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New production models: a strategic view

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In spite of the recognized crisis of the Fordist production paradigm, the emerging paradigm has not yet been clearly defined but only interpreted by several 'production models' (Lean Production, World-Class Manufacturing, etc.). Furthermore, these are rarely considered as linked to both the corporate and manufacturing strategies. An effort is made here to link the traditional and emergent 'strategic management' dictates and then to interpret the contents of manufacturing strategy. Because of this framework, a collocation of the various production models is proposed. In particular, these production models—in the ambit of 'operations management'—can be seen as different emphases on the main constituent elements of a framework that seeks to unify traditional and emergent 'strategic management' dictates.

1. Introduction

The traditional production paradigm can be designated as 'mass production', with a 'push' logic towards the consumers, and as a 'Tayloristic-Fordist model' because it refers to the principles of scientific management (Taylor 1911) and to the most significant industrial organization since earliest times (Ford).

Although it is widely recognized that this paradigm has been, at least partially, surpassed, the emerging paradigm has not yet assumed clearly defined connotations (and so it has variously been presented as lean production, World-Class Manufacturing, etc.).

In addition, proposals for a new production paradigm—here the name 'production models' is preferred—are generally disconnected from strategic management, simply maintaining the re-evaluated importance of the production function for pursuing competitive advantage.

Such a split appears even more serious when considering the revived debate on corporate strategy, in the ambit of which the traditional Harvard model of Industrial Organization (IO) (Porter 1980) is criticized by those who maintain that a firm's resources and competencies are the true source of competitive advantage.

Theories, tending towards the Resource-Based View (RBV) and Competence-Based Competition (CBC), though with some slight distinctions, have such similar layout and solution principles that one can talk *tout court* of a 'Competence Theory' (CT).

The new production models proposed do not seem to be aware of the changes taking place at the level of 'strategic management'.

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Furthermore, the role of the manufacturing strategy in relation to these emergent production models is not unequivocal.

In short, it seems that the connection between corporate strategic theories, manufacturing strategy and new production models is difficult to grasp. In the ambit of the 'operations management', there is a large amount of literature concerning the manufacturing strategy, its content and relationship with the corporate strategy (e.g. Minor *et al*. 1994); while papers on new production models, their characteristics and when they are applicable—except in a few cases, such as Spina (1998)—do not consider or completely neglect their relationship with corporate and manufacturing strategies (figure 1).

Therefore, it is clear that an examination of the new production models cannot neglect their relations with both corporate and specific manufacturing strategies, thus reaching beyond the confines of operations management and considering also topics of strategic management.

An attempt is made here to link the various production models (Lean Production, World-Class Manufacturing, Strategic Flexibility, etc.; sections 2 and 3), proposed as a new production 'paradigm', with the traditional and emerging dictates of strategic management (resulting from the IO and CT; section 4). Such a link (section 6) occurs when specifying the role of the manufacturing strategy (section 5), which is realized in the selection of performance objectives and then using intervention levers in conformance with the IO approach, and in the resources/competencies management policies with the CT approach.

In particular, it will be pointed out how the various production models can be seen as different emphases on the main elements of a greater framework, that seeks to unify the two strategic theories: IO and CT.

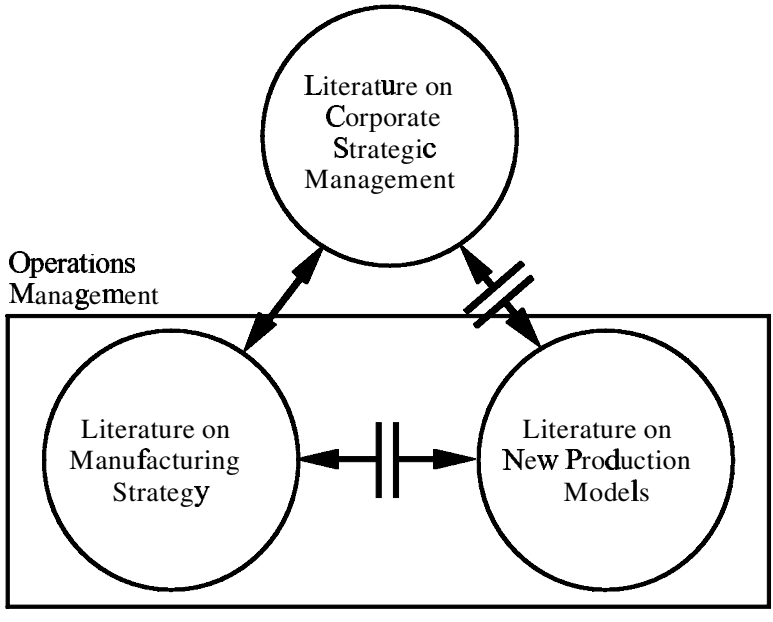

Figure 1. Missing links between the literature concerning new production models on one side and that concerning corporate and manufacturing strategies on the other.

Finally (Section 7), there is a discussion on the principles that characterize the new production models. However, it must be remembered that each modelization can only be applied within certain limits and conditions that do not seem to be sufficient to guarantee 'paradigmatic completeness' and the abandoning of Fordism. There are problems of internal (i.e. at the level of production, industrial application) and external (at the social-economic and institutional level) consistency.

2. Common principles for the new production models

The new production models, proposed to characterize a new production paradigm, have some principles in common (fundamental paradigmatic traits). These can be summarized as follows (table 1).

- Production that is as repetitive as possible even with a high variety of products (rather than repetitive mass production with a restricted range of products, or intermittent production with a wide range of products)—principle of totally synchronized production. Ohno could be considered the father of lean production. In 1975, he became executive Vice-President of Toyota; in 1978, he wrote *Toyota Production System*. He defined himself as 'the most Fordist of contemporary producers' as Henry Ford's dream was to attain totally 'synchronous' production, using flexible technology and innovative organizational management, to make a traditionally intermittent production become repetitive. The complexity of the entire production cycle, the diversification of models from the legendary 'model T', and above all the technological limits of that time, impeded the realization of the Ford's vision. The factory could not become the desired macro line, the tube where raw materials and finished products enter and exit synchronously. Ohno took up the challenge lost by Ford. He had the advantage of possessing more advanced flexible technology and so introducing organizational means and innovative management, confronted the complex problem of making upstream intermittent production more repetitive as well as increasing the rapidity of the downstream assembly with different models.

