

Reorganising the Product and Process Development in Fiat Auto

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Abstract

Continuous innovations in product and process technology, coupled with time-to-market pressure, have made rapid product development a key strategic objective of manufacturing firms. Consequently, many firms have started to redefine the ways in which products are designed, developed and produced, so as to reduce the time from conception to manufacture. The strategies employed to achieve this goal vary, and include the integration of functions through selective use of concurrent engineering, the formation of strategic project teams, and technological connections by CAD/CAM systems. The research reported in this paper, coordinated by the WZB Institute of Berlin, is aimed at examining organisational, technological and human resources practices that enhance quality in R&D by improving communication and co-operation (C&C) between the actors. Although the research was carried out in 4 countries (Germany, Italy, Japan and US) and in 3 sectors (car, personal computer and machine tools) this paper analyses the evidence provided by a set of face to face interviews of the managers, engineers and designers of a European car producer.

Jel Classification: L32; O32

Introduction

At the end of the 80s Fiat Auto's structure was widely compared to the most important car makers, although it was going through a good competitive period.

Twenty strategic projects were defined in Fiat Auto during 1991 to favour the adoption of a new style of management and the transition to a more flexible organisation aimed at continual improvement. These projects were the first elements of the Total Quality Project.

In Fiat Auto the Technical department is responsible for product development. It employs about 4,000 staff and is organised by function. The Technical department has been directly involved in two Total Quality Project projects: Time To Market and Carry Over.

The new set-up of the Technical department is structured in such a way as to operate using two different methods.

On the one hand, in the horizontal sense, the new product is developed by cross-functional teams (platforms). Platforms have to meet times, contents, costs and quality expectations defined by the Product Range Plan in the mission statement of the new model.

On the other hand, in a vertical sense, the Technical department sectors will have to guarantee the know-how of the resources: labour, facilities and technologies. Moreover, contribution to the development of a new vehicle also takes place by improving the Component Development Plan (shelf engineering).

Therefore we have the formation of a matrix structure along product lines that correspond to the various market segments (platforms) and the Technical department sectors.

The new organisational set-up can thus be seen under a twofold articulation:

- Platforms have to control the process to reduce times and costs, and guarantee the integrity of the new model.
- Sectors have to oversee the know-how of the projects to ensure quality and innovation.

1. Description of the product development process

Fiat Auto's product strategy has tried to emphasise the different car items highlighting the needs of the vehicle as a whole from that of its parts. Such a breakdown has brought about a dual form of management that briefly refers to two functional structures.

It is the Marketing department's role to oversee the stages that will lead to the identification of the new vehicle, especially as far as the formulation of the characteristic contents are concerned (client viewpoint). It is the Technical department's role to find and perfect new solutions for the development of components (factory viewpoint).

The definition of the final product has been considered as the moment of synthesis of these two realities, the meeting point in which the market needs detected by the Marketing department are satisfied in the innovative process carried out on each component by the Technical department.

The identification of the development procedures for each new car would not be so significant if it were not seen as part of the global product strategy. In Fiat Auto's case,

there are three trade-marks and about 20 different models in production, many of which are in the same segment.

In Fiat Auto, the formalisation of the launch of a new product, as well as the main features and the assigned funds, comes within the guidelines defined by the Product Range Plan devised by the Marketing department.

The Product Range Plan begins to outline the features of a new model ten years before it comes out onto the market. Obviously at the beginning only the macro-tendencies are defined. It may be supposed that the model forming part of a specific market area will very probably have a new chassis compared with that of a car currently in production, the dashboard will be created using new emerging technologies and materials and the brakes will be devised in a different way. Year after year the amount of information increases until it reaches the definition of the mission statement of the new vehicle. This happens when the beginning of the definition of the style of the new model is completely defined.

In the same period and in parallel to the Product Range Plan another plan is devised, in this case by the Technical department. The Component Development Plan breaks the car down into about 60 components. Each of these components is jointly analysed by the Technical, Technological, Production and Purchasing departments.

The same component can be supplied by several suppliers and can have different typologies. It is up to each plan team to decide the features of each of the various systems or subsystems of components. Weights, costs, reliability and dimensions must be related to client's needs, the characteristics of the product, the response of the competition and the current and future market situation.

By definition, the Component Development Plan is in continual evolution both regarding macro-breakdowns and contents. Therefore one of the basic requisites of the cross-functional teams is the continual monitoring of market changes.

In the future, Fiat Auto intends to account for around 70% of the cost of the final model on the Component Development Plan.

The formulation of the mission statement of a new model comes about in mutual collaboration with the activity of component development, and can be defined as the continual transversal reading of different component development plans.

On the other hand, it is the role of the Marketing department to integrate the plan and inform of changes highlighted by the market: new client needs, new technological developments and new national laws.

With the definition of the mission statement, the macro-definition stage ends and the real development phase begins.

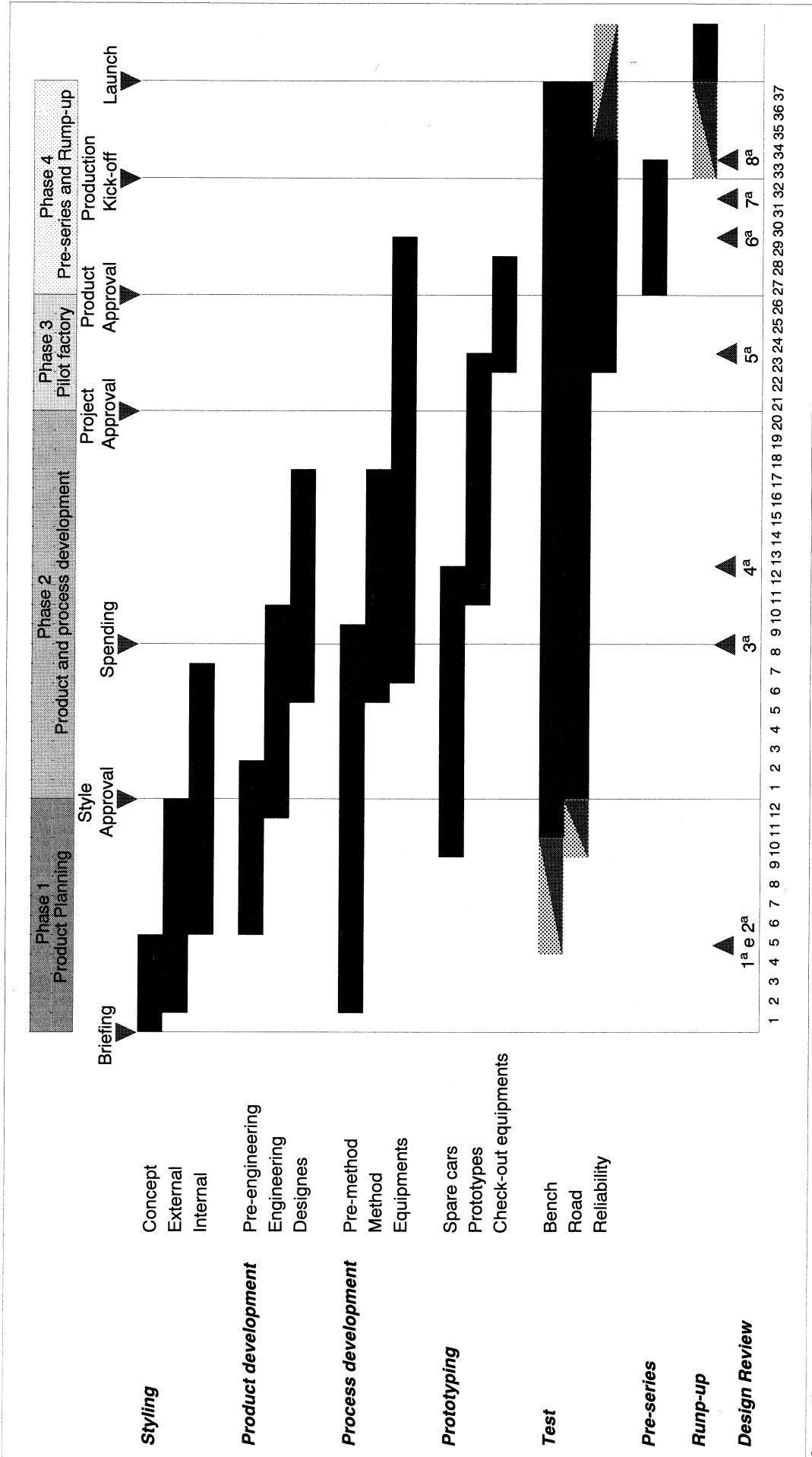
1.1 Main stages of product development and time structure of the process

Fiat Auto has divided the product development process into 4 macro stages and 9 milestones (Fig. 1).

The total time to market is currently estimated at 36 months, from style approval to production rump-up. With previous planning methods the time needed from conception to mass production was on average 60 months, that is, about one and a half years more. Fiat Auto is now going to reduce time to market to 24 months.

This result has been achieved by paralleling: overlapping product and process engineering, prototyping and pilot factory, and anticipating the activities not related to style approval.

Figure 1: Gantt chart in Fiat Auto



Source: Fiat Auto

Fiat Auto's view point on prototyping is to build prototypes with a limited amount of new contents and to limit drastically the total number of prototypes built. So tests will be dedicated to a few specific contents, in order to reduce the financial outlay and obtain results more quickly. Earlier testing is more pronounced for those components not tied to style aspects, which may be tested using "spare cars". For this reason they are also qualified as prototypes.

In the final phase of the prototype stage it is possible to carry out overlapping with the pilot plant for the repetitive parts that are not subject to further changes. Such parts, that will have to be assembled on the last prototypes will begin to be built using the same production process of the final production.

2. The relation between functional and project organisation

The platforms are functionally placed within the Technical department because one of the roles of the Technical department sectors is to make the following available to the platforms:

- human resources, once suitably trained with the professional skills necessary to carry out and achieve future goals. In fact most of the platform team members come from these sectors;
- testing equipment, on the road and on bench so that the platforms are able to compare the results obtained with the expectations for the new model;
- calculation procedures and all the relative codes necessary for the development of the projects and for the test methodologies. All these activities are centralised to ensure the same criteria for all sectors;
- CAD/CAM instrumentation, for design and to enable the creation of dies and all the equipment necessary for the production of details with CAM technologies.

To bring the required model into production in the shortest time the platforms must limit their work to the application of the components and not to its complete development. Therefore it is the role of the sectors of the Technical department to make available the greatest number of components to be assembled on the new model. That is to say, make available the components that have already got technical approval and that are practically adaptable on a developing vehicle.

Finally, the Technical department must co-ordinate the platforms in specific aspects that involve the whole vehicle system, those which cannot be studied within a specific function, and yet at the same time affect several developing models (acoustic comfort, passive safety, ...).

This need emerged following the introduction of platforms, and has been faced, since 1992, by the creation of so-called transversal plans. Fiat Auto considers the number of transversal plans between platforms a good estimation of internal communication.

