sites, virtual game worlds, and virtual social worlds (Kaplan & Haenlein 2010). This is done both to understand consumers and to use their ideas, as well to control the image or reputation creation with respect to the firm by the public through these social media.

Therefore it is understandable that Wikinomics defines the information society as a society in which the creation, distribution, use, integration and manipulation of information is a significant economic, political, and cultural activity. The idea of an information society or information economy is not uncontested. Frank Webster (2006) rightfully argues that there may be something like an information society, but the various attempts to define the information society or even to prove that we live in an information society of information economy are questionable. Nevertheless the idea of an information society is useful as it serves to ask questions what today is different from the era of the second industrial revolution ($\pm 1875 - \pm 1975$). “The concept has helped scholars to focus attention on, and to collect together, a wide-ranging and diverse number of phenomena, from occupational shifts, to new media, to digitalization, to developments in higher education” (Webster 2006:263). The media perspective on information certainly is helpful to gain a better understanding of the role of information, not in the least because the media industry (movies, games, newspapers, magazines, etc.) is of material importance to the economy.

3.3 The information based view on the firm

To understand the role of information in the economy an even broader or deeper perspective is needed. Companies like Google and Yahoo depend on algorithms as the core of their business models, providing a search engine and selling advertisements. Such an algorithm, which is used to process information inputted by their customers, is itself information. So in the case of Google and Yahoo these firms not only process information, it appears that their business model itself consists of information. This should be placed in the perspective that originally the resource based view (RBV) dominated the debate on the nature of the firm (Penrose) The phenomenon of outsourcing has made clear that the nature of the resources of the firm increasingly is knowledge, less it is physical resources, hence the knowledge based view of the firm (KBV). As Arrow (1996) has pointed out, increasingly the resources of the firm are not physical resources, but explicit and implicit knowledge and routines, whose codification, in whatever form and carrier (machine code,

work instructions, tacit knowledge) can be viewed as information. It is this type of information what makes a firm unique and difficult to imitate. The phenomenon of tacit knowledge is not new in itself. But from a second order effect in the industrial economy it has become a first order effect in the information economy.

3.4 Cybernetic categories of information

The idea of the firm as codified information leads us to the field of cybernetics because cybernetics offers a deeper insight in different types of information to be codified. Also a cybernetic view on the organization of the firm can be related to Simon's concept of complex systems (Simon 1962; Simon 1973). This is, organizations which have the capability to reprogram themselves in order to adapt to changes in its environment, whilst maintaining their identity.

Cybernetics explains how living systems, biological, the individual, social systems, different from inorganic physical systems, are *organized*. The function of this organization is to generate, acquire, store, process and to communicate information: to control the flows of matter (input-output economics) and energy (ecology) in order that the living system remains alive and whenever necessary adapts itself to changes in its environment to survive (Beniger 1986:40). In the cybernetics five types (levels) of information are defined:

1. *Goal-information* (usually codified in the mission of the firm)
2. *Motivation- or axiological information* (usually codified in the firm's hierarchy of values and or code of conduct)
3. External information
 - a. *Material information* (objective facts about the external situation)
 - b. *Eidetic information* (the interpretation (sense making) of the material information in terms of actions and choices to be made due to the material information, this should be feeding the strategy of the firm. The eidetic information will be codified in the strategy of the firm)
4. *Instruction- or effect information*. This is the description of the economic model or business model of the firm, how profit is being made. This type of information usually in an implicit way is codified in a large variety of ways, including in tacit knowledge, culture, processes, structures, etc. (Increasingly instruction- or effect

information is being expressed in an explicit business model (Kaplan & Norton 2004; Osterwalder 2004; Slywotzky & Morrison 1997). From the foregoing it follows that this effect information needs to include the working of the competitive and institutional environment as described in the field of the modern industrial organization).

5. *Pragmatic information*, also known as choice or management information

The cybernetic types of information helps to understand that a firm according to Arrow is codified information and that this code itself is part of the firm's information base. A firm can treat this information base as an asset, even if not as well-defined as a piece of land. This corresponds with the observation that the value of a firm as a *going concern* often considerably exceeds the book value of its physical assets (Arrow 1996).

The codification of the firm's information is not straight forward, complete, univocal, explicit nor easily to be detected. Much of the codified information is implicit, sometimes even unconscious, in the minds of executives, managers and workers. In the economy of the second industrial revolution much of the uncertainty and complexity was reduced by institutions in society, formal and informal. It might be argued that a part of the information base of the firm was codified in the institutional environment of the firm (labor law, work ethos, pre-organizational socialization, trade rules) Part of the codified information is in the firm's culture, which is according to Margaret Mead 'the collective programming of the mind'. With that a part of the codified information is in the communication routines of the firm, work routines, implicit decision making rules, which is consistent with e.g. Nelson & Winter's view on the firm and its path dependent development (Nelson & Winter 1982). Due to the application of enterprise systems, there is a tendency to codify the firm's implicit information-as-an-asset in the software of computer systems. It has been tried to extend this codification to tacit knowledge of individual workers (Nonaka & Takeuchi 1995), but to no avail (Wilhelm & Downing 2001).

Although considerable improvements in productivity have been achieved by the application of ICT in the various processes of the firm, these applications are not without problems as has been spelled out by Davenport (1998). The application of enterprise resource planning (ERP) systems in the early nineties of the twentieth century were successful because the *best practices* these system were based on for many firms implied a considerable improvement in the efficiency of processes, whereas at that period business models of firms had a limited variety. Partly due to the capital deepening of

ICT and the Internet the variety of business models or profit models increased and with that the basis of competition, as a result of which the best practice based ERP in the second wave of ERP implications at the end of the nineties experienced problems because the standard software failed to observe the specifics of individual business models and strategies of firms.

According to March it is impossible to define a firm's economic working in a perfect, complete and accurate way: "The systems being modeled and analyzed are substantially more complex than can be comprehended either by the analytical tools or the understandings of analysts. As a result, important variables and interactions among them are invariably overlooked or incorrectly specified" (March 2006). This is consistent with Simon's observation that the programming (tasks, objectives, corporate policies, incentives, budgets, etc.) between higher level departments and lower level departments always should be loosely coupled, allowing for adaptive behavior at lower levels in the organization in response to changes in the firm's environment (Simon 1962). The idea of loosely coupled programming from an audit perspective (Sabanés-Oxley) may be viewed as to be *out-of-control* and therefore fall on deaf ears. As Simons (2005) has demonstrated it is precisely *tight control* that causes a firm to be *out-of-control* because tight control destroys the adaptability of the organization to changes in the market. Axelrod & Cohen: "Adaptive interactions are, in fact a major, *raison d'être* of the Information Revolution. Improvements in processing, storage, transmission, and sensing make it possible for us to know the state of a system with far greater speed and precision." (Axelrod & Cohen:27)

Information can be used to constantly improve the efficiency of the firm. This started with Taylor analyzing movements in physical labor and eliminating unnecessary steps to increase labor productivity. Gilbreth and other conducts detailed time studies (time motion studies), using chronographs, to analyse and improve physical labor, processes, and later on as well office procedures. This developed later into process engineering, and the movement of Total Quality Management made processes more in detail measurable and thus subject to improvement. This was to be followed up by process re-design in the nineties, related to computer programs to execute operational processes. More recently, due to the increasing databases within firms, after the initial failure of business intelligence, efficiency improvement by using information is boosted, also because better software is available to analyze data using sophisticated techniques: competing on analytics (Davenport & Harris 2007).

3.5 Information to (re)define markets

The information processing concept of cybernetics needs an addition in order it to be useful to understand the information economy. This cybernetic control model suggests a firm to be passive with respect to its environment by only adapting to changes in that environment. It is precisely through persuasive marketing and advertising, through mergers and acquisitions, standards strategies (Shapiro & Varian 1999), but often also through public relations and other influencing activities, and not in the least simply by offering (innovative) products and services, that a firm influences and sometimes even changes its (competitive) environment. With that the boundaries of the system of the firm as assumed in the effect information (business model) are not always straight forward to be decided and may extend into the market. Apple is an example of a firm whose strategy it is to change the market's demand for functionality by its offering of hardware in combination with iTunes. Whereby iTunes not only is part of the revenue model of the business model of Apple, but a frame (Lash 2002) to help Apple's customers to cope with the overload of information (offering of information goods) on the Internet (Evans, Hagiu, & Schmalensee 2006).

3.6 Information to appropriate consumer surplus

Earlier we stated that information is becoming an input in the production function of the firm. In this two distinct types are to be discerned: information as an input to optimize response to the customer and information that creates new knowledge.