Traditional production paradigm	New production models
Principles	
Repetitive production of few products	Repetitive production with product variety
Intermittent production of many products	('totally synchronized production')
Push production to the market	Market pull ('adaptive synchronism')
Reference to standards	Continuous improvement
Human resources as antagonist	People involvement and 'auto-activation'
Managerial consequences	
Organizational structure only by functions	Organizational functions and processes
Flexibility mainly by plant automation	Greater importance of organizational flexibility
Performance trade-offs	Performance compatibility and cumulativeness
Mono-phase & mono-lever actions	Multi-phase & multi-lever actions

Table 1. New production models: common principles and their managerial consequences.

- Production 'pulled' by the market (and not 'pushed' by the firm)—principle of adaptive synchronism. If the principle of totally synchronous production can be considered a moment of Fordism continuity, that of 'adaptive synchronism' represents a moment of break. Introducing the 'kanban' (the way in which the downstream departments trigger the upstream ones, in a 'pull' logic according to the request), Ohno overturned the traditional ('push') logic of production advancement. In contrast to Fordism, where the important thing is to keep the level of productivity high, in Toyotism it is fundamental to produce in a synchronous manner, but only when required by the market. The concept that production should be decoupled from the demand by means of stored finished products, so that production and its efficiency can be protected from the turbulence of the market has been surpassed. The principle of production pulled by the final consumer effect (flow pulled from downstream) and the reduction of any slack, eliminate the barrier between market environment and the technical–productive nucleus. The new approach requires greater flexibility: of design (using standardization/modularization and Concurrent Engineering), production (flexible automated plants) and logistics processes (Just-in-Time), so the changing requirements can be fulfilled at the right moment.
- Organization aimed at continuous improvement (rather than following standards)—principle of continuous improvement. Taylor's 'one best way'—the only way to manufacture a product in a competitive environment—defined a concept that was fundamental to the industrialization of the early years of the twentieth century, i.e. the standard. Then, in post-War Japanese industry, the standard developed within the concept of 'continuous improvement'—the incessant search to refine the processes and products. The static idea of scientific analysis of time and methods became obsolete, and a dynamic perception of the existing bonds appeared: they are modified with time, they are mobile, and with continuous increases in productivity. Besides, the principle should not be applied to a single operation, but to the entire system, and attention focused on all the processes so that operations flows can be optimized.
- Extensive involvement of the human resources (no longer seen as antagonistic forces)—principle of auto-activation. The work force is no longer seen as an 'antagonist' but as a 'resource'. This is the second great split, following adaptive synchronism, with Taylorism–Fordism. Adaptive synchronism presupposes/requires the participation of all the work force to continually keep a 'pull' between demand and production. As summarized by Bonazzi (1993) in his 'crystal tube' image, the lean firm resembles a tube through which the material passes rapidly, but like crystal it is fragile. Elimination of the intermediate stocks or any other slack resource dismantles its defence and renders it vulnerable, so self-activation on the part of the people becomes fundamental. The concept of personal involvement is borrowed from the auto-active frame invented by Sakichi Toyoda (whose family, before entering the automobile business under the name Toyota, worked in the textile sector). The machine set-up by Sakichi was provided with a device that blocked it immediately there was a breakdown or blockage of the weft. This meant that if a worker detected a fault, he had to and was able to halt the line thus preventing the production of defective products. The single worker can interrupt the flow

when qualitative problems are discovered. In addition, quality is not controlled downstream, but generally upstream, preventing the defective product from taking up work time and resources.

The application of such principles implies significant consequences of the managerial type (table 1).

- Organization by process (rather than by function). To put the principle of continuous improvement into a concrete form the so-called 'process ownership' is needed, i.e. the worker must be able to view large sections of the process and not just a single operation. The versatility and capacity of the work force to carry out more than one operation is fundamental in this logic of 'appropriation' of the productive process. 'Process ownership' does not only concern the sphere of action of the operator, but reflects the 'by processes' view of the firm, which is the antithesis of the traditional approach focused on the efficiency of the single functions. The firm's operational activities draw horizontal flows that cut across it transversely, so that the organizational structure must respect this 'physiological' process, causing the traditional functional barriers to crumble (De Toni and Tonchia 1996).
- Limited automation (rather than total automation). The implementation of adaptive synchronism places flexibility at the centre of the problems. However, the Japanese firms have shown that flexibility is a problem of production process organization rather than a question of greater automation. Flexible automation approaches presuppose the existence of an unchanging patrimony of information without learning, in fact a concept of static flexibility. One of the first to think about this limit was Schonberger (1987). Using the term 'frugal automation', he pointed out that flexibility must not be understood solely as the capacity to produce a high number of different codes in low unit volume but as the capacity to pass from one mass production to another with the least possible costs. The emphasis shifted from static flexibility, incorporated into an integrated computer-based plant, to a dynamic flexibility, integrated into the whole organization (De Toni and Tonchia 1998a). The ability to change became strategic and is defined as a firm's degree of freedom to make decisions based on the workers' greater knowledge of the processes and products when faced by unforeseeable customer demands.
- Compatible performances (rather than incompatible). The production of high quality goods at a competitive price has shown that the traditional Skinnerian assumption of 'trade-off' (Skinner 1974)—that is the incompatibility of cost performances, time and quality—should be reviewed. Ferdows and De Meyer (1990), among others, have proposed the concept of 'cumulative approach' to indicate the possibility of reaching compatibility or complementarity between different performances. The new approach does not necessarily question the existence of 'trade-offs' between the performance objectives (even though some investigations have done so; Mapes *et al.* 1997, Filippini *et al.* 1998), but affirms the possibility of joint improvement of different performances within thresholds of variability. The plurality and the complementarity of the performance objectives obviously require a revision of the decisional criteria used in the design and management of the productive system, and in particular the performance measurement systems—PMS (Neely 1998, Tonchia 2000, De Toni and Tonchia 2001).