2.1 Platform structure

The basic element of the matrix organisation is the interfunctional team. Teams with different aims can be formed depending on the objectives and tasks set.

Platforms are normally structured on several functional levels. Each level corresponds to a specific team with a team leader at its head.

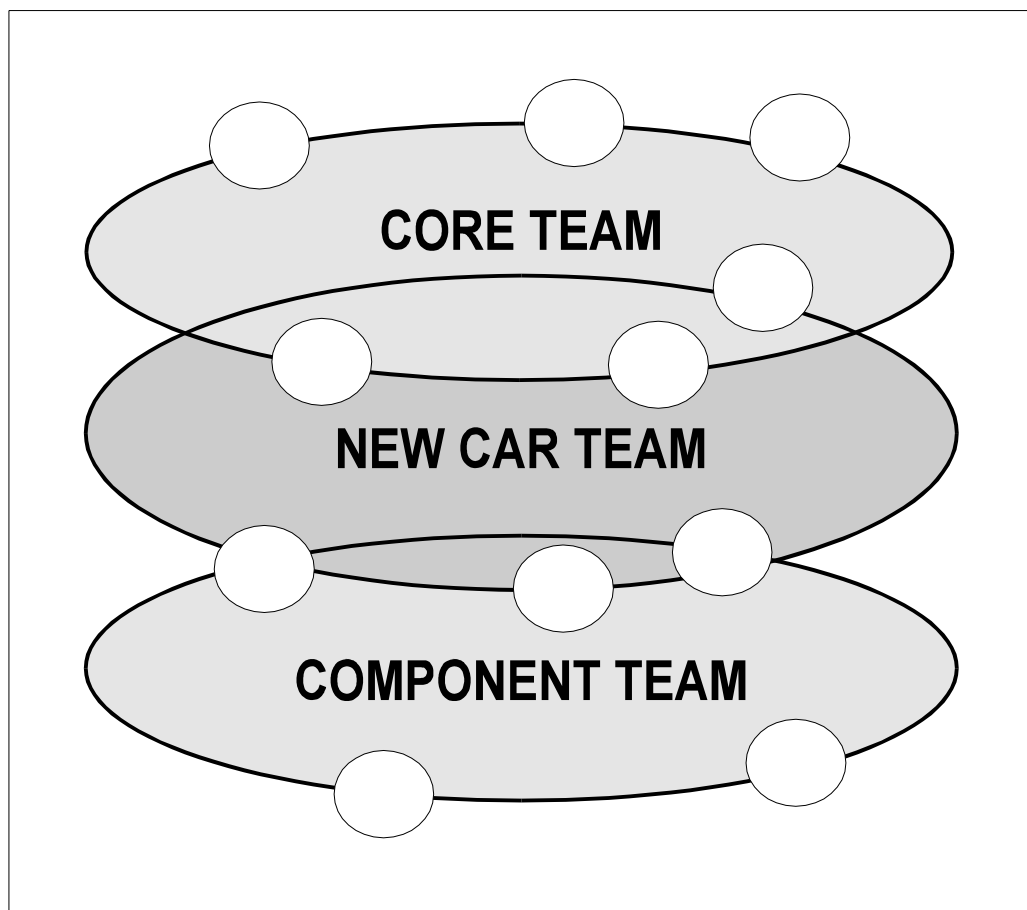
In a platform the general tasks can be divided as follows:

- The lower level, development team, has the task of following all the phases in the development of a specific part of the new model;
- The intermediate level, product team, co-ordinates and harmonises the development team's activities and defines the overall product planning;
- The upper level, core team, pursues the optimum conditions between similar products, plans the overall tasks, manages resources and reports directly to the Board of Directors.

The divisions between the different levels are by no means schematic or rigid. Some individuals may appear in more than one level, for example team leaders and some functional representatives, in order to facilitate the flow of data within the platform. So communication and co-operation (C&C) is facilitated through the direct contact between the members of the operative work groups and those above who have been delegated more of the management and co-ordination aspects.

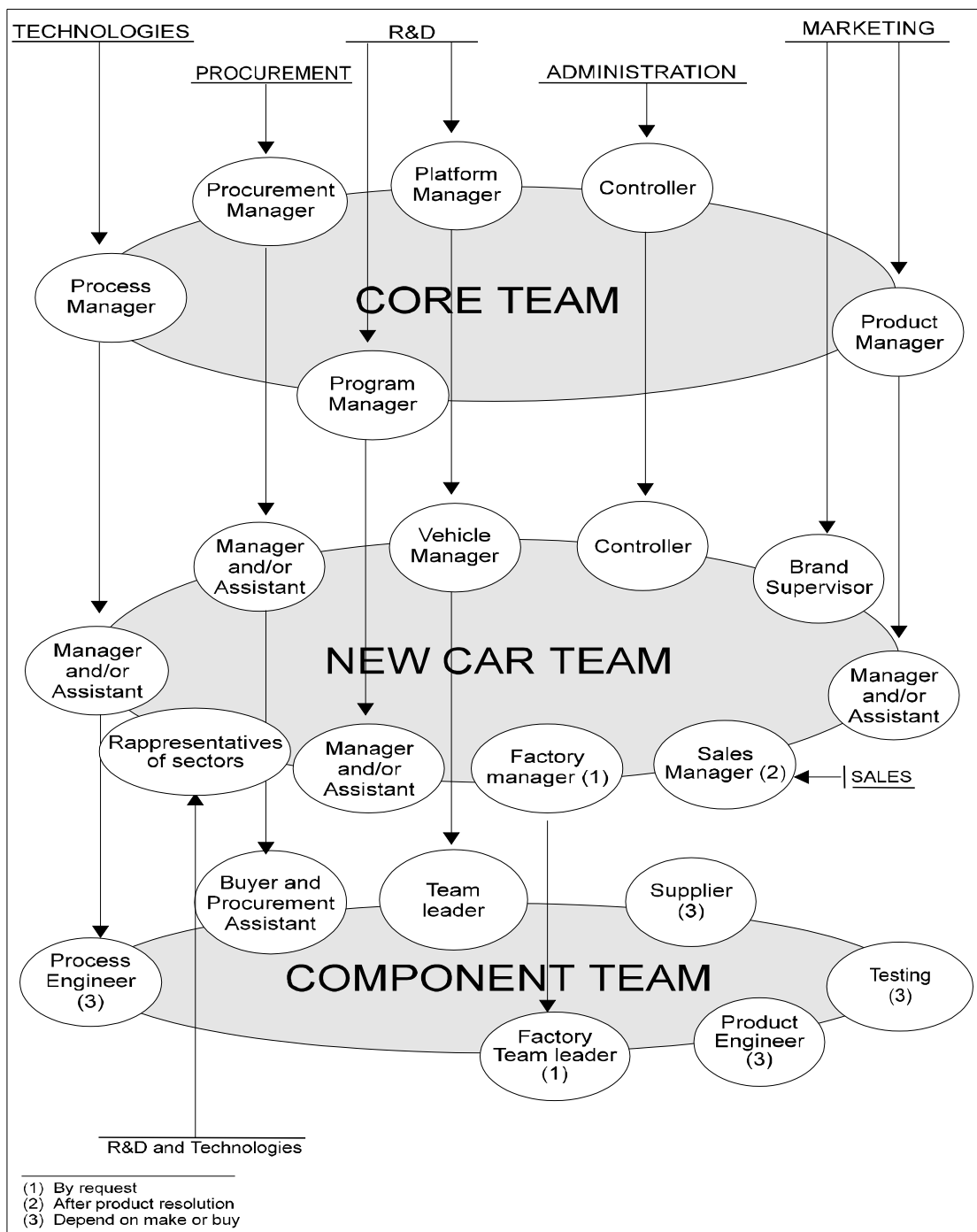
The actual configuration of the platform is, therefore, closer to a continuum of interconnected structures forming a pseudo organisational chain, than to a series of hierarchical, superimposed and distanced structures (Fig. 2).

Figure 2: Platform structure



The platform core team is composed of: Platform Manager, Product Manager, Process Manager, Purchasing Manager, Program Manager and Finance Controller (Fig. 3). The Purchasing Manager and the Process Manager are the members of the core team who interact most with the Platform Manager. They are linked functionally to the Platform Manager even if a hierarchical dependency does not exist.

Figure 3: Platform structure



The Product Manager's role is of extreme importance, in fact he guides the members of the platform from the mission statement to style approval.

Hierarchically related to the Platform Manager, the Vehicle Manager is also present in the core team. He must follow the technical aspects of the project, in order to guarantee the execution, the technical suitability and the overcoming of weak points.

Within each platform, there are several vehicles, usually one or two per trade mark. For each model, a reference sub-team is created to reflect the core team. Therefore, for each model we have a representative for each of the figures previously listed. The Vehicle Managers, representing the Platform Manager, will interface with the Marketing Assistant, representing the Product Manager, with the Purchasing Assistant and so on.

In the product team the Brand Supervisor takes part as well. He comes from the marketing area and has the task of directing the client needs, evaluating the parameters and the programmed performance and supervising the specifications of the specific brand.

Distinctions between core team and vehicle team are not rigid, managers may take part in vehicle teams and communicate with the other assistants.

Towards the end of the project the Production Manager and the Sales Manager were also involved in the work group.

The Production Manager mostly intervened during the pilot stage of production or when specifically asked, especially if the vehicle will be assembled in a plant with several models. In the future the Production Manager will be involved since the beginning of the process.

The Sales Manager tends to start operating 9 months before the launch and in a way takes on some of the tasks of the other representative of the marketing area, the Product Manager, who had followed the development process of the new vehicle from the definition of the mission statement of the model.

Many meeting points have been arranged between platforms and the functional structure of the Technical department. As well as the formal and informal contacts between the Component Development Plan (Technical department) and the Product Range Plan (Platforms), a specific professional figure is created within the organigram of the platforms, with the role of representing the sectors of the Technical department (Fiat Auto's acronym is RPA). This figure does not have the task of controlling or protecting particular interests, but is a technical reference point for the team leaders during the development of new vehicles. Besides, they must also organise the basic set-up during style definition, and identify the directives that characterise the new model.

If the total management of the teams is done by the Vehicle Managers who must coordinate all the planning and experimental type activities on all the components that go to make up the new vehicle, it is the responsibility of the RPA to monitor each individual subsystem, taking part in the vehicle team for the definition of the targets for the relevant area in coherence with those of the product.

The difference between these two figures is not only one of area, but it is also fairly substantial. In fact, the RPA limit the area they are involved in to regard only the technical, and not the technological aspect. They are purely technical figures, without the overall vision of the Vehicle Manager and for this reason fall within the sectors of the Technical department.

2.2 Simultaneous engineering teams

A third underlying organisational structure responds to the Vehicle Manager for projects that involve the formation of temporary organs, each of which are responsible for the carrying out of technical tasks and require the involvement of several people coming from internal departments and suppliers.