An example of a firm using information from customers as an input in its production function is Dell. Often it is stated that the business model of Dell is direct shipments, or disintermediation, to its customers. This in itself indeed is an essential element in Dell's business model, but there is more to it. When a market is saturated, like the personal computer market, for the basic functions of the product, but there is still a market for different versions of the product, then there is value in it to know the precise preferences of the customer. At the same time to know these preferences may be costly (costs of information acquisition), as it may be costly to produce a customized product. To produce to stock differentiated versions is risky due to market uncertainty. Unless the product has a well defined architecture, defined interfaces between its modules (microprocessor, hard disk, etc.) and well defined modules by function and interface. This modularization of the products allows for modular processes, organization, etc. serving to absorb

market uncertainty (Baldwin & Clark 2002). So when the customer enters the customer interface of Dell, either on the Internet or through the call center, the preferences of the individual customer are molded according to the modularity offered, and assembling the customer defined personal computer or laptop does not incur extra costs. In this mix-match flexibility business model the customer interface is an important process in the value creation by Dell. The information inputted by customer through Dell's customer interface allows Dell to customize a computer to the specific preferences of an individual customer and therefore to ask a premium price. This information inputted by the customer does not change either the architecture of its products nor Dell's business model. At the best this information provides Dell with marketing information on trends in preferences. It must be noted that this business model of Dell turned out to be sensitive to the market prices of personal computers in general. When these prices dropped after the dot-com crisis, and e.g. European retailers like Aldi and Lidl distributed over-dimensioned computers with a fixed configuration at low prices, Dell ran into problems. In the case of Dell the type of information acquired from customers and processed in its business system is restricted to pragmatic information (structured customer preferences matched to limited and well structured product configurations) to reduce uncertainty (Malik 2005).

The case of Dell and comparable cases exist for e.g. insurance, demonstrate that information on specific customer preferences has value for the supplier. This gave rise to the idea that e.g. through information intermediaries or infomediaries (Hagel & Singer 1999; Leebaert 1998; Wilhelm & Downing 2001) customer could monetize this information. This concept appears not to have materialized except perhaps that especially retailers (Wal-Mart, Tesco, Albert Heijn) have taken on this role of infomediaries.

3.7 Information exchange to create new knowledge

Information that creates new knowledge is to be found in the cases of co-creation between suppliers and customers (Prahalad & Ramaswamy 2004). Co-creation as a business model and strategy is a variation on Schumpeter's *Neu Kombinationen* (Schumpeter). In the case of co-creation (new) resources are recombined in which the ownership and control over resources are distributed over the supplier(s) and the customer, whereas in the traditional firm these resources are owned by the innovating firm only.

The rationale for co-creation is that the value of knowledge, especially tacit knowledge of the professional (engineer, consultant, lawyer, etc.) increases by applying it to de novo problems, as also this will create new knowledge (Boisot 1995; Jensen 1998). In this process of co-creation it is not so much that knowledge is transferred from the supplier to the customer and or from the customer to the supplier, some will. Core is that there is interaction between workers from the supplier and workers from the customer, both carrying a great deal of tacit knowledge. In this interaction new valuable solutions are created as well as new knowledge. This process of new knowledge creation is typical for engineering firms, software firms and consultancies. Google uses the possibilities of the Internet also for proto-typing new applications in a trial and error mode with customers, product development; testing and marketing new application has become one process (Iyer & Davenport 2008).

In the case of co-creation the core of the value creation process is not within the boundaries of the firm, it is at the interface with the customer, making the customer part of the value creation process. This in itself creates issues with respect to ownership of solutions, leverage on new developed knowledge and appropriation of value. Appropriation of created value also has become an issue due to the rise of network industries (Shy 2001). In a network industry the value of a system, e.g. a computer system, a home entertainment system, but also a building, is created in the market, not in the firm, by either the end-user or an integrator (e.g. a construction firm).

Creating new knowledge no longer is concentrated to the R&D-department, increasingly it is to be found in the operations, in the interface with customers and also through collaboration in the market, as e.g. in the case of open source software (Ghosh 2005). Because tacit knowledge is the property of the individual who carries it, not the corporation as the employer of the individual, the distributed organization of knowledge creation raises issues with respect to the control of the firm and the entitlement of shareholders to new created property rights. In the traditional industrial firm the investment of the cash flow in research and development resulted in new property, through patents vested in the firm, for share holders. It has been tried to codify tacit knowledge carried by workers into information in order to shift this knowledge into that part of the firm's information base as defined by Arrow, to turn it into explicit ownership of the firm (Nonaka & Takeuchi 1995; Wilhelm & Downing 2001). But precisely because tacit knowledge is an issue of ownership, the attempts to codify tacit knowledge through knowledge management systems have failed because in that process this ownership was not addressed.

3.8 Information to cope with uncertainty without reducing it

Investments in R&D-projects by definition are uncertain. There is not only the uncertainty that the project as defined within the firm, will produce a profitable result, there is also the uncertainty that outside the firm competing knowledge, patents or products are developed. Also it may be that the project organized within the firm produces products, processes or patents which are not useful for the funding firm, but may be useful for other firms. Because of a more efficient market, especially a more mobile labor market for R&D-staff and a more efficient market for financing start-up firms and growth firms, a number of firms have switched to the model of open innovation (Chesbrough, Vanhaverbeke, & West 2006). In this model a R&D project will be initiated by the firm, organized within the firm, funded by the firm, but during its development there will be a continuous scanning of the market for ideas, patents, etc. which might be relevant for the initiated project. Alike sub-results from the project, e.g. patents on modules, processes, resulting from the R&D project but are not of use for the project itself, but may be of use for other firms, will be offered at the market for a price. This buying and selling of snippets of knowledge requires technical information as well as information in order to be able to value financially prospective developments and inventions outside the firm. Whereas in the case of Dell (§ 3.6) the flow of information between Dell and its customers is pragmatic information only, the open innovation model requires multiple levels of information as defined in the cybernetic categories of information (§ 3.4). Goal-information and axiological information is needed, as well effect information to be able to value options. In the case of structuring investment projects on basis of real options and deploying a model of open innovation, information is not used to reduce uncertainty, but to cope with uncertainty without reducing it.

3.9 Information changing strategy and business models

Another type of information to be processed by the firm are events in its environment, technological innovations, political changes, demographic developments, new competition, etc. to which the firm needs to respond in terms of new strategic choices and adaptations in order to survive. This is information beyond the level of statistical-quantitative information. According to Malik and even earlier Luhmann (1984) it is information as an *event* for three main interconnected reasons. First, it makes a difference – it is event-like in that it alters the state of the system. Second, it cannot be repeated – the repetition of information (an event) is not additional information but non-

information (not an event as such). It is event like in this respect – or eventive – in that each instance of information happens only once. Third, it temporalizes and historicizes the system – its alteration produces a ‘before’ and an ‘after’ for the system, either for the system itself (as an experience) or for an observer (as a history). In the cybernetic model this is the processing of material information into eidetic information, usually codified in a new strategy and or strategic change. The way Luhmann and Malik describe this type of information and its effects, suggests it to be a process without complications. The production of the type of information that changes the system however, is to be done by members of the organization and is subjected to a variety of psychological and other behavioral aspects (Bazerman & Moore 2009). Burgelman, Bower, Christensen, Jensen, Prahalad have extensively documented, in various ways, that the production of eidetic information as required by the continuity of the firm or even to have it produce efficiently, is at least problematic.

The question is to be asked why the production of eidetic information required to define new business models for firms in order to survive has become an issue since about 1990. Since the eighties a transformation has set in, initially unnoticed, in which products and services became more information intensive. This has been described as the increasing knowledge intensity in products (e.g. the microprocessor) and services. Initially this knowledge was codified in physical products, but with the shift towards information goods and the emergence of digital technology, information has become more explicit an element in the customer value proposition. At the same time the information position of the customer, through the Internet and social media has become stronger, as well as the possibilities to provide feedback to the supplier, apart from the fact that ‘products’ are interactions, not subject to transactions and often are prototypes. Therefore it is understandable that in the modern business models (Johnson, Christensen, & Kagermann ; Osterwalder) the starting point is the *customer value proposition* (not resources) and that this customer value proposition first is translated into delivery processes (e.g. according to the method of Kaplan & Norton’s strategy map) into delivery processes, prior to the resource configuration. These delivery processes are the expression of the business model as a cause-and-effect relationship as opposed to the neo-classical black-box concept of the firm. But as the *customer value proposition* is the object of (continuous) innovation as the basis of competition, so are the delivery processes, and thus is the business model of the firm. Whereas in the industrial economy changes in the business model were triggered from a strategic level of thinking and happened roughly once very ten years, the dominance of the information in products and services, the shift from transactions to interactions makes that there is a

stronger effect on the business model resulting from operational information and a higher frequency in adapting or innovating the business model.