- Multiphase (rather than monophase) and multilever (rather than monolever) integrated actions. The most important of the present-day managerial innovations (Just-In-Time, Total Quality Management, Concurrent Engineering), being transversal to the macrophases of the operations (design, purchasing, manufacturing and distribution), are by nature horizontally integrated—reaching upstream to the suppliers and downstream to the customers. They can be seen as 'multiphase' interventions in contrast to the traditional 'monophase' actions (typically only in production). In addition, the managerial, organizational (organization-by-process and Business Process Re-engineering in general) and technological (reduction of set-ups, 'U' layout, etc.) levers must be activated in synergy in a logic of 'multilever' integration in contrast to 'monolever' actions (typically technology).

3. New production models

From a historical point of view, in contrast to the 'one best-way' (standardized production, economy of scale, physical concentration of the activities) typical of Fordism, Skinner (1974) presented the concept of the 'focused factory', where the manufacturing strategy must be focused on only one competitive priority (or key success factor). As a consequence, there is not only one way of competing through production.

However, this concept was not yet paradigmatic, for no other reason than that it suggested the 'the way of diversity'. However, the new production paradigm seems to have regained features of the 'one-best way' (Hayes and Pisano 1994), but declined, with different emphases, through the following models.

- Lean Production is the best known model. It is an integrated, coherent group of principles, organizational practices and production management techniques, based on the concept of 'being lean'. In contrast to mass production, lean production uses less man-hours, factory space, and equipment, develops products in less time, requires less stores, and produces less defects, all, however, with greater variety. The actual abandoning of Fordism, that is the translation and incorporation of the new principles into industrial practice, made by lean production, is proceeding along two different pathways, which will probably finally meet in the so-called 'lean post-Fordism' (Bonazzi 1993):
  - Western way (passing through the so-called 'fat post-Fordism'), first visualized the utopia of the unmanned factory, the mirage of the automated systems of the CIM (Computer-Integrated Manufacturing), which ignored the importance of the organizational lever and the human resources, only later to pass on to an anthropocentrism, which restored the instrumental character of the technology.
  - Japanese way (through the 'classical Toyotism'), first underwent relevant organizational innovations (using 'frugal' technologies; Schonberger 1986), but then retrieved the importance of the technological lever.

  As will be discussed in section 7, the remarks on the above two pathways are true mainly for the past, as the more recent experiences (the changes in Toyota, the Swedish experience, etc.) have much less linear dynamics and plurality of cases. Lean Production (Womack *et al.* 1990) mainly concerns the practices (managerial interventions such as Just-in-Time, Total Quality Management, Concurrent Engineering—and organizational interventions like Business

Process Reengineering), indicating a series of 'techniques for relentlessly and continuously eliminating waste from an operation', then extending the objective to the whole firm (Lean Enterprise). The organization of the 'white collars' and relationships with customers and suppliers are reassessed (Womack and Jones 1994, Karlsson and Ahlstrom 1997). Womack and Jones (1996) realized that, in addition to concentrating on reducing wastes and in general slimming down the activities, one must 'pursue perfection' in a coherent system that requires a clear definition of the value for the customer and the value chain that precedes it.

- World-Class Manufacturing (WCM), on the other hand, highlights the need to be a world leader and concentrates on the manufacturing performances. The 'world-class' producers are those who can provide the high quality, low costs, short lead times and flexibility required by the customers; this involves external measures in respect to the productive process, and internal ones in the factory (Schonberger 1990). Therefore, the focus is on performances, and the importance attributed to benchmarking is also evident. Clearly, such performances are determined by best practices. The famous 19 principles (Schonberger 1990) are levers for a world-class performance, but the performance analysis remains the key point. WCM does not only require an excellent level of performance (truly 'world-class'), but all areas of performance are involved (cost/productivity, quality, time, flexibility—according to Wheelwright's 1978 original classification); in fact Schonberger gives an alternative definition of WCM: 'the reversal of the "trade-off" notion'.
- Strategic Flexibility model asserts that being 'world-class' is not enough, but a firm must be 'able to change gear', i.e. have 'strategic flexibility', modifying with time its own competitive priorities. Hayes and Pisano (1994) re-evaluate Skinner's concept of the focused factory, criticizing the 'one best-way' (which leads to firms becoming similar to each other and so impedes the possibility of gaining a competitive advantage). They state that trade-off in its exact sense cannot be surmounted, but—by means of strategic flexibility—world-class firms can adjust the focus of their strategies and so attain performances which are apparently irreconcilable. Spina *et al.* (1996) discuss a paradigm of 'Strategically Flexible Production', founded on three basic principles: (1) multifocusedness and strategic flexibility (at the same time a plurality of objectives is pursued and in addition one must be able to rapidly modify the competitive priorities); (2) process integration (so as to reconstruct the continuity of the value chain); and (3) process ownership (that is delegation, involvement and motivation of all the personnel). To stress the ability to make a dynamic change in the competitive priorities, the term 'Agile Manufacturing' was coined, 'agile' meaning the capability to move even into different businesses, in a competitive environment characterized by 'war of movement' (Stalk *et al.* 1992). Duguay *et al.* (1997) use the term 'Flexible/Agile Production', and point out that the new paradigm requires both 'flexibility' ('the capacity to deploy and re-deploy production resources efficiently as required by changes in the environment') and 'agility' ('which introduces the notion of speed in the pace of changes driven by the enterprise'). In particular, the flexible and agile manufacturers do not emphasize—as the lean manufacturers do—the minimal use of resources. Indeed, they have extra-resources for flexibility. In a stable environment, they would be less competitive than lean manufacturers, but they overtake them when the context is turbulent.

- Dynamic manufacturing model considers the capability of 'being dynamic', mainly founded on organizational competencies and 'learning-by-doing' (Hayes *et al*. 1988). This model has four basic principles: (1) the central role of management; (2) the 'holistic' view of production system management (i.e. an overall integration of the various elements); (3) the competitive advantage deriving from continuous improvement, aimed at customer satisfaction; and (4) the importance of the human resources and organizational learning. The manufacturing competencies theme is dear to one author in particular (Clark 1996), who observes that the strategic decisions are determined not only by more or less important trade-offs, but also by the past, that is, accumulated knowledge and competencies developed by the firm. These studies open the fascinating branch of Evolutionary Theories (*à la* Nelson and Winter 1982) now specifically applied to manufacturing. The importance of the longitudinal type of empirical research is stressed (one need only think of the simplifications created by most empirical researches, which consider and highlight practices and performances at the same time. However, in reality that relationship depends on the conditions when the practices were initially applied and the transitory period between the application of the practices and their effect on the performances).