In each of these groups a team leader is appointed by the Vehicle Manager and the Function Managers, to co-ordinate, according to the modalities of concurrent engineering, the activity in co-location. The opinion of the production team leader may also be required at this point. Fiat Auto's plants are also organised by team.

The skills and targets that the team leaders must reach are jointly defined by the Platform Manager and Vehicle Manager. Usually the same team leader is kept throughout the life of the project.

The RPA are present in a transversal position to the team leaders and cover 5 areas: body, electrical equipment, engines, chassis, and finishing. They may take part in the activities of the teams to ensure coherency with the defined set-up.

The co-operation between the teams that are interfunctionally active on different models or platforms is not specifically included. Dialogue takes place with the Brand Supervisor or via the RPA.

During the development of Fiat Auto's new model for segment C, the role of the representatives of two sectors of the Technological department (assembling and pressing) emerged as well. Their tasks are similar to the Technical department ones, but they are not yet well defined.

The team leader is a professional figure with relatively new tasks that has only recently been introduced in Fiat Auto. Before simultaneous engineering a project leader was appointed to co-ordinate a dozen designers in the development of a particular macro component. The present team leader comes professionally halfway between the previous project leader and the ordinary designer. The presence of the RPA in the platforms is essential to support the transformation of the former designers into team leaders. As a matter of fact the RPA are none other than the former project leaders.

2.3 More than concurrent engineering

Concurrent engineering, co-location, co-design are methodologies largely debated in literature and are basic in managing product development information.

The need to share specific knowledge and information during the initial and final moments of overlapping phases has highlighted the multiform competence present in determinate organisational units of Fiat Auto. They are fundamental along the process chain in correspondence with the customer dissatisfaction gaps and may act as units for meeting and exchange between different specialist contents.

The designers of the style centre are more able than product engineers to take in marketing points of view. The product engineers and process engineers intervene in the prototype construction to improve the product and anticipate the problems that may arise during production. In the pilot factory the production process is experimented by the members of the development team and the factory workers.

The logic of co-location remains because not only data are transferred but also the data holders. In the initial phases the product development teams work prevalently in collaboration with the style centre. During the study of the details some product and

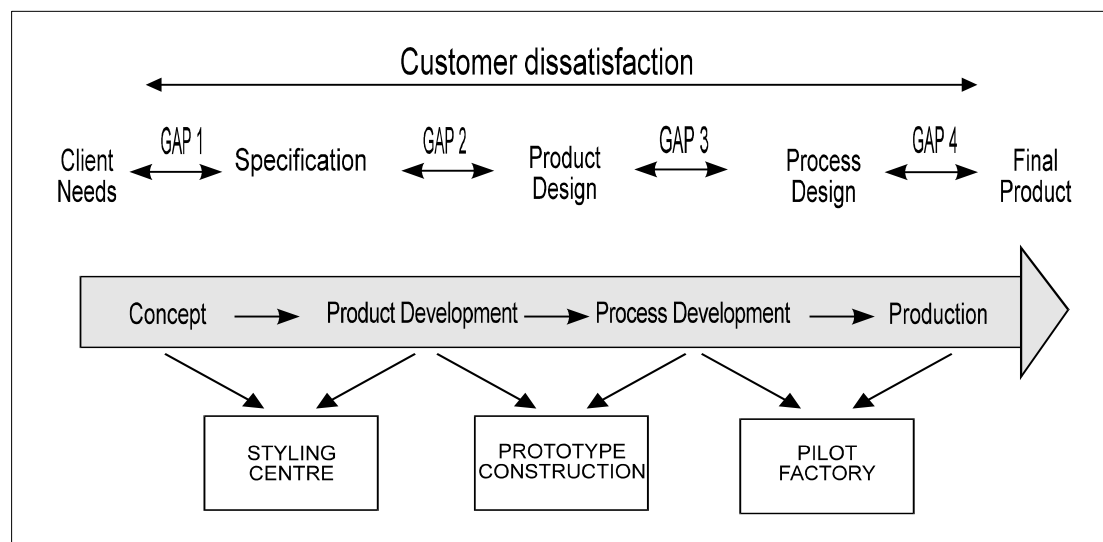
process engineers follow the construction of the prototypes closely. All the work groups move to the pilot factory for the process tests.

The identification of the specific capabilities of these organisational organs tends to locate these units when the principal milestones occur. They constitute a functional integration method in addition to co-location.

Style centre, prototype construction and pilot factory existed before simultaneous engineering, but their potential in C&C had not been widely used. Styling was a sequential design phase. Prototypes were generally constructed by craftsmen located in Fiat Auto's Technical department. In the pilot factory only the process was tested and the transfer of knowledge to the factory did not take place.

Figure 4 highlights the data flows alternative to concurrent engineering which are able to reduce the disturbance factors in the transposition of the client expectations to the new product.

Figure 4: Information flow complementary to concurrent engineering



3. Factors facilitating the implementation of platforms

The advantages obtained by the overlapping of the activities in terms of time, costs and quality, can also derive from a different relationship within the structure.

On the whole, contrasts mainly concern technological incompatibilities during the changes, lack of workforce and the changes that have taken place during the reconfiguring of the product. In fact, the extent use of co-location has reduced hierarchy and spatial distance the traditional sources of obstacles to interfunctional co-operation.

This does not mean that all the problems have been solved. The fact that the main causes of disagreement between the various functional areas depend on the clarification and the adaptation of respective targets, on the attempt to maintain bureaucratic relationships, on the presence of technological incompatibilities, shows the lack of a

sufficiently shared space of agreement and a mutual understanding of their respective needs.

For this reason, facing strong potential resistance, intense and diffuse preventative action was taken by the Board of Directors to manage this change.

The cultural leap, the turning point had to be pursued overcoming possible resistance and at the same time avoiding permanent damage. The role played by the CEO was fundamental. Physically present in all the phases and in the decisive moments of time to market.¹

Support for the new structure was given by degrees. Initially moderately, in order to avoid immediate opposition and rejection. Following the platforms the authority and reliability needed to reach pre-defined objectives were supplied. This allowed the demonstration of the efficacy of such instruments to those, not only for power reasons, but for real conviction, who had always used traditional operative methods which have lost their efficacy over time.

The commitment of the top ranks of the company was shown particularly by their letting the platforms operate above the functional structures, calling for far-reaching organisational choices.

Among these, for our purposes, co-location and lean organisation should be remembered.

It is important to underline that co-location is not restricted solely to the members of the team that develops the single detail, but is effected simultaneously among all the development teams.

Their gathering together in one large room, without divisions or paratia has certainly facilitated, from a psychological point of view, C&C. It is no coincidence that informal communication is preferred to formal or written communication in specific rooms.

There is a danger in co-location. Many firms feel that when spatial separation is eliminated, the other functional barriers that hinder C&C will also disappear. There is the real risk that the initial euphoria and the benefits deriving from co-location will soon vanish if really shared work is not experimented within spatial proximity. Co-location must be seen as a tool, not as an aim. It must be followed by a series of operations that are able to create a mutual process of orientation between colleagues that had previously been separated and are now spatially together. For example: management of delegation, reduction of bureaucracy to a great extent, adoption of a common language and of clear and concise objectives, and the role of the project manager and the team leaders.

The third factor which has facilitated the use of platforms in Fiat Auto is associated with the internal organisational redistribution, through the reduction in hierarchical levels, defined in other terms as implementation of concepts of lean organisation, the re-dimensioning of the staff, the elimination of many intermediate bosses and the insertion of personnel with academic qualifications.

If on the one hand the reduction in hierarchical levels permits the attainment of efficiency objectives by saving on structure costs, flexibility objectives by improving the client response capacity, and efficacy objectives by finalising efforts to the essential, on the other hand lean organisation imposes a radical re-thinking of the structural model and the organisational functioning. The lean organisation creates the conditions for

¹ Quoted from an interview

streamlining C&C processes. By reducing the number of passages, barriers to rapidity and clarity of information are eliminated.

However, the use of co-location and the introduction of lean organisation concepts would not have been enough to win over resistance if these organisational methodologies were not made concrete in simultaneous engineering

The project was in itself of fundamental importance and the advantages derived from the new organisational structure were immediately obvious. Success was seeing a product conceived in a radically different way².

4. Communication patterns in the process chain of Fiat Auto

Depending on the organisational units involved, three different difficulties can currently be identified: those concerning platform structure, those concerning the relationship with the Technical department and those concerning the C&C to the other functions in general.

Despite the fact that C&C within the platforms have been widely recognised as fundamental and are the subject of continual extension, preferential relations undoubtedly exist dictated by the needs of the moment or situations embedded in company culture. These relational factors are not fortuitous and follow precise rational behaviour.

The results in figure 5 and figure 6 are obviously reflections on the data obtained³.

The importance of the platforms as a bonding factor between the functional areas involved in the development of the product is further confirmed by the fact that all the components of the core team have declared that on average 70-80% of the informative flow takes place within this structure, whereas the other forms of contact turn out to be computerised systems (10%)⁴ and less importantly written communication and telephone conversations (5% for each).

Another element that shows the importance of platforms can be linked to the nature of the necessary documentation to begin the activity of each team. In Fiat Auto such documentation emerges mainly from within the platform and therefore it does produce potentially wrong interpretations.

4.1 External interfaces

Figure 5 shows the external interfaces in the early phases. The traditional net separation in the management of external relations stands out. The industrial departments - Technical, Purchasing, Technological and Test function - as well as the Financial Control function were assigned the task of interacting with suppliers, in particular with

² Quoted from an interview

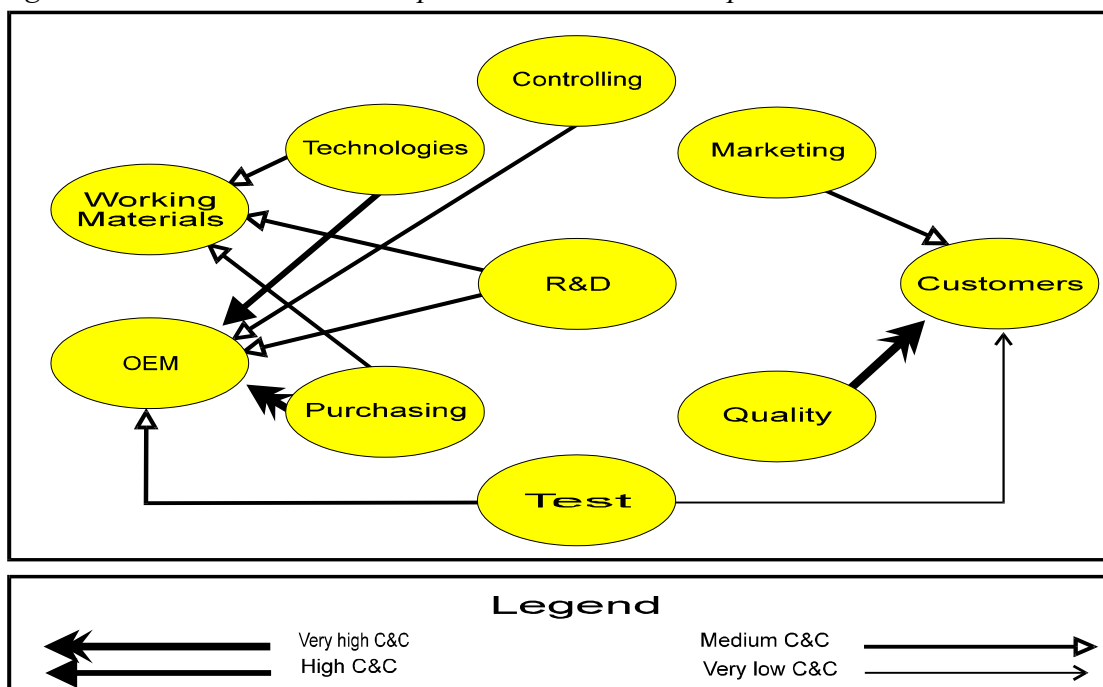
³ The difference in the figures is due to the representation of the intensity of co-operation. A minimum level of interdependence exists at any stage between the members of the core team but it has not been shown graphically for simplicity. With regard to external partners, however, if no arrow has been included, it is because no interrelations have been declared.