That is to say that the information processing capacity of the firm, or more precisely, the sensemaking of data into information, has become much more distributed at various levels in the organization, but also that the firm as a codified information base has become more dynamic in order to cope with the increasing amount of information and options in its environment.

3.10 Information changing the consumer

The Internet and digital technology not only changes markets and firms, it also changes the consumer. The market is not only a coordination mechanisms that clears demand and supply (at least in the text books), for the customer the market also is a space for discovery of new products and services. The art of entrepreneurship is to turn latent needs and preferences into manifest demand. The offering of new products and services may turn latent needs into manifest needs or change the preferences of the consumer. Sears' catalogue broadened the market compared to the local mom & pop shops or the year market for the farmer. The Internet is an immense source to discover new products and services, apart ideas of different kinds. The consumer is bombarded with product information, print advertisement, TV-adds, newspaper adds, flyers, advertising on radio. As a result of which attention has become a scarce good in the market. The shift from search goods to experience goods, e.g. news, has made reputation, e.g. that of the Wall Street Journal, into a scarce good (Lewis & Bridger 2000). In the industrial economy, dependent on economies of scale and some other factors their would often be in a market a more or less bell curve type distribution of the size of suppliers. In the case of an economy of attention and reputation and scale free networks like the internet the distribution of suppliers tends to be power law based: the second supplier by size being half the largest supplier, the third being half the second supplier by size and so on (Barabási ; De Kuijper). The Internet tends for a number of specific products to create a 'winner takes all market', e.g. in the case of Google, or Microsoft. Time has learned that their often positions are contestable, but this does not deny the issue of competing for eye ball time.

At the same time the immense offering of products makes the consumer uncertain what to choose. Some suggest that individualism reigns in society, not in consumer markets. Consumers do want to make their own choices, but most of them do so in the context of fashion, trends and social images and identities they want to relate to. Consumer goods like clothing, cars, life-style elements,

books, music, they also serve a social purpose, not only use value. For this reason many consumers are looking for frames with which they can identify and feel trusted. Examples of such frames are Oprah Winfrey, iTunes, and some magazines and newspapers also exploit their reputation to make money by offering other product lines. Competing on information is not only about possessing information; it is as much providing a meaning to available information.

4. New strategies evoked by the changing roles of information

4.1. Information as a resource

Information is becoming cheaper to acquire & have access to, to store, to retrieve, to process and to communicate (De Kuijper 2009; Jorgenson 2001). This results in a higher transparency in markets, a shift in power relations between suppliers and customers, and new industry structures. Search costs are being reduced, information asymmetries are being reduced, transaction costs are falling, information goods are being distributed via the Internet. Product information can be distributed or made accessible in great detail to a large audience, doing away with the traditional richness or reach limits in the industrial economy (Evans & Wurster 2000).

In the neo-classical economy the production factors in the production function of the firm are land, capital, labor and raw materials. The relation between output (y), capital (K), labor (L) and raw materials (M) is usually represented as:

$$y = f(K, L, M)$$

in which f represents the multi productivity factor which includes such factors as management, organization and also information. Cases like Dell, Google and Yahoo illustrate that information itself has become an explicit production factor, a resource to be acquired processed and to be exploited (Johnson, Christensen, & Kagermann 2008; Kermally 1999).

A resource as an input to a production function is being transformed into a product or service which has value to users of that product, especially use value. That is to say it provides a solution to a problem or a need. Information as a resource may exist in different forms and types as

well it may end up in different types in the solution for the customer, aka the customer value proposition.

A first form of information as an input is information as codified knowledge. Different types of codified knowledge exist: it may be embedded in processed, semifinished goods as inputs. Information may be knowledge as coded in purchased equipment and software. Information may be coded as tacit knowledge of workers employed by the firm. These types of information as an input are included in the conventional production function, especially in the factor f .

A second form of information as an input in the production function is pragmatic information or choice information with respect to specific customer preferences within a finite structured product offering or customer value proposition. The difference between this type of information as an input in today's businesses and that before the computer age is in degree, not in kind. When Alfred Sloan defined General Motor's divisions, he did so on basis of a segmentation of the market, based on income brackets, assuming that different income brackets would prefer different styles of cars. A variety in market demand in terms of price brackets was met with a limited variety of car models positioned in corresponding price brackets. Within each of those brackets an individual car could be customized somewhat through additional accessories and e.g. choice of engine power. The emergence of modular products like personal computers but also the growth of information goods make it easier to differentiate product quality and prices matching a situation that the easiness, speed and level of detail with which customer can communicate their preferences to supplier has increased. This mix-match flexibility has increased in speed, variety and granularity, making the processes of such information as an input to an essential element in the production system.

To this second category of information as an input should be counted point-of-sale data. Retailers like Wal-Mart, Tesco, and Albert Heijn use this information to optimize their value chain with suppliers, to increase their negotiation power with suppliers, to specify to suppliers customer preferences to be answered in product design and to optimize the product offering in terms of availability, pricing and information on e.g. ingredients of products to customers. Also in this case it is the emergence of computer connected cash registers, using bar codes, that has made possible a detailed recording of data, communication and analysis possible in an efficient way. The use of this data in connection with a new set up of distribution centers and a distribution system made it possible to improve the customer value proposition in combination with a higher efficiency in the distribution system and more bargaining power vis-à-vis suppliers (which as in the cases of e.g.

Nestlé and Heineken therefore were forced to reorganize their information to counter this increased bargaining power).

Also to this second category should be related business intelligence aka data mining. The problem of data mining is that this is often pursued from a perspective to demonstrate that there is more value in ICT. The pitfall of especially large data bases is that a statistical analysis often will produce some significant correlation between variables, simply on basis of mathematical laws, not having any relation with the reality of economic life. Therefore often business men are annoyed by the results of business intelligence. A more recent move is that the analysis of available data basis is done under the supervision of or by business consultants; this provides a better link with business needs. Also now a number of CFO use business intelligence to define new reporting dimensions and formats. This is an improvement but reportable dimensions should be defined by a business model and by strategic options.

A specific case of the second category of information as an input is the questions users of search engines like Google and Yahoo input in those systems. Different from modular products users are free to input whatever words or phrases, they are not limited by pre-defined choices (Iyer & Davenport 2008). In doing so they reveal their preferences and demands for new subjects to which those system can respond with additional indexing of website. Also search terms and questions are exploited to sell, through an algorithm, targeted advertisement, by which search terms are monetized. Parallel to this customer through their own website or e.g. Wikipedia, volunteer new information on the Internet for free (Tapscott & Williams 2006; Tapscott & Williams 2010) making the offering of Google and Yahoo more valuable to its customers.

A third form of information as an input is to be found in situations of co-creation. In this case information is also about codified knowledge, but in this case the source is the customer. In co-creation a customer, e.g. a car manufacturer is looking for a break through solutions with respect to some function in one of its new to be designed car, to improve efficiency and the customer value and will turn to a manufacturer with engineering capabilities. In this case knowledge of a customer with respect to a future market demand and often knowledge with respect to new design, will be combined with the knowledge of the supplier-engineer to produce a Schumpeterian *neu Kombination*. Also in this case such a phenomenon in itself is not new, but it is the deployment of CAD/CAM systems for designing components and subsystems, the possibility to connect the CAD/CAM systems of the customer with those of the supplier, to create a process of co-creation with a higher frequency, lower batch sizes to a level that only proto-types are being designed, produced and sold.

As innovation is a key element in competition, to have customers with an innovative demand and which are willing to exchange (tacit) knowledge through a process of co-creation, becomes a key element in being competitive.

A fourth form of information as an input into a production function is user generated content as experimented e.g. by newspapers like the Guardian and the New York Times but is also applies to website like e.g. Facebook. This also is typically for products, like newspaper whose customer value proposition consists of semantic information, both discursive and as disinformation.

Information as an element in the customer value proposition also plays a role in non-information goods, e.g. by providing detailed information on a product. In addition to that there is the mediation of products (Lash & Lury 2007). In today's markets a product hardly is considered to be serious, whether it is a bicycle or shoes, if it is not supported by a website.