4. Integration of the Competence Theory (CT) and Industrial Organization (IO)

In the field of strategic management, the authors proposed (1998b) a framework for the integration of the CT and IO (figure 2). Starting from the two different concepts of the relations between strategy and competitive advantage, and proceeding to where the two approaches finally converge, an attempt was made to relate the various elements that distinguish the two theories, and show the need to consider both to make a complete analysis.

The separated constituent elements of the two theories are articulated according to a sequential scheme of analysis. On the left, figure 2 shows the scheme characterizing the IO (sequence 1–2–3–4), on the right that characterizing the CT (sequence A–B–C–D).

The Industrial Organization scheme of strategic analysis resumes Porter's well-known sequence 'structure–conduct–performance'. The industry structure [1], i.e. the competitive environment in which the firm operates, occupies a position within the market and challenges the competitors, and this determines the firm's conduct or strategic decisions [2]. These are accomplished through the selection of competitive priorities (i.e. identification of the key success factors of the industry) [3.1] and the intervention choices [3.2] most likely to attain these competitive priorities. Though representing both the competitive priorities and the intervention choices the 'contents' of a strategy, is defined according to a sequence that first examines the definition of the competitive priorities and then the definition of the intervention choices. Then the conduct determines the firm's performances [4] and thus the competitive advantage.

On the other hand, the scheme of the strategic analysis according to the Competence Theory can be represented by the sequence: [A] analysis of the resources/competencies possessed (with the noted distinction between resources and competencies); [B] evaluation of their potential profitability; [C] consequent definition of a strategy fit to exploit, valorise and consolidate them; [D] carrying out of that strategy using appropriate policies to manage the resources.

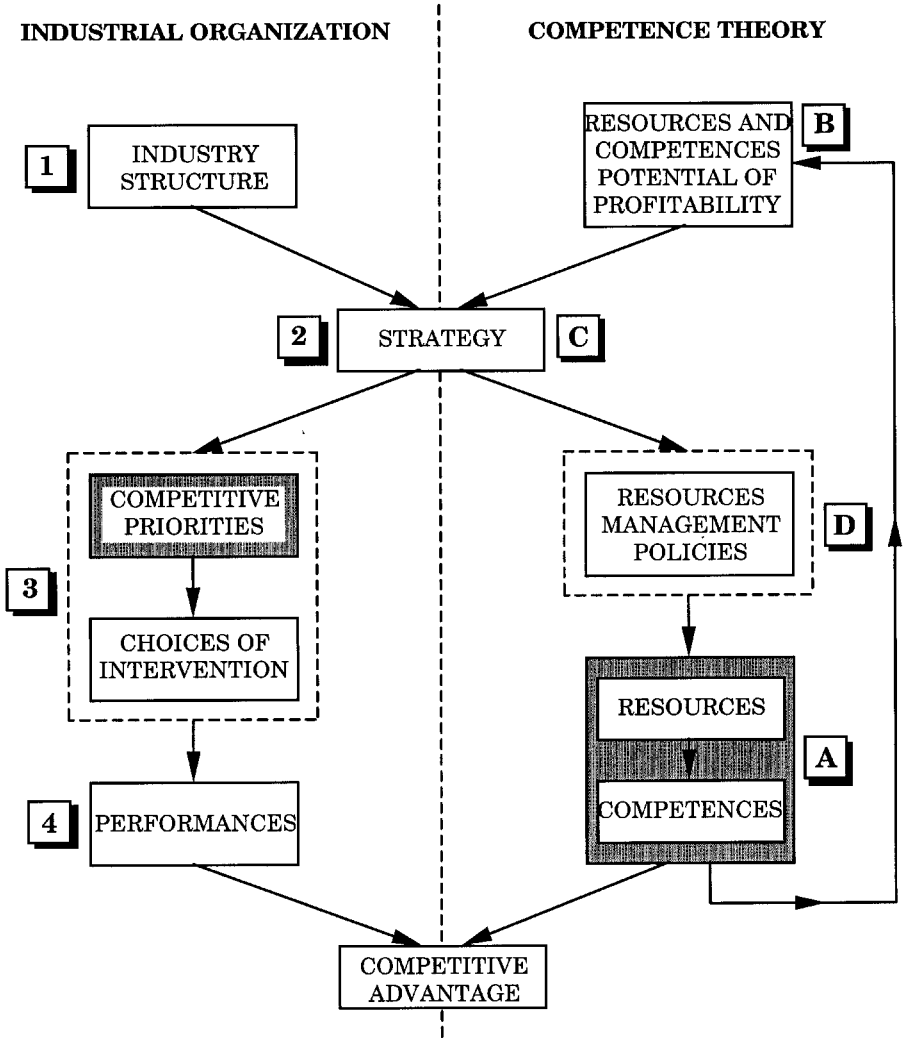

Figure 2. Proposal for the integration of Industrial Organizational and Competence Theory by the joint analysis of competitive priorities and resources/competencies (in shaded boxes); the significance of 'strategy' is evidenced by a dotted square.

Hence, the resources may constitute the source of the competitive advantage, or define the strategic direction of the firm, according to the virtual circle typical of the 'learning organization' and recognizable in figure 2 on the right.

Therefore, according to the CT, the strategy cannot be interpreted as the definition of competitive priorities and choices of intervention (as in the IO), but as the definition of the policies which are best suited to the management of the resources. In fact, according to Grant (1991), 'the essence of strategy formulation is to design a strategy that makes the most effective use of these core resources and capabilities'.

The two different ways of seeing the strategy are evident in figure 2 in the dotted squares.

The single elements of the proposed model are always related to the environment. The value of the performances or of the resources/competencies is not absolute but depends on that of the competitors. In addition, competitive priorities (or key success factors) change according to the industry and the possibility of intervention depends on the technology available and on social–economic variables. Even so, the competitive advantage may not be sustainable under changed environmental conditions, etc.

Besides strategy and the common objective of the competitive advantage, the link between the branch on the left (IO) and that on the right (CT) of figure 2 is given by the comparison between competitive priorities (or key success factors) on one side and the resources/competencies on the other (both shaded to highlight this link). The IO model requires verification of the practicability of the competitive priorities considering the resources and competencies possessed, similarly the CT model for the acquisition, concentration and conserving of resources needs confrontation with the key success factors present in the IO model.