⁴ With the complete development of the CAD model it is thought that the communicative flow through the computerised systems can double.

OEM suppliers. Communication and co-operation with regards to suppliers were rated highly during the entire development cycle of the new model. On the other hand, the product management sectors - Marketing and Quality - had the task of finding the voice of the client and the Test function alone made direct reference to the clients. This is due to the fact that during prototype checking it is not only the reliability of the solutions which are taken into consideration, but also the feel of driving the vehicle which is seen as a distinctive brand feature within Fiat Auto.

At the end of the process the external interfaces changed a bit, particularly by the Technical department. A more intense relationship with suppliers and weak signals of un-mediated openings to clientele have been pointed out.

Figure 5: Communication & cooperation in the external process chain

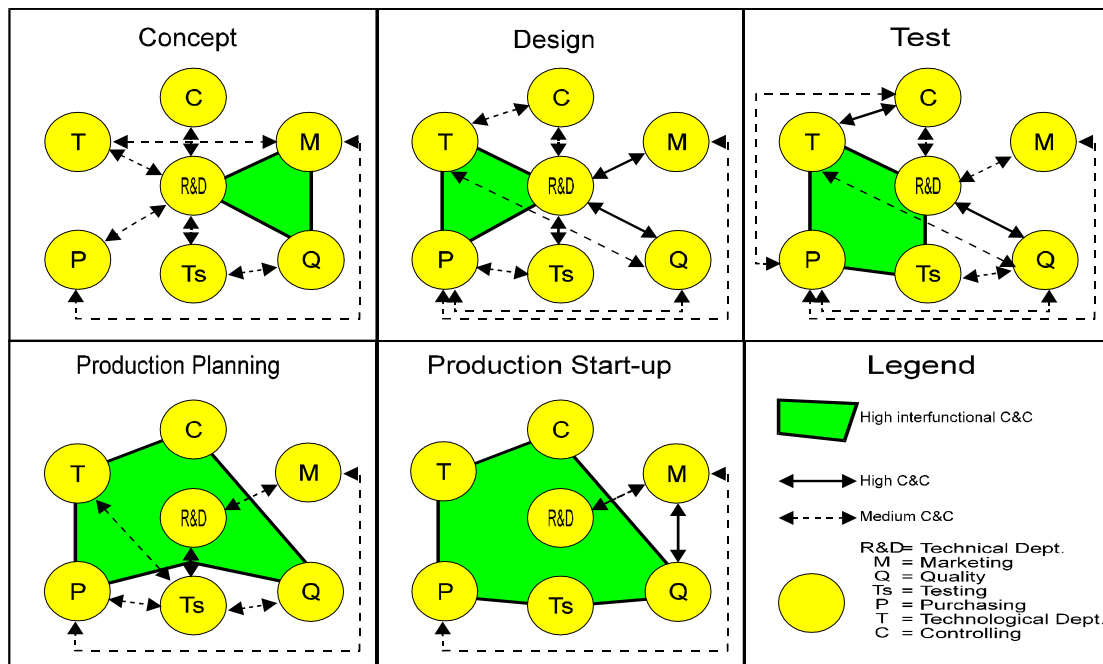


4.2 Purchasing role

Apart from Technical department, figure 6 shows the *trait d'union* role of Purchasing among all the partners. Purchasing plays a basic role in the connection between external and internal interfaces. According to Grando and Siamesi (1991) the Purchasing function is more and more a boundary organ between internal and external, attempting to render the company's needs compatible with respect to volumes, means and time.

Here lie the principal analogies with marketing, and the constant connection highlighted by figure 6. Both functions lie on the extremes of the process of purchasing, transformation and sales. Purchasing and marketing, in particular, seem to reach out in their constant monitoring of the external environment and interfirm negotiation processes.

Figure 6: Communication & cooperation in the internal process chain



Product development is a process characterised by uncertainty, by continuous problem solving, by elaboration of marketing data which may also be inferred through suppliers. In the traditional organisational model (Sandell, 1994) environmental uncertainty was correlated to an increase in specialisation and differentiation between the functional organs in order to distribute the uncertainty between them. Increasing interaction between company and the environment, induced by global competition and product complexity requires instead, a progressive integration between functions focused on internal processes and functions outwardly oriented to improve the process of conversion of market expectations into adequate solutions.

Using platforms, the operative flows have not only been modified but also extended, greater involvement of suppliers in co-designing necessitates attention and complexity. Moreover, purchasing represents one of the principal cost centres where more incisive leverage can be carried out than for other expenditure (Mediobanca, 1993).

The common ground between marketing and purchasing on the internal-external boundary has caused a new orientation within the purchasing function with respect to the management of medium to long term objectives. Through buyer's marketing and procurement mix the purchasing function becomes a strategic interface to respond efficaciously to market changes, registering technological evolution. The move towards externalisation changes the traditional role of purchasing from the administrative management of suppliers, to the management of suppliers integrated with company needs, thus improving C&C flows, transfer of technology and competence.

In the past design was mostly carried out internally. The Purchasing function's task was, therefore, to ensure the availability of supplies at the lowest price. This related the purchasing function to production, while under the current situation the connection is more with product and process development (Burt, 1985).

This organisational change also causes new operative implications for the buyer and the

controller, the principal professional figures in the purchasing function. The buyer, who formerly dealt only with price and the arrival times and modes of the goods has moved his interest to the management of design components, to management relations, in order to be at the suppliers disposal and to active participation in the complete product development cycle. The controller, for his part, has given up the role of supervisor to become a consultant to the production flow in order to adapt the reciprocal needs in the customer-supplier relationship.

The role played by the purchasing function loses the content of simple interfacing with suppliers and takes on that of operative support.

Figure 5 highlights the absence of an exclusive relationship between suppliers and the Purchasing function, but it is open to the other members of the development team and has increased over time. Using traditional interpretation such a situation could have been judged as a bypassing of the Purchasing function whereas now it signals a plurality in interfacing. Nevertheless it requires more co-ordination.

Final responsibility with respect to suppliers no longer belongs to the Purchasing function but to the platform core team. For example, in Fiat Auto the ratification of co-design contracts is also up to the Platform Manager and not only to the relative functional head.

4.3 Internal interfaces

Moving on to the interpretation of internal interfaces (Figure 6) - the first fact to be underlined is the role of technical management, represented by the Platform Manager who is always involved in the highest levels of pluri-interfunctionality and continuous connection, with all the components of the core team. All the functions involved in the product development process reciprocally communicate and co-operate, but technical management is assigned the central role with more intense and constant communications flows.

Technical management interfaces mostly with (in order):

- Product Quality and Technological department with a maximum evaluation in all phases,
- Purchasing with which collaboration is elevated especially in the final phases,
- Marketing with which very close interaction occurs during the conception phase of the vehicle,
- Test function, the involvement increases from the conception phase to the pre-series production,
- Financial Control with which collaboration is constant from the conception phase and intensifies from the pre-series production onwards.

Furthermore, figure 6 shows that the interrelations between the internal partners grow and deepen alongside the project. As the project matures the investment made and the number of people involved increase, the number of items, for example the number of drawings, grows dizzyly as the production stage nears, the time necessary to affront problems diminishes and it is necessary to adopt drastic measures to resolve them.

Moreover, one notes an alternation between the functions leading the development activity which are marked by the gridded area in the diagram. With the end of the concept phase the involvement of Marketing lessens. During the conception phase of the new vehicle the Marketing representative covers a role of primal importance in that he has the task of guiding the platform members to the feasibility study. However,

afterwards his participation decreases, maintaining only preferential relations with the Technical department and Purchasing. The client needs are represented in these phases by Product Quality. In the final part of the process many of the product Marketing tasks are taken over by the Commercial department.

From engineering to industrialisation of the new model there is a continuous growth in the pluri-interfunctional relations on behalf of the principal industrial management sectors. Initially between Technical, Purchasing and Technological department, successively in the production planning phase with the Test function, during the pre-series production with Product Quality and Financial Control. At the moment of production rump-up the involvement of all the functions is complete excluding, as mentioned, Marketing.

Pluri-interfunctional co-operation, however, does not exclude bilateral relations of interest.

During engineering and industrialisation Technical management actively co-operates not only with industrial management, but also with Marketing. Also in this phase the Product Quality organ installs bilateral relations of medium intensity with Purchasing and the Technological department, interfunctional relations which will later be intensified and extended to the Test function.

The involvement of Financial Control occurs progressively. In each phase the number of interfunctional relations is increased by one unit, initially only with the Technical department and later with the Technological, Purchasing, Product Quality and Test function departments.

4.4 Design-Marketing interface

Within the firm the interfunctional relations which have been most critical are those where technical management interact with marketing and production. The problems in such relations may be seen as a comprehensible result of the sequential model in company task management. In the past they had distinct tasks: marketing had to think, research and development to study, and finally the plant had to produce.

The principal organisational factors which negatively influence C&C are in general: structural complexity, operative formalisation, central decision making and spatial distance.

To these conditioning factors we must also add socio-cultural elements which mostly regard the interfacing between marketing and technical functions.

Marketing people use more subjective, qualitative and indistinct information, whereas product engineers require objective, precise and defined contents. The marketing function is generally accused of paying little attention to technological aspects, while product engineers are not very market orientated. The two functions observe reality with two different horizons: marketing has a short term prospective and tends to react rapidly to changing market conditions, while product engineering operates in the medium to long term. Gupta and Wilemon (1988) affirm, for example, that product engineers find using marketing data difficult as they are judged incomplete, imprecise, not finalised and lacking in technical content. Biemans (1995) reports a long list of reciprocal judgements which are often underlined by the two functions, with the risk of generating useless stereotypes and prejudices.