So when De Kuijper suggests that the star driver of new strategies is the vanishing costs of information this in itself is right, but her concept of information is the engineering concept of information limited to decision-making analysis (both at suppliers and with consumers). There is more to information than its vanishing costs. The firm itself over time is changing from a resource based view, via a knowledge based view, to Arrow's firm as an information base, to which is to be linked the dynamic capabilities view, especially the capability to reinvent the business model of the firm. With respect to computer programs, which are a form of information, which process information, Neumann realized that the information to be processed could alter the program as information. In terms of economics, the nature of the production function is the same as the nature of the production factor. Which raises the question to what extent, in what pace can or should information as a resource be allowed to change the business model of the firm.

4.2 Costs of information and sustainable profit

The vanishing costs of information and communication increase the transparency of markets, by reducing information asymmetry and reducing transaction costs. Also access to customers and to suppliers becomes easier. Digital technology changes the scarcities, imitation and mobility of resources; in many cases this becomes easier for firms to acquire resources to enter attractive markets. Under the dynamics of perfect competition, no competitive advantage will be sustainable (Besanko, Dranove, Shanley, & Schaefer 2004:449). Therefore the vanishing costs of information and communication make firms to reconsider and re-invent their isolating mechanisms

(legal restrictions, superior access to inputs and or customers, market size and scale economies, intangible barriers to imitating a firm's distinctive capabilities: causal ambiguity and social complexity (Besanko *et al.* 431)), in order to maintain a competitive advantage. According to De Kuijper (2009:151) such isolating mechanisms in the informational economy can be achieved by:

1. Brand, e.g. MacDonald, brands with hub dynamics e.g. Apple
2. Secret, special or proprietary ingredients. E.g. Coca-Cola, Monsanto (genetic material)
3. Regulatory protection. E.g. German beer
4. Focused Financial Resources. E.g. Toyota financing its suppliers
5. Customer Base with Switching Costs. E.g. SAP, ISP's with e-mail addresses
6. Proprietary Processes or Modus Operandi. E.g. Procter & Gamble's manufacturing process for diapers
7. Distribution Gateways. E.g. Wal-Mart's purchasing power with suppliers, controlling access of suppliers to the market
8. Dominant Position in a Layer. E.g. Intel's microprocessor (Yoffie 1997), or mastering a critical (software) platform (Evans, Hagiu, & Schmalensee 2006), also this is about mastering a standard that is essential in a or in multiple industries, be it either *de jure* or *de facto* (Shapiro & Varian 1999)
9. Increasing Mutual Utility (positive returns, product synergies) Apple's iPod + iTunes
10. Aikido Assets = *informational interacting with customers, making use of customer feedback and POS-information*
11. Filters and Brokers, e.g. magazines, eBay (*using reputation*)
12. Hubs, e.g. Oprah Winfrey (*power of attraction, audience building*)

It should be noted that De Kuijper's alternative isolating mechanisms 1 to 6 are not specific for an information economy, these isolating mechanisms apply to the industrial economy as well. Other strategies to build market power are building a capability power (e.g. IBM once with its main frame computers), competitive power (to power to choke the main source of free cash flow of a rival firm (D'Aveni 2001)), non-competitive pressure (the power to hinder rival firms through e.g. court cases), and deep pockets to drive out competitors (D'Aveni 1994).

4.3 New strategies

The question to be asked is whether the declining costs of information and the availability of data, in combination with low costs of communication, speed of communication and a high capacity of communication implies that conventional strategies are deployed with a higher intensity, with a different mutual weight, or that strategies are deployed which do not fit into the conventional matrix of strategies as suggested in table 1.

Initially, probably prior to about 1995, ICT was more or less deployed within the concepts of strategy as depicted in table 1. After 1995 the emphasis with respect to alternative strategies as depicted in the matrix start to shift. Initially it was assumed that strategy was mainly on the conduct level in the SCP-paradigm, constricted by basic conditions and market structure. Various authors have criticized this idea. Cheap information and communication change quite some of the basic conditions, like price elasticity, market size, type of good (information goods), method of purchase, lumpiness of order, etc. Because of a higher transparency in market a shift is going on from strategy at the level of conduct to the level of market structure. It is the shift from competing *in* markets to competing *for* markets (Besanko, Dranove, Shanley, & Schaefer 2004). The emergence of corporate account management combined with shared service centers has changed the economic model of the traditional corporate strategy from a holding model into an integrated firm (e.g. IBM), thus blurring the distinction between corporate strategy and business strategy. The elements of the traditional business strategy at the conduct level, as a results of lower costs of information are converging with operations, partly in conjunction with the shift towards competing on the edge. Corporate strategy itself has moved into grand strategy.

Functional strategies have changed. Finance and accounting, in conjunction with ICT are deployed to organize information disembedded from the internal structure in order to create an infrastructure capable to serve a range of business models. Manufacturing and logistics either are organized as shared service centers or are outsourced. The lower costs of information and communication make it possible to have more efficient execution of strategies and with that to execute strategies which conceptually are not really new, but now have become feasible. The availability of information and fast feedback make it economic to have trial-and-error execution of new strategies, shifting the effort from planning to execution. The lower costs of information also make it possible to exploit synergies, process synergies, product synergies, customer synergies in an

efficient and controlled way, different from what was possible in the past (Kaplan & Norton 2008). This in its turn makes it possible to compete on business model innovation, because implementation of new customer value propositions becomes easier.

The matrix in table 1 however does not capture a change with respect to the customer value proposition and thus on what attributes competition is pursued.

Apple does not stay with the customer nor does it push its products up market toward higher-end customers, Apple changes the market’s demand for functionality, combined with competing against non-use and provides with iTunes a frame for customers to cope with the overload of information goods on the Internet, thus pursuing a double-sided market strategy as well.

Customer value differentiates from use-value to include social value (status, esteem), hedonic values (play, fun, aesthetics) and may include altruistic values (ethics, spirituality) (Figure 1).

		Extrinsic		Intrinsic	
Self-oriented	Active	Efficiency (O/I; convenience)	Economic Value	Play (Fun)	Hedonic Value
	Reactive	Excellence (Quality)		Aesthetics (Beauty)	
Other-oriented	Active	Status (Success, impression)	Social Value	Ethics (Virtue, Justice)	Altruistic Value
	Reactive	Esteem (Reputation, materialism)		Spirituality (Faith)	

Figure 2. Types of values a product or service may represent for a consumer (Holbrook 2006).

The combination of available information, cheap communication, digital devices, the complementarity between hardware en software, discursive information and disinformation, makes it easier for firms to respond to the wider variety of values. Related to this is a mediation of things, that is that customers for virtually all products expect to find information on these products, be it groceries or high fashion, a simple tool or a new car, detailed information on the internet, including photo’s, video’s, technical details, prices and availability.

The question to be asked is how to execute such new strategies, especially the combination of various strategies to create a market power as needed for profitability. De Kuijper asks the question: Do you have an optimal business model? But due to reflexivity between (successful)

business models in the market as now has been intensified by information goods, social media, etc. the optimal model of the firm is a model that can generate in an efficient way new business models, like in the case of Google (Iyer & Davenport 2008).

It is possible to identify a number of different types of competing on information:

1. Information is used to increase markets, including disintermediation;
2. Information is used to lower coordination costs with suppliers
3. Information is used for mix-match flexibility based on modular products or services;
4. Data is used for competing on analytics
 - a. Improvement of internal processes to reduce costs;
 - b. Improvement in marketing, understanding customer behavior, fine tuning of offering, price optimization;
 - c. To optimize supply chains;
 - d. Yield management e.g. in airlines and the shipping industry;
 - e. Exploring markets by data driven business experiments
5. Information is used to increase bargaining power towards suppliers and to set quality standards to suppliers;
6. Information is used to innovate the customer value proposition continuously to extract a higher part of the consumer surplus;
7. Information is used for improved match making (this includes the use of information in credit markets to have lower risk, more efficient lending decisions (Hauswald & Marquez 2006));
8. Information is used to build audiences, to have the attention and the trust of the consumer and suppliers.

In addition to this it has to be added that firms also need to organize their information on markets, competition etc. more detailed and up to date, because the increasing transparency of markets also implies that competitors have more detailed information on markets and on rivaling firms, and most likely are able to identify faster and with greater detail weak spots in either operations, strategies or markets to attack these.