In other words, the IO postulation which prescribes the derivation of competitive priorities from an analysis of the industry is insufficient. A confrontation with the possessed resources/competencies is needed, which can confirm or redirect certain priorities, having analysed the potential profitability of the resources/competencies available. Likewise the resources/competencies typical of a firm are of value not only if compared with the outside (industry or market) but also in relation to the competitive priorities selected by the firm.

In conclusion, both the competitive priorities and the resources/competencies are analysed in two ways: in respect to the outside (the environment in terms of industry/market) and between each other.

In the link between competitive priorities (performances on which to focus) and resources/competencies may lie the key to solving the problem of competencies and their strategic value, even though this relationship remains anything but clear, being scantily supported by empirical studies (Swink and Hegarty 1998).

It will be seen in Section 6 this could be valid not only at the corporate level (in the ambit of 'strategic management'; figure 2), but also at the production level (in the ambit of 'operations management'; detailed in figure 3), by reconsidering the role and significance of the manufacturing strategy.

5. Manufacturing strategy

The manufacturing strategy is the deployment of the corporate strategy extended to the production function, in other words how a business unit deploys its manufacturing resources to achieve its goals. Like the corporate strategy, the manufacturing strategy can be treated in terms of 'content' and 'process' (Swamidass and Newell 1987, Leong *et al*. 1990, Swink and Way 1995).

Though less widespread there are other approaches to the manufacturing strategy. For example, Leong and Ward (1995) consider six 'views' of the manufacturing strategy (their approach is analogous to that of Mintzberg 1987 for the corporate strategy): (1) as a planning process; (2) as the ability to anticipate new processes and managerial techniques ('proactiveness'); (3) in terms of actions (intervention choices); (4) in terms of portfolio of competencies; (5) as programmes of improvement; and (6) through performance measurement.

The 'content' concerns both the *competitive priorities* (basically, overall performance objectives) and the *intervention choice* used to achieve these priorities; the 'process' regards the *formulation* and *implementation* of the strategy itself.

However, the different manufacturing strategies are generally distinguished by the *competitive priorities* chosen (Mills *et al.* 1995), which represent 'a convenient device for measuring operations strategy' (Ward *et al.* 1995).

For example, Miles and Snow (1978) distinguish between 'defenders' (who pursue efficiency), 'prospectors' (oriented towards product development and market), 'analysers' (who try to pursue efficiency, like the 'defenders. when the contexts are stable but otherwise behave as 'prospectors'), and 'reactors' (without a clearly defined strategy). Stobaugh and Telesio (1983) differentiate between 'cost-driven', 'technology-driven' and 'market-driven' firms. Wheelwright (1984) simply separates a 'technology orientation' and a 'market orientation'. Sweeney (1991), interpreting the original thesis of the Manufacturing Futures Project (long research over the years produced contributions such as Miller and Roth 1994), that distinguishes between 'caretakers', 'marketeers', 'reorganizers' and 'innovators'. In relation to the level of service offered and the innovativeness of the processes (in particular, the first two especially the 'marketeers' aim at the service, the others at the innovation, principally the 'innovators').

Kim and Lee (1993), retracing Porter's competitive strategies, conclude that all the manufacturing strategies can be reduced to three classes: 'pure cost-leadership', 'pure differentiation' and 'mixed strategies'. Williams *et al.* (1995) and Reed *et al.* (1996) adopt Wheelwright's distinction between 'technology orientation' and 'market orientation'. Also, the three strategies considered by Kaplan and Norton (1996) can fit into this classification, as the 'revenue growth and mix' strategy has an external (market) focus, while the 'cost reduction/productivity improvement' and 'asset utilization/investment' strategies have an internal (technology and operations) focus.

Kotha and Orne (1989) dissociate themselves from the prevalent approach. For them the 'primary dimensions' of the manufacturing strategy are: the 'process structure complexity' (level of automation, etc.), the 'product line complexity' (number of product parts, variety of the final product, innovativeness, etc.), and the 'organizational scope' (market scope, vertical integration, economy of scale, etc.). Then the two authors combine the manufacturing strategies with Porter's competitive strategies (of cost–leadership in the case of high 'process structure complexity' and low 'product line complexity'; of differentiation in the opposite case). In contrast, the segmentation strategy (of both cost–leadership and differentiation) is seen in correspondence with a low rather than a high 'organizational scope'.

The *intervention choices* become more a consequence of the choice of competitive priorities than a way of characterizing the manufacturing strategy. The intervention levers regard both the structural and the infrastructural areas of the firm, that is the 'hard' elements characterizing the productive system (plant capacity, process technology, span of process, etc.) and the 'soft' elements that support its functioning (human resources management, quality, new product development, planning and control, etc.) (Hayes and Wheelwright 1984).

From another point of view (De Toni *et al.* 1992), the levers are seen as belonging to the areas of: technology (both that incorporated into the products and into the productive processes, and that of information—Information Technology), management (including techniques ascribable to Just-in-Time, Total Quality Management

and Concurrent Engineering), and organization (both internal and relations/interface with customers and suppliers).

Indeed, the process of *formulation* and *implementation* of manufacturing strategy has been far less discussed in the literature than the content (Menda and Dilts 1997). This is understandable if one remembers that in the greater part of the cases nothing else matters but the sequentialization of the definition of the competitive priorities and selection of the intervention levers (Platts and Gregory 1990). At most the 'organizational culture' in which that process was developed, people involvement, and the management 'as a project' of the process itself are considered (Mills *et al.* 1995).

The manufacturing strategy should be considered as part of the whole corporate strategy. Several confrontation/deployment models have been proposed.

Hill's (1989) well known scheme, beginning from the corporate objectives, derives the *marketing strategy* (decisions regarding product markets and segments, range, customization, etc.; Berry *et al.* 1995), then distinguishes the product 'order-winning criteria' (which capture new customers) and 'qualifying criteria' (simply industrial standards that are in fact the 'market hygiene factors'; New 1992), and finally considers the *manufacturing strategy*, in terms of structural and infrastructural choices, aimed at obtaining the aforementioned criteria.