According to Sandell (1994) the search for functional adjustments to integration must not be founded on the elimination of the differences and characteristics which are the

constituent aspects of the respective company missions. Adjustment should therefore come about through mutual and reciprocal adaptation to the respective roles assigned in the product development process.

In particular, as far as the co-operation between the Technical and Marketing departments is concerned, it emerges that if the relations of co-operation from the problematic aspect and not from the conflictual aspect are meant, maximum of attention should be paid, in order, to:

- the evaluation of the need to develop new products in order to adapt the requests of the client to those of product engineering,
- the categorical impossibility of postponing the announced date for the commercial launch,
- the evaluation of the need to jointly resolve determinate problems. It is a fact that Marketing is particularly inconsistent in defining objectives and project development cannot stand continuous changes in set-up,
- the reduction of the time needed to define and communicate a change to the initial project.

Within the Marketing sector it is also possible to find different points of view: Quality Control tends to achieve high standards of product content, the Sales department to rapidly arrange the broadest possible range of the different versions. Product Marketing has to mediate these two different visions.

4.5 Integration of manufacturing in product and process development

The same industrial nature of production focuses the discordances about the integration of manufacturing in product and process development on the technical area more: productive feasibility, respect of quotas, maintenance of tolerances, time management and above all, responsibility when changes are made to the original project.

This situation is valid for all the stages where the productive functions are called to realise a new product, in other words test, pre-series and mass production.

It must be remembered that in the product development process the process engineers act as representatives of the production lines and consent early highlighting of the critical points in the use of productive resources.

This does not, however, rule out the existence of substantial differences. In the technical sectors the largest cost item is labour, while in production is focused on fixed capital and supplies. Performance evaluation criteria thus differ. The workshop calculates machine times and material control, the technical office, on the other hand, personnel output. The reduction in the product life cycle has caused technical management to be organised by product while in Production the organisation is of a functional type. Task uncertainty is high in product development and minimal in production. Moreover, from these differentiations derive distinct forms of work organisation, in the productive functions bureaucratic forms prevail whereas technical and technological management are most professionalised.

The point of view of production is of great importance since the basic philosophy of Fiat Auto was mainly based on production until a few years ago. Obviously, a lot depends on the representatives and their mentality. The new organisational set-up has brought about a reduction, in a relatively short period, of a large part of the barriers that existed between the two functions. For example simultaneous engineering teams will carry out some of their operative functions in the plant. Moreover, the logic of the

integrated factory on the one hand and simultaneous engineering on the other have brought about an involvement of plant when the equipment is tested.

At the end of the design process the new plant lay-out must be evaluated, automatic functioning must be tested, component matching must be checked and specific equipment experimented with. The pilot factory has the task of certifying the realisation of the project, that is, the coherence with that which was planned and designed on paper.

In the previous set-up the systems and the equipment were not defined in detail, the production cycle was described in a general way and was not even formalised. It was the factory's duty to arrange everything with the high risk that it would not completely meet the set-up criteria⁵.

Now the start-up stage of production is carried out by the transferral of the product development teams along the productive lines, where the product engineers, process engineers and suppliers work together with the line workers to solve the problem of the activation of production. The cycles between them must be completely defined, respecting the initial logic and intervening on the product, if necessary, to make industrialisation easier or to solve any possible logistic problems.

Furthermore, the transferral of design know-how to the production process begins at the pilot factory. As the production volume increases knowledge of the project spreads: from the last prototypes partly realised and assembled with the definitive equipment up to the pre-series shortly before the commercial launch. In practice the pilot factory is a training school for the rest of the plant, allowing the highlighting of problems added by production volumes.

Simultaneous engineering logic is expanded to all the phases. Many of the problems arise precisely when line production is attempted: problems with supply, staff training, product problems, problems with technological feasibility, etc. The presence of the development work team during the perfecting of the process enables a solution to be found in a short time that before traditionally took months, in that the factory had to make the problem known to the process engineers, and if they failed to solve it had to involve planning, without considering the fact that the people who had established the work might have been transferred and the problem would have to be solved by others.

Co-operation in general and especially co-operation with Production is, therefore, fundamental.

The management of pilot production takes on considerable importance. The first perfecting of the process during this stage takes place in a suitable building near the co-location. As well as the equipment to be tested, there is also the transferral of the simultaneous engineering team and the staff of the plant that will have to produce the new vehicle. This is the moment when the factory is closely involved in the development of the new model, when it begins to grasp a clear knowledge of the product and of the production process. The presence of the workers of the productive plant during the pilot stage can be seen as real training, not simply passive, in that the representatives of the factory are specifically asked to test the equipment and propose changes to the process, and also to the product should the former not be possible or economically feasible.

The crucial point arises during the passage from the pilot factory to the plant. A lot of

⁵ Quoted from an interview

the information gained by the workers involved in the pilot factory is insufficient because it only represents a very small part of the whole production line.

The improvement in manufacturing worker's involvement is threefold:

- the first concerns an earlier involvement with production staff, right from the conception phases of the product. The process engineers are not able to transfer all the know-how to production, especially with regard to the carry over that will become ever greater in future. The Plant director is on the way to being permanently involved in the core team,
- the second factor is the extension of the development activities after the mass production activities, avoiding therefore a rigid sequencing of deliveries,
- the third factor, a process which has partly begun, is the transferral of the Process Manager involved in the core team to the factory where the new model will be produced. In this case, the problem is the number of plants involved.

4.6 Communication & co-operation enhancements in product development

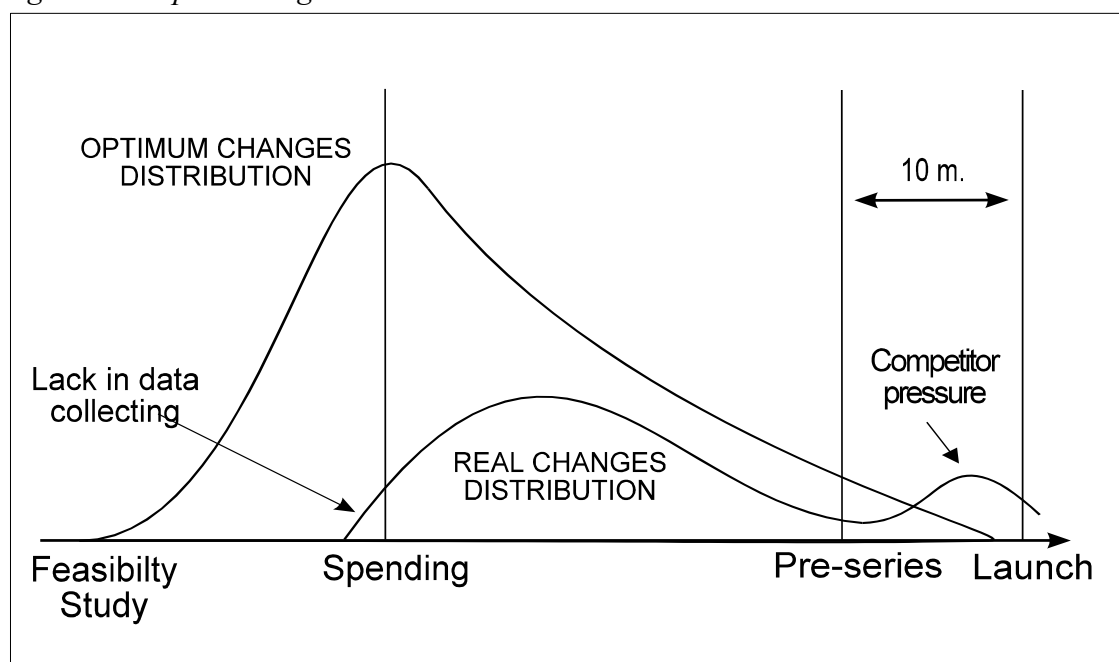
A way of testing the efficiency of interfunctional C&C is given by the management of *ex-post* changes to the project and connections with the other developing products.

- The carrying out of a complex project such as the market launch of a new vehicle creates many checking processes and redefinitions of the objectives. These changes may be caused by a wrong project set-up or from improvements made after style approval. Great attention has been paid to the reduction of project faults, improvement of experimentation planning, advance highlighting of the critical moments, involvement of the suppliers, increase in computer aided calculation and simulation, improvement of the definition of the specifics, and so on. These changes should occur at the beginning of the development process, when the cost increases are less and it is possible to intervene easily, due to the fact that the work is still being done on paper and the project is not yet at the operative stage. The optimal distribution of the changes should be shown by a strongly positive asymmetric curve with a maximum value at the moment of spending (Fig. 7). However, the real situation is different with a curved movement towards the right and a second increase in the changes from the production of the pre-series. The discrepancy from optimal distribution is in the first case due to organisational defects on statistical findings. In the second case it is primarily due to changes in market demand that must be immediately complied with: new customer needs, innovative solutions of the competitors and new national regulations. Failure to introduce these changes to the product could invalidate its market success. C&C are important precisely in these situations where there is very little time at disposal. Fiat Auto changed the style definition of some important components, for example the instrument panel, only four months before the market launch. In some cases the changed component was even available before the release of the designs. Interfunctionality is overcome by the exchange of tasks, product designers also dealing with process, and vice versa. The contact with suppliers is direct and not mediated even for the aspects that are not of a technical nature. Plant problems are shared by all.
- Transversal plans are projects where the sectors of the Technical department must help the platforms to introduce the same component in all the developing models. The internal technical memories or CAD files cannot be consulted if a common, immediate need emerges. A specific interfunctional team is necessary to guarantee

that the component chosen by everybody will have the same characteristics, and that it will be applied by everybody using the same specifications and that the problems found during its application to a model will not be repeated in other projects. The lack of co-ordination in these contexts could result in the repetition of the same error, forcing several people to find the same solution and so causing a waste of time and financial resources.

Information sources outside the team are sometimes substituted for internal sources as personal risk-reducing strategies for team members (Allen, 1978). Teamwork promotes more efficient use of internal data but, on the other hand, reduces C&C outside the team (Griffin & Hauser, 1992). Therefore, the transversal plans represent a new dimension in the matrix organisational structure.

Figure 7: Ex-post changes distribution



5. Supplier Involvement in the Product Development Process

As a part of a widely extended divverticalisation strategy, Fiat Auto asked suppliers for greater involvement, exceeding purely operative execution. Thus suppliers have already begun to contribute in the lay-out stage of the product specifications, and can be included, full-time, in team work, in order to safeguard the best implementation of their component.

The greatest number of conflicts arise due to technical incompatibilities, in qualitative controls and reaching fixed goals. The strong deverticalisation process focused attention on the principles of transparency, crucial moments, collaboration and team work.

Once a suitable supplier has been chosen the collaboration process begins.

Not all co-design work is carried out together with the same intensity. Collaboration is urgent especially in the first phase when feasibility has to be reckoned, style frozen and the project studies carried out and in the final two phases beginning from the pilot

factory for process testing. The supplier's work is mainly carried out internally when internal components have to be developed and the assembly and style prototypes have to be constructed in parallel.