In the past concepts like Henderson's growth-share matrix, Porter generic strategies, and alike such, often simplified, models were helpful to management or were used by consultancies to

assist managers to think through their strategies and make clear cut choices to be executed. The question is whether such a simplified model is possible for the information economy. There might be a risk in such a simplified model in view of the increasing complexity, that is in the growing multiplicity of choices to be made and most likely the possibility of new strategies.

A concept that may help to comprehend the various alternatives to deploy information in competition is created value as the difference between the maximum willingness-to-pay and the costs of resources (Figure 3).

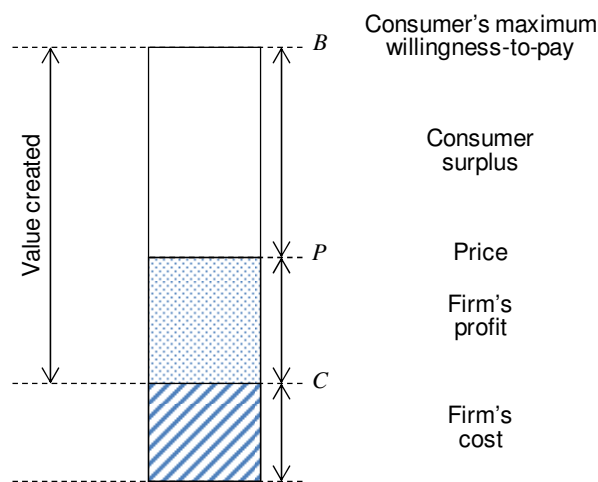


Figure 3. Definition of the value created by the firm.

Firms need continuously to invest and to innovate to maintain the customer's maximum willingness-to-pay as well as to increase efficiency. The willingness to pay has to do with the various values depicted in Figure 2. Efficiencies can be achieved in various ways. Based on Figure 3 the various uses of strategy listed before are arranged as in Figure 4.

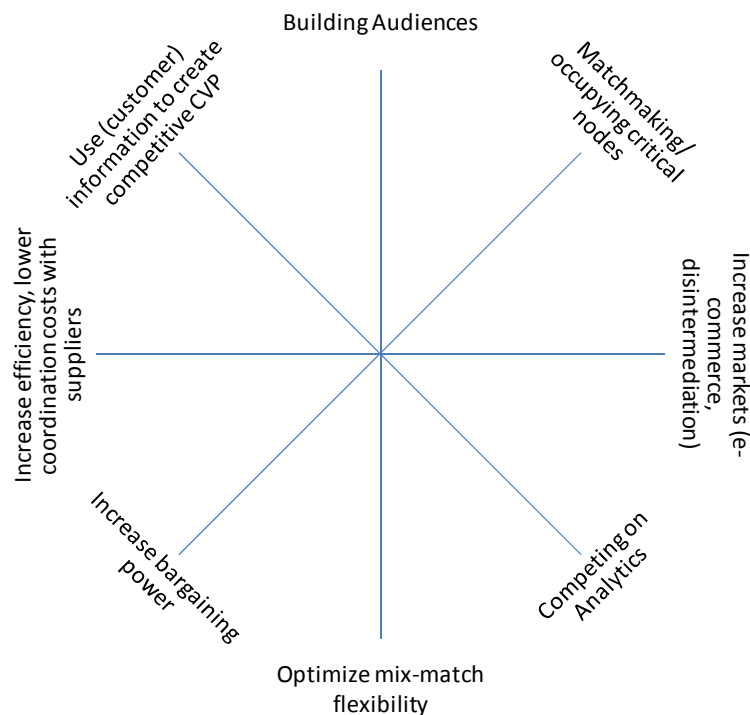


Figure 4. A diagram to create profiles how firms compete on information.

The isolating mechanisms like standards are not included in figure 3. A strategy like e.g. building audiences not only is to be found in the media industry as such, but Apple's strategy can be seen to do so but also Google and other firm's building reputation with their customers. eBay is in match making like other websites, whereas retailers use information in various ways, a.o. to improve an adjust the customer value proposition. Dell's mix-match flexibility has become a standard operating procedure with many industries, but the dimension of competing on analytics or on data still has an enormous potential. But to use data for efficiency improvement only has limited potential if it is not matched by a value for the customer.

4.4 A reflexive relation

To the case of Google applies what is being observed by Lash & Urry as being one of the characteristics of the information economy (Lash & Urry 1994:61): "It [reflexive accumulation] emphasizes how knowledge and information are central to contemporary economies. Knowledge though is not just a question of increasing information intensity as a way of coping with a complex and uncertain economic environment. Knowledge on the basis of reflexivity operates via not just a single but a double hermeneutic, in which the very norms, rules and resources of the production

process are constantly put into question. Further, reflexivity is partially aesthetic and hence contemporary economies not only involve information-processing capacities but also symbol-processing activities. Symbols here include both information and aesthetic signifiers and other non-informational symbols. Hence there is an important centrality in production of the design process.”

The production of the design process not only applies to the design of products and services, as well it applies to the design of business models. The latter is reflected in e.g. Martin’s *The design of business: why design thinking is the next competitive advantage* (Martin 2009).

Defining a new (combination of) strategies is one, executing a new strategy is a different thing. As Bower and others have demonstrated (Sull 2005), especially executing new strategies in an existing firm is not a matter of routine. Arrow’s information based definition of the firm, which to a large extent corresponds with Bower’s *systemic context*, needs to be redefined, but for a large extend is vested in the form of tacit knowledge with the workers of the firm. The traditional budget driven, bottom-up resource allocation process to execute strategies, due to the increasing role of intangible assets, no longer is a reliable tool to execute new strategies (Bower & Gilbert 2005; Prahalad & Krishnan 2008). The new designs needed are beyond De Kuiper’s variation in business models expressed vertical integration or not, mastering of power positions and orchestrating power relations (that is mastering a product architecture). The question is to be asked whether Kaplan & Norton’s combination of the strategy map, their BSC and their model of strategy execution, is a viable alternative for Bower’s obsolete bottom-up resource allocation process. Kaplan & Norton’s approach addresses the primacy of the customer value proposition, the role of intangible assets (human capital, information capital, organization capital, consistent with Arrow’s observations) and the fact that due to the vanishing costs there is a convergence between strategy and operations, and that new knowledge creation is distributed in the organization.

Kaplan & Norton’s concept of strategic themes as accountable entities lends itself for investing in customers, in co-creation projects and defining the customer as the primary profit center. To define the architecture of delivery processes, the establishment of process performance parameters Kaplan & Norton propose a new function in the firm: the Office of Strategy Management (Kaplan & Norton 2005). By doing so Kaplan & Norton try to solve the problem of the dominant logic as a social phenomenon in the firm as observed by Prahalad & Krishnan and Bower’s problem with the phenomenon of the systemic context. The concept of the Office of Strategy Management assumes that this office has access to or is able to acquire all information from the organization needed to redesign the firm. That includes the capability to decode the existing—

implicit—business model, to perform what-if analysis to discover new business models, etc. It should be clear, apart from specific situations, that the awareness of existing business models, their limitation, the discovery of new business models should be a distributed (dynamic) capability in the organization. This issue takes us to what actually is: information superiority.

5. Information superiority as a requirement for competing on information

5.1. Definition of information superiority

In the military information superiority is defined as: “The ability to collect, process, and disseminate information as needed; anticipate the changes in the enemy’s information needs; and deny the enemy the ability to do the same” (Alberts, Garstka, & Stein 1999:54; Perry, Signori, & Boon 2004:xxxii). Hays-Roth observes in his book *Hyper-Beings: How Intelligent Organizations Attain Supremacy through Information Superiority* (2006:loc 1197-8): “Organizations have understood the advantages of information superiority for millennia. Powerful monarchs, prelates, and political leaders have employed spies to collect information about their rivals. They have used various means to spread disinformation that would mislead their opponents. They have used propaganda and advertising to cajole and nudge individuals, ethnic groups, and international audiences to align their personal models with sponsored ones.”

Information plays different roles in the strategy of the firm and there are different natures of information, varying from simple engineering type information to the mediation of things. Information is needed in various ways to create market power for a firm in order to be profitable; a firm needs some type of information superiority. Hayes-Roth: “Information superiority means you are a step ahead, better prepared, more potent, and more in control than your competitor.” Alberts c.s. (1999:54): “Information superiority [is] a state that is achieved when competitive advantage is derived from the ability to exploit a superior information position.” The concept of information superiority can be related to Hayek’s ideas about the role of knowledge in the economy, especially the need for decentralized processing (by decentralizing decision authority) of information in order to maximize the information processing capacity of the firm. To achieve this information

superiority, that is to maximize the data or information processing capacity of the firm, requires more than just decentralized decision authority.