New (1992) proposes a scheme that links the marketing strategy ('marketing mix' decisions—regarding product, price, place, and promotion) and the manufacturing strategy (with decisions regarding 'manufacturing mix', i.e. product, plant, process, and people) at the same level. Harrison (1993), though deriving the manufacturing strategy from the marketing strategy (by means of order-winning criteria), suggests a double confrontation of the corporate strategy, that is both with the marketing strategy, and directly with the manufacturing strategy (without passing through the marketing strategy).

According to Corbett and Wassenhove (1993), each customer sees three things: (1) the price; (2) the product; and (3) the place and time of delivery. As the customer evaluates price taking the product quality into account, it can be said that the customer considers: (1) the price (in relation to the product quality); and (2) the service (including the 'external' time performances—such as delivery speed and reliability—and some specific service characteristics, such as pre-, during and after sales assistance, the customization of product/mix, and favourable payment conditions).

However, a performance analysis centred on the operations—according to Corbett and Wassenhove—includes the dimensions of: (1) cost; (2) quality; and (3) time. The link between the operations performances and the customer satisfaction (in terms of price and service) thus becomes the 'missing link' (Wheelwright 1984) which fuels the debate on the relationships between corporate and manufacturing strategies.

According to Menda and Dilts (1997), starting from the corporate mission, marketing plans are developed, 'functional views' are established (on the market itself, production, logistics, quality, cost accounting, etc.), by mutual consent the order-winning criteria are defined, the consequent manufacturing tasks are determined, and then the manufacturing structural and infrastructural decisions are made.

Some requirements have been specified concerning the links between manufacturing and corporate strategies.

These are: (1) 'contingency' between the corporate/business strategy and the competitive environment (Tosi and Slocum 1984, Fine and Hax 1985); (2) 'external—in respect to manufacturing—consistency' between the competitive priorities of the manufacturing and corporate/business strategies; (3) 'internal consistency' between the manufacturing objectives (derived from the competitive priorities of the manufacturing strategy) and the allocation of the productive resources (Kim and Arnold 1996), the key decisions regarding structural and infrastructural investments (Boyer 1998) or the management styles, organizational culture, stage of firm development (Mills *et al.* 1995). Such consistency refers to the degree of coherence, according to the well-known concept of 'fit' (Jelinek and Burstein 1982, Venkatraman 1989, Miller 1992).

In particular, regarding the 'core competencies' of the firm, Spring and Boaden (1997) inquire what influence the Competence Theory could have on the traditional deployment of the strategy:

> 'It contains a number of concepts that challenge the traditional view of both competitive strategy and manufacturing strategy. The product/market arena is not abandoned, but seen as merely the surface of the 'multiple-layer game' that strategy has become, in which competition is not solely between product and product, but between alternative organising logics ... manufacturing strategy no longer means selecting the right process technology and production planning system for the selected competitive criterion, but also involves developing the competencies that enable quicker and cheaper asset accumulation to occur'.

Apart from the above-mentioned contribution, papers specifically on the relations between manufacturing strategy and CT are rare. However, it is to be hoped that the space gained by this latter in the ambit of 'strategic management' (partially replacing the traditional strategic planning of the IO) will lead to a revision of the prevalent definition of manufacturing strategy (competitive priorities plus intervention choices). The new way of interpreting the strategy according to the CT (as resources management policy) appears to be consistent and adequate even for a closer consideration of the specific manufacturing strategy.

6. Integrated view of the new production models

Employing the scheme (presented in Section 4 and represented in figure 2), which jointly considers and integrates the construction elements of the two most important strategic theories (the IO and the CT), and using it as just mentioned in regard to the manufacturing strategy, it seems possible to collocate, within a single conceptual framework, the four production models proposed as an emerging production paradigm and described in Section 3.

The fact that no single one is imposed upon another leads to the supposition that they are not alternatives, but rather embrace and accentuate different aspects of an overall framework which encompasses them all.

The conceptual framework presented in figure 3 returns to strategic management, and in particular to the framework proposed in the first part of the paper, that jointly considers the constituent elements of the two main strategic theories i.e. Industrial Organization and Competence Theory.

The IO scheme considers the manufacturing strategy in terms of the competitive priorities (performance objectives) of the production function and the intervention choices made by that same function. These manufacturing performance objectives