The space allocated within the platform to the supplier is large: from the style approval stage they are an important part of the interfunctional teams, and for the duration of the work together, have all the data regarding the component performance requirements (reliability, weight, bulk.....), the product details, as well as desks, telephones and necessary work instruments, as in CAD workstations. They may also use the internal canteen service. For this purpose one or two of the supplier's designers, called resident engineers, are transferred to the client with a role of support and direct responsibility.

The resident's preparation is purely technical with competence in design and engineering. Good interpersonal relationship qualities are also required and predisposition for group work. The platform may even be moved to the supplier's premises and the presence of a resident engineer from Fiat Auto at the supplier's is also possible.

The choice of resident is made by the supplier. At the end of the stay a final evaluation is made. The resident experience has been judged very positively. In some cases the resident has been assigned the role of team leader within the work group to which he was assigned.

The relationship with the resident is based on complete trust built up by the conviction that it is to both sides' advantage to collaborate fully. By definition the team cannot be other than transparent. In some cases it was even the supplier's representative who realised the basic plan for the new component.

Contacts during the development phases must be continuous. Due to the tasks carried out the resident is treated as an internal employee, thus in the case of problems he must refer to the team leader. Only if there is a serious disagreement is the platform manager involved. The resident is also present at production start-up.

Common work carries on through the pre-series checks and this reduces the risk of having to make changes during the countdown to production. Suppliers are called on to participate actively during the product development phases carried out at the pilot factory with assembly testing and afterwards along the assembly lines at the final plant in direct contact with the integrated factory team. Any hitches in assembly, emerging criticisms, or logistic problems are dealt with in real time and action to resolve or refine can be taken in time before the large production volumes start up. Suppliers are directly involved in the various operative design reviews to verify and revise objectives.

The co-design work enables a reduction in planning times for both parties. In fact, as soon as the pre-studies are ready, the suppliers can begin the lay-out of the design for which they are entirely responsible. Formerly, the supplier had to wait for the final design from Fiat Auto, and then adapt it to its own technologies: this meant a waste of time and efficacy in terms of unsuitable solutions to the needs of Fiat Auto and the supplier. This shared work also continues during the pre-series check stage and therefore eliminates the risk of carrying out modifications at the moment of production.

At the greatest degree of design deverticalization (now 59%, in the future 70%) suppliers will be required to test components or the whole assigned system. Consequently, Fiat Auto will intervene only to check the compatibility of the details with the vehicle.

The level of the design specifications depends on the typology of the detail and supplier. If the supplier ranks among the leaders the specifications become only the essential ones.

This change means that the old collaboration systems, particularly those using single individuals, have become obsolete.

Even though suppliers are in many cases considered to be integrated members of the development teams, they can not be compared to the internal functions. The client-supplier relationship is more conditioned by factors external to the process, for example spatial distance, bureaucracy and hierarchy instead of quality, competence, technical incompatibilities. In these cases the partnership can suffer from lack of motivation, overly rigid procedures, limited decision-making ability⁶.

In general the same conflicts arise with respect to suppliers as with the different internal partners: respect for the defined timetables, costs and performances, finding compromise solutions etc. There are, however, changes in conflict management as often the relationship is not seen by both sides as equal. Some suppliers are incapable of dialogue and are not predisposed to propose alternative solutions. Initially the supplier often takes on a defensive position⁷.

Fiat Auto, on the other hand, has to speed up the unlearning of consolidated practises such as: the short term view of the single supply operation, contingency tactics, the reluctance to abandon specialist parts of the production process, lack of trust, and the placing of relationship management at the border functions.

The definition of contracts with suppliers is certainly one of the organisational structures that has been changed most, affecting their whole relationship.

First of all, the procedures have changed. The contract is not made solely by the Purchasing department but together with the Platform. In fact it is the Platform Manager who signs any agreement made.

The drawing up of the contract, even if it is in co-design, takes place during or even at the end of the development stage and includes each part of the product details: first and foremost the qualitative standards, costs, weights and development times.

The delay in the wording of the contracts was considered as being a strong limitation to co-operation between suppliers especially by members of the slices. This was because the respective responsibilities were not immediately defined (e.g. whose job it is to transcode the CAD data if the systems are not homogeneous) and the certainty of the supplier offering complete collaboration is therefore reduced.

The choice of supplier is not always made quickly enough, and this should happen as soon as possible for everyone, right from style definition and the feasibility studies. This way, the ability and responsibility of the supplier would be put to the test and ascertained.

Three more problems arose during the development in co-design. The first two problems concern all the suppliers, whereas the third mainly concerns small firms.

- The Fiat Auto experience found the suppliers lacking in sensitivity regarding the border areas between the components. The focus is more specialistic and less on the

⁶ In general, small suppliers are more flexible but demonstrate less initiative, suppliers which are members of the same industrial group pursue similar strategic approaches but the relationship is more bureaucratic, the leading suppliers are more rigorous but slower.

⁷ Quoted from an interview

system. In this case the car maker must probably make a greater effort in defining points of contact;

- the principles of single-sourcing have not always turned out to be efficient. In some cases a greater level of competition could be considered necessary;
- many suppliers are able producers but are not so skilled in product development. In many cases they are completely lacking and therefore make use of external engineering houses that in fact form an intermediate step and make the information flow between the client and the supplier difficult.

With some suppliers the co-design partnership has been extended to the creation of permanent design offices within the client's technical department. The passage from co-design to co-habitation reduces the distance between the partners and consequently improves communication and co-operation. Using co-habitation the similarities between just in time and simultaneous engineering are enriched by the physical closeness of the supplier, a particular element in the integrated factory.

6. CAD/CAM Strategy

The use of CAD in Fiat Auto has taken on an organisational value since 1989 as a transversal implementation in order to harmonise the respective functional developments carried out up to that time.

The previous situation led to a slow and above all different extension of this instrument. Its development had occurred with different speeds and orientations between the areas of the Technical department and the Technological department, while it was notably absent in the connection with plants and suppliers.

The penetration of this technology in the other car firms was much higher, but the real difference was one of approach. In Fiat Auto CAD was essentially seen as an efficiency instrument, while in other firms, especially Japanese firms, it was principally seen as an efficacy instrument. The long term experience has even shown that effective efficiency can only be obtained in the measure that balanced and widespread CAD development is planned for, thanks to the extension of this technology to all the areas dealing with the same contexts.

For these reasons, in Fiat Auto CAD was not conceived of as a simple instrument to automate drawing, but as an information system able to emphasise human relations - organisation - instruments.

The implementation of CAD had therefore to be carried out with the participation and control of all the interested bodies and above all with the formulation of a global plan which considered all the aspects: technical, architectural, quantitative, formative, of revision/development methodologies, organisational, cost, return on investments.

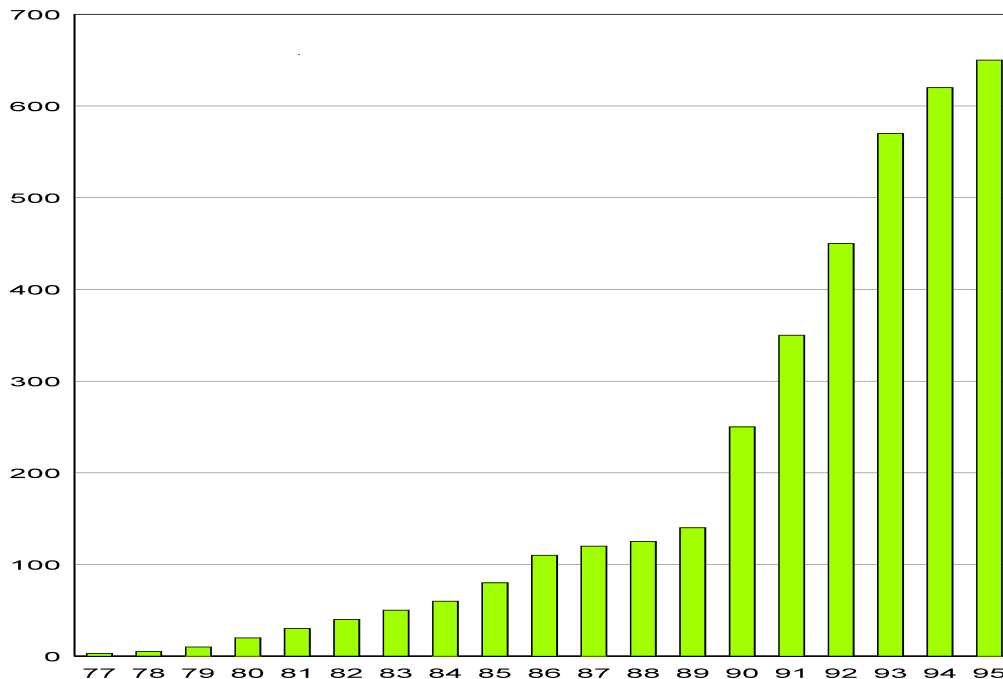
The programme, called the Master Plan, still continues and the end is estimated for 1997, even if a follow up is anticipated.

A specific interfunctional team composed of directly interested functional representatives was set up to lay out and manage the plan.

The main objective of the Master Plan was to internally homogenise development logic between the various areas and externally towards the suppliers, defining a balanced development between the Technical department and the Technological department. Secondly, the plant had to begin to be taken into consideration, given that many of the benefits of the efficiency of CAD are lost if the final user continues to work with traditional support methods.

The Master Plan also laid out the type of equipment necessary, the availability of human resources and training, the definition of a global architecture which harmonised the various databases developed in the meantime, a series of guide lines to propose to suppliers to assess their availability, the equipment in their possession and the right level of integration.

Figure 8: CAD penetration in Technical department



Source: Fiat Auto

Since 1989 the introduction of CAD in Fiat Auto has come about in a programmed and widespread manner. Figure 8 shows the progressive penetration of CAD in the Technical department, the notable impetus given since then emerges clearly.

The progressive passage to the new design mode has, on the one hand limited the trauma of the introduction of new technology and methods, and on the other has allowed attention to focus on the most opportune use of this new technology.

In synthesis, the organisational impact of CAD in Fiat Auto may be analysed under four headings: the technological aspect, the activities involved and the degree of extension, integration with suppliers and work organisation.

6.1 The technological aspect

Up until 1991 Sun workstations with CAD 3D software by Computervision (Cads4) were used.

During that period the system sometimes showed itself to be redundant with respect to specific needs and with a cost/benefit analysis which was not always satisfactory. For this reason Fiat Auto introduced CAD 2D for personal computers by Autodesk

(Autocad). Two dimensional systems were introduced because of the limited initial outlay involved, the possibility of eliminating designs on paper thanks to the raster technique, and for the ease of use allowing the involvement of design engineers who were not CAD experts.

From 1996 on, new models will be entirely designed by parametric CAD. Moreover, there will no longer be a single software supplier, but Dessault's Catia4 will be added to Computervision's Cads5.