Information superiority over competitors or customers is not simply a matter of having available more or better information compared to those competitors or customers. Information superiority, so can be deduced from the cybernetic model of control, is coded in multiple aspects of the organization, as will be explained in the following sections. Core to information superiority is the capability to process or to interpret data, via information, into new or increased revenue streams. requires a number of elements to be in place and working in the organization of the firm. Interpretation of data into information is a dominantly human activity, which only for a limited range of problems can be codified in algorithms. Some of the available data can be turned into decisions through algorithms, e.g. search phrases entered in Google or Yahoo are turned by an algorithm into offerings for advertisers. To interpret data into useful information requires the presence of a social context, be it at the level of the individual, the individual firm or at the level of institutions. Meaning is a social process and structure, not a material or technical phenomenon (Brown & Duguid 2000). Therefore information superiority is about organizing human organizations in which individuals and teams are stimulated to assign new meanings to available data. This does not require data to be perfect. It is precisely the role of the social or institutional context which enable individuals to make reasonable good decisions on basis of imperfect data. Provided there is a strong purpose and there are clear values (§ 3.4).

To understand information superiority it is necessary to make a distinction between information and information technology (King & Grover 1991). Information technology serves to record data and to make data accessible. Information technology is the technology to serve those who have to interpret and to exploit data. Information as defined in figure 1, especially semantic information, is to be found, respectively to be organized in multiple types of codification and carriers in multiple aspects of the organization, varying from machines codes, decision rules, corporate policies, routines, social relations, values and including the explicit and tacit knowledge of individual members of the organization. This implies that to invest in the *information capital* of the firm requires more than investments in ICT, whereas in national statistics often investments in ICT are taken as a proxy for investments in information capital (van Rooijen-Horsten, van den Bergen, & Tanriseven 2008). Due to their complementarity, and all of them having information aspects, there is a close relation between (investments in) *human capital*, *organization capital* and *information capital* (Aral, Brynjolfsson, & Alstytne 2007).

5.2 An understanding of the information economy

A first requirement to organize for information superiority is an understanding of the working of the information economy, different from the industrial economy: how consumer behavior is affected by information, how industries change due to lower costs of and available information, how rules of games change, but also that different types of information exists and that information is a ubiquitous multi-faceted phenomenon, outside the firm, and inside the firm.

Within firms this requires that a clear distinction is being made information and information technology, and especially that it is acknowledged that information management is a line responsibility, not a responsibility of e.g. an ICT-department (Strassmann 1995). In many firms the focus is still on *total costs of ownership* (TCO) with respect to decisions to invest in information technology. This approach assumes that information technology may be a necessary technology to be in business, but that it does not contribute to the value of the firm, respectively the value creation by the firm, and subsequently the costs of ICT need to be minimized. In the knowledge based view of the firm (KBV) information also may be codified knowledge, as part of the organizational capital of the firm, and thus that type of information is or should be an object of investments (Arrow 1996). The information society with its different types of information as summarized in Figure 1, not only produces different consumer behavior, also workers will be different with respect to identification and motivation, as will be competitive behavior.

Another fundamental difference between the industrial economy and the information economy is that, in various degrees for different firms, information is or will become a resource, an input in the production function. Whereas in the neo-classical economy information is assumed to be a residual factor in the production function. Information being a resource is consequential for defining business models (Johnson, Christensen, & Kagermann 2008), making investment decisions and the issue that the firm is in-control (has access to those resources as needed for its continuity (Fligstein 1990)). This changing role of information implies that information superiority not only implies changes at an operational level, but as well on the level of concepts (e.g. in management accounting, management control) and at an institutional level (possibly including ownership issues).

5.3 The role and nature of a mission

A second requirement for information superiority is to define a mission for the firm that resonates with the social characteristics of an information economy and information society. Google's mission is "to organize the world's information and make it universally accessible and useful." Be it that this mission is made operational in: "to monetize consumers' intentions as revealed by their searches and other online behavior." The question is what mission a firm can or should pursue which have no such power law type market position as does have Google. Most likely, as e.g. in the case of Swatch, not so much the product as object or its technical attributes should be emphasized, as well the sign nature of a product, its experience, relation to life style and specific non-economic consumer values.

A mission plays a pivotal role in the selection and interpretation of data as an input for decision making, developing strategies, but also in self-coordination and taking initiatives. It is the first element in the cybernetic system of information needed to be in-control (§ 3.4). Without a clear mission the members of an organization by definition are likely to suffer data overload.

The intuition expressed in the nineties of the twentieth century that firms needed a mission was itself right as entrepreneurial intuitions so often are (Bart 1999; Bart, Bontis, & Taggar 2001). Unfortunately the idea of a mission in many cases was misunderstood to be an issue of *communication*, not of what a mission in reality is, a form of *information*, especially goal-information (§ 3.4). As a result the writing of a mission statement was delegated to a department for communication or an external consultant for communication, with predictable results; including a wide spread cynicism on the usefulness of mission statements as expressed in e.g. Bart's article *Sex, Lies and Mission Statements* (Bart 1997). By seeing the mission statement from a perspective of cybernetic decision making, its role in the administration, decision making, taking initiatives, making choices, the latter also with respect to available data, becomes clear. Without denying the role of a mission statement in the motivation and especially the identification of workers with the organization as explained by Simon. This internal role of the mission statement does not deny its external role with respect to customers, suppliers, complementors and other parties with which the firm creates *shared value*.

5.4 Values

A third requirement for information superiority is the hierarchy of values a firm embraces to set itself apart in a world of commoditized products and services. Alike as with mission statements the intuition in the nineties of the twentieth century (although examples of successful values are older, that values are needed was correct. But values were perceived to be part of the culture of an organization. In the model of organization culture as defined by Schein (Schein 1985) values are a reflection of the (often) unconscious or subconscious assumptions on markets, customers, on what works and what doesn't, as an element in the collective programming of the thinking of members of the organization (with which organization culture is part of the routines of the organization). In the concept of cybernetic information (§ 3.4) values as a layer in organization culture as defined by Schein, is *effect information*, such values reflect assumed or experienced cause-and-effect relations. However, the role of values as effect information is diminishing due to the development in which business models more and more are made explicit and its assumptions, due to the increasing availability of data, are continuously validated through analytical techniques.

In the cybernetic categories of information values are axiomatic information, expressing the identity and what a firm or institution stands for in its contribution to society and thus in upholding society. Hence the definition of a value: A value describes what an individual or a group in prescriptive sense wants to be true, respectively in prohibitive sense not wants to be true, irrespective of the actual, concrete situation (Cha & Edmondson 2006; Rollinson & Broadfield 2002).

Values as axiomatic information have multiple roles. A first role is to differentiate the firm in the market and to attract customers on non-price attributes to avoid price competition. E.g. to pursue a reputation based on reliable information as in the case of Wall Street Journal, is both a value as defined before as it is a non-price attribute of the WSJ as a products. A second role is to differentiate the firm on the market of creative knowledge workers as a source for information in the form of tacit knowledge, that the firm has a clear hierarchy of values which with creative knowledge workers can identify. A third role of values is to guide in the organization the process of selection from available data, sensemaking, taking initiatives, and making decisions especially to solve dilemma's. Also a hierarchy of values also is needed to make decisions in view of different hierarchies of preferences of stakeholders of a firm or even to select stakeholders. Companies like Nestlé, DSM, Unilever pursue values aimed at attracting investors with a long term commitment to the firm and to discourage shareholders interested in short term profit only. *Our Credo*, the hierarchy

of values of Johnson & Johnson implies that dividends for shareholders, that is a sound profit, *results* from its primary responsibility to develop, produce and sell good products for doctors, nurses and mothers, profit is not the primary objective.

Values, especially a hierarchy of values (Cha & Edmondson 2006) therefore are indispensable (although in itself not sufficient) to interpret data on situations, changes, new developments and opportunities, into (meaningful) information. Without a clear hierarchy of values data on new developments, changes, etc. may cause tiresome debates, or even turf battles with respect to their meaning and implications, often as a reflection of personal, parochial interests. Usually this results in hierarchical, centralized decision making. Vice versa: in order to have a as high as possible processing capability in the firm to interpret data into information, to process information, whilst maintaining the integrity of the firm, a hierarchy of values is needed.