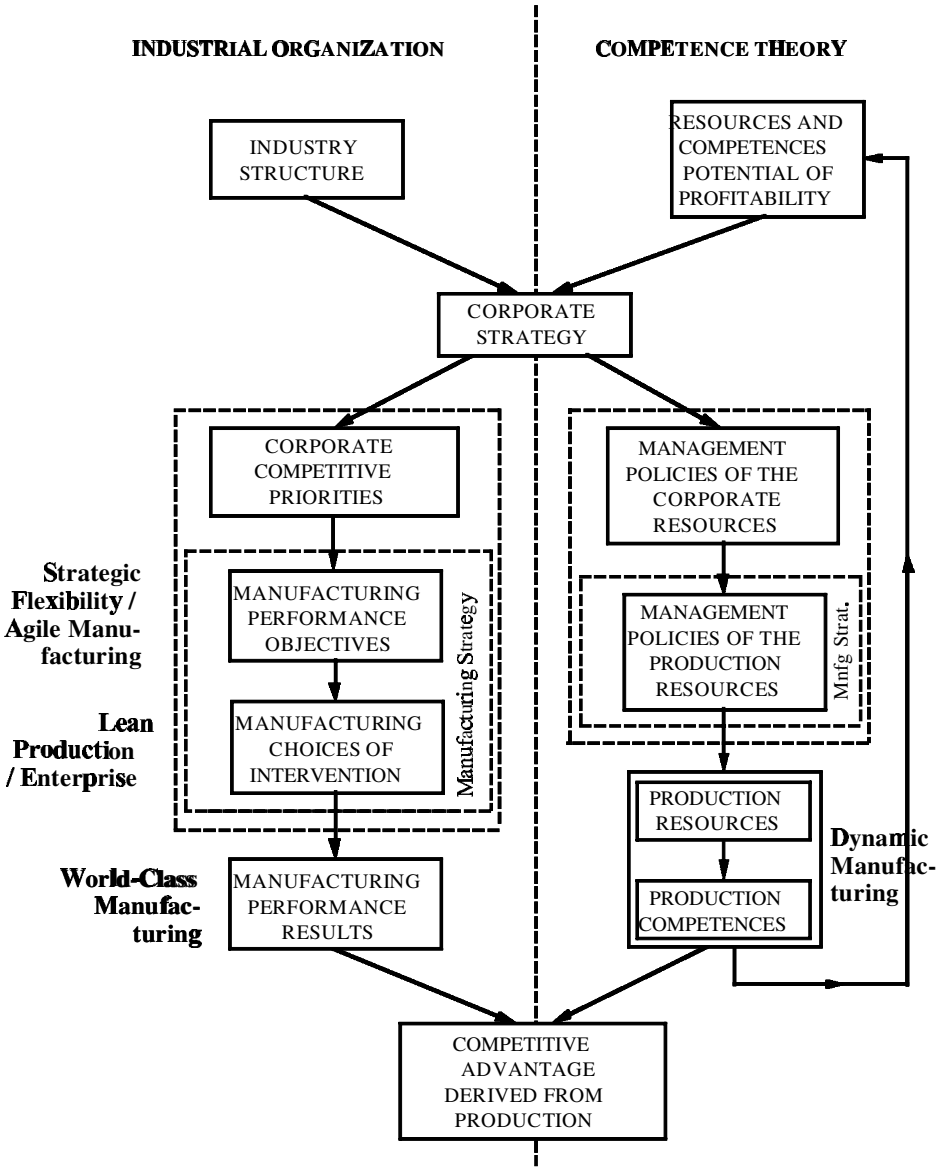

Figure 3. Industrial Organization and Competence Theory integrated view of corporate strategy (external dotted squares) and manufacturing strategy (internal dotted squares): proposal for the collocation of the new production models.

are the tasks that must be carried out by the production function in order to reach the corporate competitive priorities (key success factors), identified by the deployment of the corporate strategy. The manufacturing strategy thus becomes one of the 'levers' (together with the strategies of other functional areas—these ones are not shown in figure 3) to attain corporate competitive priorities. Therefore, both the corporate strategy and the manufacturing strategy are interpreted as a choice of priorities and intervention actions.

The CT scheme considers manufacturing strategy in terms of policies for managing production resources, while the corporate strategy considers the management of all the firm's resources and not only the productive ones (also commercial, financial, etc.).

The missing links in figure 1, between operations management (through the new production models) and strategic management (both corporate and manufacturing strategies) could be reduced by this interpretation. In fact, the scheme suggested for the strategic analysis enables the different proposals advanced for so-called 'post-Fordism' to be considered within a single strategic framework (figure 3):

- Strategic Flexibility (or Agile Manufacturing) model concentrates on the competitive priorities (overall performance objectives) and on the capability to change them in time (we could say the Skinnerian concept of 'focused factory' interpreted in a dynamic sense).
- Lean Production/Enterprise emphasizes practices and intervention choices which help lower consumption of resources, whether of production or other functions of the firm (as will be seen below, Lean Production—or 'first Toyotism'—was successively developed stressing different aspects—'Swedish' and 'German' models—and the first original Toyotism has been revised and softened to such an extent that one may talk about a 'second Toyotism').
- World-Class Manufacturing—though in many ways similar to Lean Production—focuses on attaining excellent 'world-class' performances, at which the intervention choices must be aimed (the latter are not selected because they lower the consumption of resources, but for the performances which they help obtain). In other words, the WCM firm could be slightly 'fatter' than a 'lean' one (as in the case of the strategically flexible enterprise, 'fat' is chosen as it is more than counterbalanced by the advantages of being agile on the competitive scene, but for the WCM firms this 'fat' could favour performances other than agility e.g. quality capability or service facilities).
- Dynamic Manufacturing appears to be the only case in which a new production model, besides holding principles in common with the others, in some way recalls concepts leading to the Competence Theory. 'Manufacturing strategy can no longer confine itself to guiding short-term choices between competitive priorities like cost, quality and flexibility... manufacturing strategy is not just about aligning operations to current competitive priorities but also selecting and creating the operating capabilities a company will need in the future' (Hayes and Pisano 1994).

The main interpretations of the new production paradigm seem to consider, from time to time, all the construction elements of a logical process which develops the strategy along the dual pathway of the levers/performances and management of resources to reach a competitive advantage. It can also be seen that proposals for the manufacturing strategy (thus in the ambit operations management) fit perfectly into the picture of the corporate strategy (thus in the ambit of strategic management).

The different production models, considered conjointly, appear to be something more than a simple collection with some principles in common. However, taken all together, do they really represent a new 'production paradigm'?

7. Discussion and conclusions

The proposed framework provides an overall view of production models. One can deduce how the main interpretations of the new production paradigm appear to consider, from time to time, all the constructive elements of a logical process that develops strategy (both corporate and manufacturing) along the dual pathways of practices/performances on one hand and resource management on the other, to pursue the competitive advantage. Thus considered jointly, the different production models appear to be something more than a simple collection of models having principles in common. Taken altogether, can they really represent a new 'production paradigm'?

First of all, it must be made clear that this hypothesized paradigm is not immune to limits and/or applicability conditions (Cusumano 1994). It is sufficient to remember that the empirical examinations apply mostly to the automotive industry, where variety is accompanied by high numbers. Carrying out a flow production in small firms which operate on customers' specifications evidently poses problems. Involvement of the work force is also a limiting factor, and is nation-conditioned too. As a whole, the new paradigm seems to be efficient if everything is functioning well, but has few defences if a difficulty crops up. The elimination of warehouses and all other 'slack resources' strips the production system and makes it vulnerable to oscillations in input.

Not so much in regard to the limits as to the paradigmatic incompleteness, Womack *et al.* (1990), in *The Machine That Changed the World*, underline the company's areas/activities that have not yet been touched by the new trends, in particular: finance, human resources and globalization. 'We maintain that the lean producers must face the problems of financing, management of the personnel and the global co-ordination of different activities taking place in various parts of the world, in a very different way from mass producers. The lean approach to these activities, if it can be perfected, will complete the lean enterprise'.

In spite of the limits and conditions mentioned, and a certain incompleteness that could be the result of infancy, why does it seem hazardous to consider the emerging production models as 'a paradigm'? In our opinion, there are two reasons.