Starting in 1996 Fiat Auto intends to install conference systems on the most powerful workstations in order to allow several designers to converse simultaneously about the same detail.

All databases are networked at high speed. In this way the users with permission to link in, using predefined and controlled access modes, can exchange data. Furthermore, there is a connection with the bill of materials for the exchange of information regarding the product structure. A relational type database is also being set up for simultaneous development activities. As well as all the designs, this database will hold all the technical information, the experiments, the calculations and all that is inherent to the development of a motor vehicle. At the end of the product development process the contents of this database will merge into the Master database.

6.2 The activities involved

The extension of CAD instruments and methods in Fiat Auto took place primarily in the sectors where CAD generated information could be used to carry out checks: on the project, functions, ease of assembly, and fitting. And in the sectors where the mathematical models produced could be used immediately to begin working with CNC machine tools, to realise drawings using rapid prototyping techniques, to define measurement paths and to operate robots.

Currently approximately a thousand CAD stations are operative, principally in the Technical (650) and Technological departments (250). The remaining stations are distributed among Prototyping, Test, plants, Purchasing and EDP. The Master Plan provides for more, mainly in the plants and the Technological department. The programme provides for the involvement of all bodies, including the style definition operations. In this case very sophisticated equipment which comes close to manual modelling is needed.

According to the Plan, two design engineers refer to each CAD station, but in reality the number of workstations is greater by 75%.

6.3 Data transfer with suppliers

In order to continue the improvement of the integration of suppliers in the Fiat Auto system, a supplier development plan has also been devised as an integral part of the CAD/CAM company development plan.

This plan aims at ensuring that the substitution of the traditional planning and design in Fiat Auto with CAD does not have its impact on an unprepared supply base, but favours a development that is parallel and coherent with the company.

Firstly a CAD/CAM supplier data bank has been set-up, where all the suppliers with this system, their hardware and software organisation, their dedicated resources and the type of activities developed with CAD, are recorded.

Particular attention must be paid to suppliers in co-design for whom the possibility of networked linking with the data base of the CAD Planned drawings is planned; they must be as compatible with the company system as possible.

An initial group of suppliers belonging to the Fiat Auto Group has been allowed direct access to the central MDB, with the same procedures as the internal Fiat Auto users, organised and controlled by information access authorisations.

Suppliers external to the Fiat Auto Group may have access only via a specific database (DBF), that operates like an intelligent box number, filtering and endorsing the operations carried out on identification of the supplier. Two procedures are used: if the supplier has been certified, he can operate directly on the MDB, even if it is filtered by the DBF; should the supplier not be certified, the transfer of the information from MDB to DBF, and vice versa, is activated by an internal designer as well as being filtered by authorisations.

The transmission link with suppliers is increasingly on line.

In all the above-mentioned situations, as well as for internal information exchanges, a standard definition, structure and format of data rules are essential, to ensure the correct use and interpretation by all the users involved, whether they be internal or external. Seven integration levels have been devised to outline the rules and interchange procedures from the physical transportation of the data to CAD planning methods.

6.4 Work organisation

CAD requires role redefinition. In Fiat Auto the professional figures of designers and engineers, for example, are united into a single figure. So the product engineer can control the results and simulate the effects of eventual changes without waiting for the realisation of the physical model. Moreover it becomes necessary not only to prepare a continuous training programme, but also to prepare a specific function to support internal and external users, including suppliers, in the use of the network, the hardware, the software, the data, the development of applications and the training.

The introduction of CAD has altered change management moving from “push”, whereby the person who had made the change communicated it to the other interested parties, to “pull” where those directly involved ask to be up-dated.

Requests regarding the detail level and marginal information which with the old procedures were not considered necessary, have increased notably. These complaints, however, do not have noteworthy effects on the relations between the different partners in that the use of co-location facilitates C&C, unless it involves a supplier which does not possess the same procedures.

A good knowledge of the instrument is essential to being able to obtain complete use of the functions on offer. However, good training in the methodologies that are considered the most suitable for the development of CAD planning is equally important.

In Fiat Auto, the length of training depends on the different technologies and methodologies used: for two dimensional CAD drawing one week's training is sufficient; for three dimensional CAD modelling four weeks are necessary. These are spread out in such a way as to leave sufficient time between each module for on site consolidation of the concepts learnt, by means of operative stages. Courses for bosses are also planned, lasting one week. Updating is supplied in different ways, defined each time on the basis of real necessities and the type of updating required (new release, new functions and new methodologies).

The introduction of a new professional role has been devised to enable a correct and efficacious learning of CAD techniques.

In fact, for about two years now, around 50 designers have been given the task of dedicating circa 20% of their time to the training and support of newly-qualified CAD designers. This professional, called innovation diffuser, has the job of working with a teacher during the consolidation phase, so that the young designers can have a tutor as their reference point.

Other professionals work alongside the diffusers: application engineers, whose job is mainly to support the correct use of the instruments, application hardware and methodologies used.

The presence of diffusers and applications shows that theoretical learning is insufficient when facing the instrumental and methodological complexity involved in the planning of a vehicle via CAD.

In order to use CAD to the full a period of work activity is necessary, varying from a few weeks in less complex cases, to many months in the case of the planning of very complex parts.

7. Professional relationships within the platforms

One of the most arduous tasks which the platform heads have to carry out regards the real activation of delegation processes, that is, to ensure that the members of the interfunctional work groups have really been delegated by their function heads to take autonomous decisions. This is a problem which in Fiat Auto has not been totally resolved. This is mainly because delegation is seen as a loss of personal power and not as a way to supply what is needed to work better.

For this reason it is important to take up the argument with the lowest possible hierarchical levels, which correspond to the highest possible level of specific competence.

Thus delegation in a platform structure must also be activated between the different competence levels, from the core team to the product team, and from these to the development team. The need for operative-decisional decentralisation is based on the experience which relates that only the teams can take correct decisions, given that the specific knowledge is concentrated there.

Bureaucracy is closely connected to the concept of delegation. The move of co-ordination activities and decisional power to the lower levels of the platform is accompanied by the transfer of bureaucracy in the same direction.

Bureaucracy is a term which with process integration may generate misunderstanding. In general, the tendency is to associate bureaucracy with filling in forms, files and paperwork to document the progress of the project and not its use in the indirect control of the process.

Much of the production of such documentation, which has been notably reduced, has been partly transferred to the lower levels of the platform and has become the responsibility of the direct operator and no longer of his superior. Thus there are two different views of bureaucracy: that of the new producer of bureaucracy which considers it as time taken from creative work, and that of the former producer of bureaucracy who sees it as an indispensable support for process management and a historical document for the future improvement of the process.

A valid example of delegation within a platform was the institution of the new organisational figure of the Anomaly Management Head in Fiat Auto which has budget autonomy of up to 250 Lire per change in component and 20 million for investment. This figure does not necessarily have functional or hierarchical tasks, in fact he is often a mere designer. The task of The Anomaly Management head is to resolve tuning modifications rapidly and to avoid long approval paths. He will be responsible for all the relative documentation.

At organisational level the introduction of the Anomaly Management head was a radical change because he has rendered the flat organisation within Fiat Auto's product development process operative and visible.

This is a classic example of delegation mechanism. However, the focus on processes suggests an inversion in the delegation process. Instead of waiting for delegation to be conceded it is necessary to develop such abilities as to consent the acquisition of autonomy. It is not enough to make people responsible, they must also be available and put in the condition to take on responsibility.

The delegation process interests every level because everyone must be fully involved in the project otherwise it may not work. It is important to create responsibility even in little things and not forget that those delegated have to be helped to grow⁸.

Traditional systems of personnel development were laid out functionally and not by process, career paths were predominantly linear and changes between specialised sectors were an exception. The evaluation of personnel remains with the functional sectors, so having collaborated on a project as a team leader or not is not significant in one's career.

Training basically aims at the furthering of specific knowledge, attributing a limited role to the weighing up of organisational competence so the boundaries between functional sectors and between the functional and project organisations, like the interfacing problems, are accentuated instead of reduced⁹.

The interviews carried out at all hierarchical levels in Fiat Auto indicate a great feeling of participation between the personnel involved in the product development process. Teamwork, task identity in relation to the whole project and *leadership* activities are the principal factors motivating individual initiative.

However, due mainly to western culture, any commitment and initiative requires immediate acknowledgement and fair evaluation. Incentive schemes based on results do not allow for the isolation of the single contribution to group activity and collective mechanisms may result too general.

To support the new organisational types systematically, different personnel growth paths must be created which are not made up of a succession of formal qualifications, but rather a series of different tasks. A process style organisational layout implies non

⁸ Quoted from an interview

⁹ This need was particularly felt in Fiat Auto. Much attention was paid to the team leaders, to team work, and to problem solving, while for technical-technological questions training courses are organised as the new equipment is installed. Moreover, in support of the extension of technical knowledge within functions a professional figure, the know-how engineer, with the task of defining the know-how level necessary, evaluating the know-how present and putting professional growth plans into practice.

linear career paths where lateral mobility offers the opportunity to acquire new abilities and enhance professionalism¹⁰.

One of the principal complications linked to the introduction of matrix organisational structures regards, for example, the change in resource evaluation. Traditionally the evaluation of the employees is carried out by the hierarchical boss, but the team leader or platform head is the real user of these people. Thus it becomes imperative to find an evaluation system which allows a shared judgement in terms of resource management, merit, professional growth and hierarchical advancement. All are means whereby not only is the model perfected but management, both functional and platform, must meet, interact and in some way co-ordinate themselves outside the traditional set up¹¹.

In platform organisations the various heads, representatives and team leaders delegated to the task of co-ordinating personnel with different hierarchical levels and specialistic know-how or entire phases of the process, cover a vital role in team work.

In this situation an important role is played by the people at one's disposal and above all the choice of platform manager, who in this case, becomes the new point of balance and synthesis of the product development's different functional needs. The Platform Manager decides that which is allowed and possible relative to the budget and the objectives set, or the need to ask the Board of Directors for derogations or changes to the mission statement.

The Platform Manager's position is functional not hierarchical, without a background of trust, strongly linked to people and leadership ability, collaboration and participation will be almost impossible to obtain.

Similar managerial tasks are asked of the other figures of authority on the platform.

In Fiat Auto, for example, the introduction of the role of team leader met with some difficulties due mainly to the need to create professional capabilities that were not present in the former organisational lay out.

The team leader needs not only to manage people and suppliers, but also to possess know-how from all the other specialisations: Purchasing, Technology, Production, Controlling etc. In fact, the team leader is a Platform Manager on a smaller scale.