Values as defined here before are to be distinguished from values as often expressed in order to have a sound psychological climate in the organization: a climate of tolerance, of openness in the firm, allowing for opposing minds, experiments, learning from failure and that strong values in no way may nor should result in group think. Which in themselves also are important to avoid e.g. that out of data dominant logics, individual and collective, distort the process of sense making. Especially that such a psychological climate blocks a group to see what is really new.

5.6 The reflexive relation between markets and business models

A fourth requirement for information superiority is an understanding and acceptance of the reflexive relation between a business model and its customers. Such a relation also existed in the industrial economy. Peter F. Drucker predicted correctly that the business model of General Motors precisely by its success, because it changed customer preferences, apart from other developments undermining the assumptions underlying Sloan's model, would become obsolete (Drucker 1946). It only took about thirty years before this insight was acknowledged.

The computer scientists Von Neumann observed in the forties of the twentieth century that because computer programs, which process information, are information themselves (mathematical information), the information processed by a computer program is capable to change the computer program. Due to business models becoming more information based as explained before, the emergence of information goods, the increasing role of information (data) in the marketing, sales and distribution channels, and customer having available more information (data), the intensity of

the reflexive relation between a business model and its customers becomes more intense, as well that the cycles of change become much faster, in some cases even of a real time, continuous nature.

This implies that the business models in exploitation, how profitable they may be, should not be used as frames to collect and to interpret data. Information superiority requires that a firm has the capability to change a business model as a results of new data and or has the capability to experiment new business models, parallel to exploiting business models. This is reflected in the trade books which promote e.d. data driven business experiments, but for a longer time was to be found in the phenomenon of corporate venturing.

5.7 The organization of sensors

A fifth requirement for information superiority is the ability of a firm to acquire and sense data from the outside world as will with respect to its internal organization. Sensors exists in different types, varying from human to technological and can be organized in different ways. Traditional sensors used to be the entrepreneur itself, departments for various types of research (market research, technology research) or hired firms for various types of market research. Sensoring in general will be at different levels, varying from scanning changes in the macro-economic, geo-political level, to an operational levels, e.g. on the level of sales processes and tactical consumer preferences. Sensoring used to be dominantly centralized organized, although decentralized sensing existed for a longer time, e.g. through debriefing sales staff on questions asked by customers as in the case of the fashion chain Zara.

Since through digital technology transactions (sales) are recorded at point of sale (POS) firms have found that this information can be put to use, e.g. in improving the planning of the supply chain, to have fast feedback on preferences and dispreferences for products, and to increase negotiating power with suppliers. Through POS-data warehouse chains have become competitors of traditional market research firms. Through e-commerce and the Internet the clicks of customers and search phrases entered, the website of a firm has become a sensor on consumer preferences as well. To this needs to be added the social media. A number of firms, e.g. KLM and UPC, keep track on the mood of customers wit respect to their products and services by continuously monitoring the social media and if necessary to take actions to correct a change of mood which might harm the reputation or the perception of the firm.

In engineering firms and in the business of deal-making a process of co-creation exists. This process of co-creation not only is a process of value creation, it is also a process of sensing in great detail especially new preferences of customers.

More in general the sensor functions of a firm can be organized distributed at various levels in the organization, especially with front line workers, apart that increasingly technology will be used in this sensor function. Simons (Simons 2005) explains that tight control, especially on staff in a customer interface, e.g. by setting a strict limit in terms of second to a customer call and keeping staff strict to the script to be followed, denies firms to be sensitive to new demands from customers and thus such firms fail to use their customer interface as a sensor on changing customer preferences.

The organization of the sensing function in the organization should be independent of existing business models and existing products / services, to avoid biases in sensing information, new market opportunities. Increasingly firms organize the responsibility for sensing marketing opportunities different from the responsibility to exploit resources. The sensing functions needs as much to be oriented on the supplier side of the firm and the domain of complementary products and services as it should be on the side of customers and competitors. The abundance of data created by web-based transactions creates a risk that more future oriented sensing for information tends to be neglected. Life-style artists, painters and poets often are reliable vanes directing to new trends. It should be acknowledged that a sensor system of an organization never can be made perfect. Especially in dynamic environments it will require some experimentation and variation, using new, seemingly useless new sources or channels.

In the human type of sensors a number of psychological mechanisms are at play, e.g. Ansoff's surveillance filter, confirmation bias, bounded awareness, availability heuristics etc. Such filters may have different sources, dependent on personality, responsibility, psychological climate, dominant logic, etc. (Bazerman & Moore 2009; Kahneman 2003; Pfeffer & Sutton 2006).

Another element to be considered in the organization of the function of sensing is Ansoff's power filter, some managers may filter sensed data because they perceive this data a threat to their personal power.

5.8 Sensemaking

A sixth requirement for information superiority is the process of sensemaking with respect to sensed, acquired data or information. Sensemaking is providing a meaning to data. A meaning that 'serves as a springboard into action' (Weick, Sutcliffe, & Obstfeld 2005). Sensemaking is turning data into pragmatic or choice information in the cybernetic scheme of types of information. Sensemaking is typical a human facility, supported by technology (Weick 1995). Sensemaking, like sensing, is riddled with psychological mechanisms e.g. dominant logic, confirmation bias, belief persistence, belief conservatism, event certainty, representative heuristics, etc. (Bazerman & Moore 2009; Kahneman 2003; Pfeffer & Sutton 2006) as well it is being influenced by contexts (Weick, Sutcliffe, & Obstfeld 2005). Some of these psychological mechanisms may be evoked or reinforced by elements in the systemic context of the internal organization of the firm, e.g. the incentive system, the career system, power relations, the budget system as well as by the nature of the psychological climate.

A most strong factor in sensemaking by an individual may be her or his interests (Habermas 1973). Business unit managers, which are responsible for both managing market opportunities and for resource exploitation, dependent on the style of control by corporate, tend to undervalue market opportunities. For this reason Procter & Gamble and also e.g. PWC in the Netherlands has split the responsibility for market opportunities from resource exploitation (Strikwerda 2008).

Sense making may include inductive thinking or deductive thinking, but ultimately it should feed the essence of entrepreneurship: abductive thinking (Martin 2009). Sensemaking is about seeing new opportunities, new possibilities, new relationships. In that way entrepreneurial sensemaking is different from business intelligence or data mining. Question to be asked to stimulate abductive thinking have be listed (figure 5) by Hamel & Prahalad in their book *Competing for the future* (Hamel & Prahalad 1994).

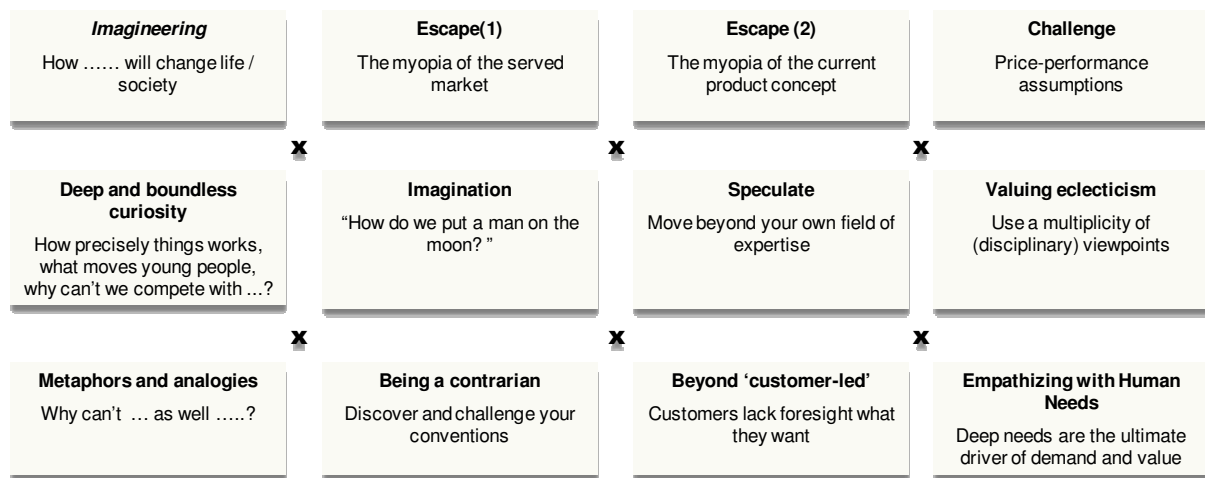


Figure 5. Examples of questions to be asked to feed abductive thinking in explorative sense making (Hamel & Prahalad 1994)

Sensemaking is at play at multiple levels of abstraction and conceptualization. A first level is about interpretation of what is happening in the economy, in industries, consumer markets, competition etc. At this level sensemaking is about seeing new patterns and possible new disequilibria in the market as a source of profit, but also at the level of new power relations in the industry structure

At the operational level sensemaking can be retrospective (explaining actual behavior especially errors made) or prospective, on what new data might or should imply for the future, this is creating eidetic information in cybernetic terms. With respect to the latter a distinction can be made between sensemaking aimed at maintaining or improving the existing (business)model of exploitation versus sensemaking with respect to exploration, in terms of new opportunities and new business models.