- At an exclusively productive level, there is the difficulty in interpretation and the existence of many production models, the principles held in common are not sufficient to claim that it is truly a paradigm (problems of 'internal coherence').
- At a social–economic and institutional level, there is not an adequate answer to the changes which are evident in the factories (problems of 'external coherence').

These two aspects will be now briefly discussed.

Focusing only on the productive level (for the moment, setting the social–economic considerations aside), according to different authors (among others: Engstrom *et al.* 1996), an agreement has not been yet reached on the interpretation of post-Fordism; there are the following.

- Those who uphold the complete abandonment of the Fordist factory, and then consider Lean Production as a perfect model or, in any case, completely severed from the past (a new production paradigm really exists).

- Those who assert, in contrast, that post-Fordism is still something indeterminate, they discern the break with the past, but the answers are several.
- Those who maintain that these responses, in reality, can be reduced to a few common principles, and so a new paradigm exists, though there is a certain amount of difficulty in identifying the basic principles.
- Those who believe that you cannot speak of a true paradigm, as the above mentioned principles are declined too differently in relation to the national contexts or the strategy/size of the firms.
- Those who declare that the different declinations will eventually converge, and that their diversities (in any case much less relevant than those that exist with Fordism) are only due to transition and different starting points.

The only certainty is that there is not perfect uniformity in the choices made by the lean/world-class manufacturers. Though not considering a firm's size and different strategies—which will be discussed later—doubtlessly new production models exist that are different. The problem is, rather, to evaluate the actual degree of difference.

Among the most significant models, whether undescribed or later than *The Machine That Changed the World*, can be found, are the following.

- Swedish one.
- German one.
- Japanese one, known as 'second Toyotism'.

The Swedish experience (Berggren 1993, 1994, Sandberg 1995, Karlsson 1996) is, to an extent, a case apart. It has not been exported and indeed is differentiated within Sweden itself. Both Volvo and Saab (the two main producers) have gleaned experience from other industries (industrial and aeronautical vehicles, etc.). However, there are, two fundamental features in common: a clear, constant social–technical background, and continuous learning/experimentation, to such an extent that sometimes one could speak about involution if not cyclicity. Omitting the solutions adopted in the joint ventures with Mitsubishi and Renault (clearly influenced by the partners), now the Volvo factory in Torslanda seems to have discarded the first Uddevalla experience and drawn much closer to the Japanese model.

The German model (Jurgens *et al.* 1993) is characterized by a product of high quality, an extremely professional work force, a constant quota of work decoupled from the line, marked social consent and an efficient educational–instructional system. If on one hand there is conspicuous anthropocentrism (in part derived from the Swedish model), it is important to underline that there are also important differences in respect to the lean model for antonomasia. Just think of the high number of personalized products from the Rastatt Mercedes factory, for example. This latter characteristic is present also in the so-called 'second Toyotism'.

The development of the 'second Toyotism' or more simply the revision of the classic one, is a consequence of the changes that have occurred recently in Japan. It may be summed up as the effect of the price of the yen, reduced demand, the increased cost of money following the 'bubble economy' of the 1980s (in particular the credit system), and consequently reduced investments, and last but not least an incipient social change, with especially younger people demanding a better quality of life. As far as specifically productive aspects are concerned, all this translates into an attenuation of the guiding-principles of classic Toyotism, though at present limited to a few factories, including the famous Miyata one. The broken lines and the out-of-

line are noticeable to such an extent that one could say it is a partial revision of the classic Toyotism.

Recapitulating, when one sees a Volvo that seems to have become less 'social–technical' and more 'Japanese', and a Toyota which vice versa seems in some way to resuscitate Uddevalla (also the General Motors' Saturn factory owes much to Uddevalla; Rehder 1994), one can have doubts about the convergence of the different production models into a single production paradigm.

Regarding the productive level, a final but important question concerns the relations between the new production models, firm characteristics (size, structure, overall strategy, etc.) and environmental variables (industry type, market dimension and dynamics, intensity of competition, etc.). It is true that every new theory involves conditions under which it can be applied and adapted to different situations, but it is equally true that very little exists about the characterization of these models, for example, in small and medium enterprises (SME) or different types of industry. The only thing that can be said is that, if 'the essence of strategy is the diversity' (Porter 1996), then not only 'lean/world-class' producers have success, but also high quality producers (almost 'neo-craftsmen') with a market limited to a precise segment, or price–competitors (almost 'neo-Fordists') with a low degree of innovation and medium–low quality.

The different declinations of the models presented seem to regard the geographical origin of the models exclusively—that is in the context of a specific country—rather than other factors. As a consequence, empirical research aimed at investigating not only the degree of diffusion of these new production models and their commonalities, but also their relationship/differentiation in respect to the firm's characteristics and environmental variables, are decidedly missing.

Extending the analysis, undoubtedly one notes the absence of links between new production models and the social, economical and institutional context, connections that were well characterized in the case of Fordism. In fact, the problem of the 'external coherence' of the new production models may be the true obstacle hindering reference to an emerging 'paradigm'.

The so-called 'post-Fordism' (having to resort to the term 'post-Fordism' demonstrates the paradigmatic insufficiency of the new production models) lacks social–economic change comparable to that in the work/wages relations and in the aggregate demand/offer which occurred in the golden age of Fordism.

Fordism has gone through two phases: the first before the crisis in 1929, when production was 'scientialized' but not society which continued to function according to the old rules (there were few jobs in industry and the demand for work—mostly by ex-farmers—was high while the wages were low, etc.); the second phase, after the second world war, was of 'mature Fordism': both factories and markets were 'scientialized', and in addition there was the Keynesian State, that is political and social agreements.

As a result of the petrol crisis and monetary fluctuations, Fordism is no longer here. There is a return to risk, to individualism (personal and collective), which from one point of view brings newly earned freedom, but from the other an increased sense of precariousness.

Mature Fordism was supported by a 'corporative' society, while today we are living in a 'universalistic' society, characterized by universal features (borderless technology, globalization of finance and markets, demand for mobility, etc.).

The new production models do not give this the consideration it deserves. Often they do not really seem to emerge from the factory and consider also markets and society, thus giving rise to a paradigmatic completeness.

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