Sensemaking with respect to uncertainty reduction (exploration) requires an explicit business-model expressed in cause-and-effects (effect-information) to interpret such information to create a profitable customer response. This type of sensemaking is aimed at interpreting data to confirm and improve the existing business model.

Sensemaking with respect to exploration should result in (strategic) choices on what to do (different or new) and what not to do or to withdraw from. This second type of sensemaking should question the existing business model and therefore should not be guided by the existing models and therefore needs a strong mission (§ 5.3) and a clear hierarchy of values (§ 5.4). This second type of sensemaking is e.g. about creating new customer value propositions.

Sensemaking at the level of exploitation (increase efficiency) includes competing on analytics. This is making use of available transaction data (a) to improve internal processes and (b) to improve marketing and supply (Davenport & Harris 2007). Analytics for internal processes will include (Davenport & Harris 2007:58-59):

- Time-driven activity based costing
- Bayesian inference
- Biosimulation
- Combinatorial optimizing or integer programming, e.g. to optimize a product portfolio
- Constraint analysis
- Experimental design
- Future-value analysis
- Monte Carlo simulation
- Multiple regression analysis
- Neural network analysis
- Textual analysis
- Yield analysis

Analytics on data for marketing will include (Davenport & Harris 2007:87):

- Chi-square automatic interaction detection
- Conjoint analysis
- Life time analysis
- Market experiments
- Multiple regression analysis
- Price optimization
- Time series experiments

Analytics on data for supply will include (Davenport & Harris 2007:99):

- Capacity planning
- Demand-supply matching
- Location analysis
- Modeling
- Routing
- Scheduling

Extreme examples of competing on analytics are Google and Yahoo which use complicated algorithms to process data and turn these into value stream, e.g. through algorithm based sales of advertisements (per millisecond).

Sensemaking at the conceptual level, the interpretation of events, depends on personality, experience, preferred type of thinking, whether the sense-maker is an experimental innovator or a conceptual innovator. Sensemaking should be guided by the mission and the values of the firm, but personal values may be as important. Sensemaking often is guided by models-in-use, but the real sense making is about using new information to question models-in-use and to think about new models. In sensemaking the scope of thinking plays a role, time-horizon, operational versus strategic, market versus industry, firms versus institution, adaptation versus transformation. Sense making as much as possible should be organized distributed in the organization, including the front-line workers, those who interact with the customer. Sensemaking is a human process, information is being processed by people, not by computers. Sensemaking is a combination of individuals doing so and it is by teams. To avoid old or restrictive thinking teams best can be composed through resource mobilization, that is creative knowledge workers composing teams themselves. In the traditional organization sensemaking in terms of frequency was linked to the yearly budget-cycle. Increasingly that is too slow and sensemaking needs to be a continuous process in which speed of thinking also plays a role. A rolling forecast at two levels, market performance and firm performance may be a help. Some traps in sensemaking are companies looking too much to existing customers for new trends, whereas non-customer offer better prospects for new opportunities, a neglect of small markets as these don't answer the growth needs of large customers, and a too early emphasis on quantification of markets and financial returns, whereas not-yet existing markets cannot be analyzed in that way (Christensen 1997). Another issue is that sensemaking of new information is in terms of possible and impossible actions of the available or easily accessible capabilities, whereas new capabilities might be needed for survival. Prospective sensemaking can be compared to learning processes, which should not be myopic (Levinthal & March 1993).

Sense making as an element in information superiority is also the art of seeing new equilibria in the economy as sources of profit; it is the art of seeing new patterns of behavior and preferences in the market or where these can be created. Sense making is also the art to see where, because of old restrictions, e.g. regulation being eliminated, changing prices, new business models are possible and new rules of the game, e.g. in open software.

A complicating factor in sensemaking is that the data to interpret, especially disinformation, also often is communicated to influence the process and outcomes of the sensemaking process.

5.9 Turning information into revenues

A seventh requirement for information superiority is that information produced in the sensemaking processes timely and efficiently can be turned into new products, services, customer value propositions, tactical moves at the level of the industry, and other actions needed to create and maintain a profitable flow of revenues. To absorb the uncertainties in the market this will require modular processes organized across resource units, including these being open to external suppliers (open business model). Also is needed that there is co-location of knowledge, information, decision rights and feed-back, in order that as many as possible members of the organization can decide (calculate) for themselves which of their alternative initiatives or decisions will contribute most to the performance or value creation of the firm, including externalities of such decisions on other departments. Thus usually requires the elimination of information asymmetry, all types of information included.

In traditional organizations, information about competitors and the business environment goes to senior management, who ponders it and, if it is disturbing enough, launch a change initiative. In a built to change organization, this information goes to all employees in order to create a culture and a structure where organization members are connected to the environment (Lawler & Worley 2006:121). Turning new information requires a complex organization, as defined by Simon (Simon 1962; Simon 1973): A complex organization is an organization with a hierarchy of nested subsystems (departments) between which exist information processes in the sense of programming, this programming is loosely coupled, allowing localized instances of adaptive behavior in response to new situations to ensure both the continuity, integrity and the identity of the system as a whole. That is to say, turning new information into new value flows is not only to improve efficiency, but also should be about producing new business models.

5.10 Fast feedback

The eighth criterion to have information superiority is to organize multi-level fast feedback and explorative learning processes. Feedback is an essential element to be in-control. Often feedback is organized at the level of performance management to adjust quantity and mix of products, including price adjustments. As we have seen this is necessary (for self-control) but not sufficient. A second level of feedback is needed to monitor which adjustments need to be made to

the business model(s) of the firm. This may include value propositions, revenue models, delivery processes, etc. A third level of feedback needs to be organized at the level of strategy, especially the strategy at industry level. This feedback should provide insights how to move on to maintain market power, what assumptions at the level of the market power strategy are at stake etc. Fast feedback is at the internet real time, in sync with customer behavior.

6. Conclusion

Who inspects the latest editions (even those of 2012) of text books for strategy management or strategic analysis will find little on the specific roles of information in the strategy of firms. Certainly firms like Google, eBay, Amazon and Dell are dealt with, but very little is reported let it be explained or modeled with respect to the various uses of information in the firm's strategy respectively what new strategic issues are created by the Internet and digital technology.

This scant attention to the role of information in strategy is comparable to how the role of information was ferreted out of modern economic theories (Stiglitz 2000). In the economics of information the emphasis is still on the specific nature of information, that it is different from other commodities: information has many of the characteristics of a public good, its consumption is nonrivalrous. For that reason the issue of appropriating the returns to investment and knowledge is central in the economics of information. The various ways information is being deployed in strategies demonstrates that this issue is wrong phrased: the concern needs to be in appropriating the returns to investment in new business models. Due to the Internet and the increasing transparency in markets these new business models need to be based on strategies on the level of the structure of markets, that is these need to have explicit strategies to create and maintain market power.

Attention for the role of information in strategy is growing through the opportunities provided by the huge data bases firms create themselves through digital recording of transactions and customers searches as well as by data bases available at the market. This approach makes sense in terms of strategy but is limited to making existing business models more efficient and to improve the customer value proposition within the scope of existing business models. A number of firms have broken out of this restriction by persuing data drive business experiments.

The core of the new available information, the Internet, digital devices, the increasing information context of goods, respectively the customer value proposition and the mediation of goods and services, is that this provides the opportunity and the necessity for innovative business models. These innovative business models, again based on the lower costs of information, now can be supported by innovative organization forms, solving many of the restrictions of traditional organization forms. A key characteristic of the new organization forms will be a high capacity to acquire, record, store, retrieve, combine, and interpret data and to turn these into differentiated products and services both by quality and prices. As in war, those firms who manage to do so superior to their competitors have competitive advantage. Porter's definition of competitiveness can be upheld, the way it is achieved is changing. However, the discrepancy between what firms are doing with information and how they are doing it, both at the level of strategy and operation, compared to what textbooks are dealing with is in itself an example that quite some authors have difficulty to see what consequences competing on information has or should have with respect to the theories of strategy and organization.

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