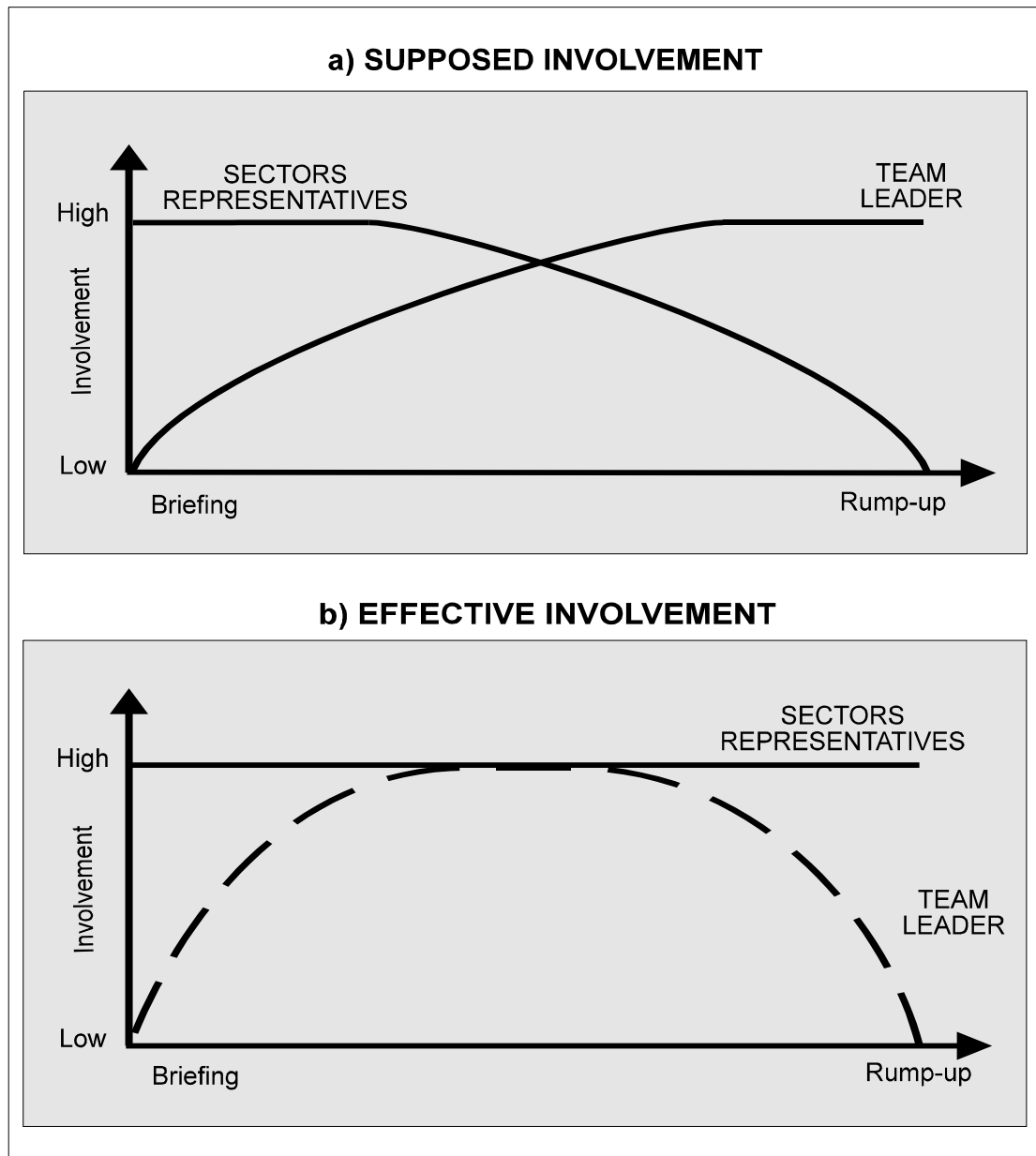
The very lack of a systematic view has forced Fiat Auto to modify the relation between team leader and RPA during the process stages. In the original layout (Fig. 9a) the RPA, thanks to their long experience, should have ensured the general layout of the project and be progressively substituted by the team leaders. In effect the participation of the functional representatives remains fundamental in the project for the entire period as the team leaders have been unable to assume professional capabilities outside their own specialisation (Fig. 9b).

¹⁰ In Fiat Auto a path within the product development process could be found, for example, in the platform structure (simple designer, Team Leader, Vehicle Manager, Platform Manager) which intertwines with the various responsible tasks (Anomaly Management, Component development, RPA), or else in a move from product engineer to marketing assistant or to process engineer. Given that in future it is presumed that the most qualified design activities be concentrated in innovation or shelf engineering another path could be defined following the sequence: improvement for the product on sale, application in platforms and innovation in functions.

¹¹ In particular within the platform the evaluation of human resources occurs between the various heads to avoid individual judgements. Moreover the reduction in hierarchical levels obliges merit evaluation using less tangible elements so rendering human resources management more sophisticated. The assuming of responsibility and autonomy, or the achievement of real qualitative improvements (professional capabilities) are difficult elements to quantify compared to production objectives.

Operative overlapping, professional dependence and the different hierarchical levels (RPAs may be managers, whereas the Team Leaders are at most executives), create inevitable friction and conflict even where the RPA and Team leader come from the same function and work in co-location. RPAs are the representatives of the functional departments and answer to these while the team leaders answer to the Vehicle Manager.

Figure 9: Team leader and sectors representatives involvement



The organisational division into functions and platforms and the need for these two structures to dialogue has inevitably pushed Fiat Auto into the search for more efficient means of communication.

These co-operation methods occur at both the upper hierarchical levels, with the so-called “weekly reports” where the problems of function and platform are defined and faced, and at operative level, with a view to delegating to the highest possible level of specific competence.

Collaboration between the platform RPAs, the heads of component development and the heads of testing from the Technical department functions are among the moments delegated to the lower levels. These meeting allow the RPAs to illustrate their problems in the application of components and to be informed immediately of the new results

obtained by the development and experimental units. In this way eventual errors in the development and application of the component can be found more easily.

With these meetings, purposely made obligatory and institutionalised, Fiat Auto intends to noticeably change work cultures based on a focus on the single separate task, into a work concept based on task integration and continuous data exchange.

Current information technology is not only more flexible but also offers notable professional enhancement, in terms of application knowledge and company information. The calculating power of the new CAD positions is such that even young designers from the lowest levels of the organisation can carry out complex analysis. This is partly documented by observing the rapid adaptation of new-employees in the Technical offices to the carrying out of complex and sophisticated operations which once were only possible after many years of experience. CAD may be seen to have favoured the learning of design techniques, while process techniques were learnt more quickly thanks to the definition of process rules and the greater availability of more senior colleagues.

The unification of the tasks of the designer and the engineer into a single professional figure is a consolidated option in Fiat Auto. In foreign automobile firms the situation is totally different.

However, with the introduction of platforms new forms of specialisation according to the attitudinal tendencies of the design engineer come about: depending on preference for innovation, application or improvement. That is to say, between those who tend towards a function for shelf engineering, towards the platforms for product development and towards the work groups to improve the existing models.

If, on the one hand, the rotation of roles between functions and platforms tends to avoid fossilisation on only one of the possible design activity methods, on the other hand, the transfer to un-accepted collocation may counteract the design engineer's motivation.

The time spent working in the platform, for example, should mostly be dedicated to the application and integration of that which has already been designed for shelf engineering, foreseen in the component development plan and considered to be carry over from the previous model. However, this layout is considered by the design engineers as a limiting factor for their potential creativity. Obviously, if the component is complex it is not redesigned but as the component becomes more simple the design engineers prefer to redesign it rather than consult the relative data base.

The result is an explosion of product codes and an increase in the number of drawings released, higher production costs, logistic complications etc. The economic advantages offered by standardisation even of small details are innumerable and can only be achieved by imposing rigid design methods. But this would transform platform design engineers into mere operators and could demotivate them.

8. Next Steps

From the interviews carried out in Fiat Auto the factors which could further facilitate the product development process emerged clearly. Mostly they refer to work methods, the current organisational plan and the development of the strategy-structure relationship.

Work methods include: the use of a common language, the identification of clear and shared objectives, the reduction in bureaucracy, the early involvement of all external and internal partners, the leadership role of the Platform Manager, the management of delegation and *ex-post* changes. In the area of organisational instruments the following

are reported: the management of work groups, co-location, the use of computerised supports and function-platform integration.

Despite most of the firm taking part in platforms, functional conflicts are not excluded. Obviously the use of platforms makes problem solving easier, but it is definitely unable to avoid all disagreements. It is no surprise therefore that most critical comments on platforms have come from people on the outside.

Platforms are relatively recent organisational instruments that have changed internal power distribution. However, this does not exclude the necessity to re-configure them on the basis of the context in which the platforms have been introduced.

Fiat Auto's new organisational structure has been supported by a series of actions aimed at giving wide visibility and at highlighting the new operative method, direct intervention of company management and co-location are clear examples.

However, an opposing effect can be found. There has been a depreciation and fall in the perception of the value of the activities carried out especially within the sectors of the Technical department.

The most typical activities of the Technical department sectors, as the development of know-how and of human resources, have been and risk being reduced.

Thus it is evident that there is a need for re-balancing to make clear that medium term investment activities have as much value.

It is necessary, however, to state that the change was accompanied by the commercial launch of many new models in a short period so applicative development inevitably took resources away from innovative research.

The organisational transformation was introduced in a highly functional reality which was not used to operate in matrices, nor to work for interfunctional projects. The traditional background of the personnel in the functions involved in product development was based on hierarchy.

The product and process engineers suffered the changes most, especially those called to roles of co-ordination.

The aspects recognised as being of fundamental importance for Fiat Auto and held as still being at an initial stage can be resumed under two thematic macro-aspects: global market vision and the verifying of internal organisational processes.

Global market vision principally means improving the knowledge of the external client to the point of translating it into the minimal details of each component.

Generally, client perception arrives at the development teams through other functions. Above all from Marketing and from Purchasing, but not directly from the Sales Management, whose presence is only provided for during the final development phase, since the pre-series production. This situation may in some ways be seen as incongruous. It may be justified in part by the need not to augment the number of core team participants excessively, and by the fact that some members, particularly the Marketing representatives, may bring a Sales Management influenced view. In this way, however, the contribution of the retail network, able promptly to incorporate in each trade outlet the changes in clients' tastes, is missing.

The development of a new car risks being considered as a separate factor. The fact that a new model is developed to replace one in production, in the same market segment and probably the same client group, should induce the installing of all possible links with the product on sale and those who have the specific task of selling it, avoiding the focus of attention only on carry over.

Alongside the sales network another indispensable font of market perception comes from the suppliers with whom the co-operative relationship must not be reduced to the externalisation of activities but must define him as a privileged contact able to propose interpretative solutions which had not yet been followed up.

Suppliers must therefore take on a propositional attitude, a new operative mentality and also the risks involved in the realisation of the project. This is a challenge for Fiat Auto as for years the suppliers was seen as a mere subordinate.

One of Fiat Auto's strong points was the management of the design and production activities. The changes which have taken place mean that the personnel need to look at market conditions and consumer needs. Previously technical staff had only to deal with the technical aspects of the new models, whereas it now has also to consider their best commercialisation. This passage may be difficult to realise.

A recent opportunity in Fiat Auto for the only direct contact between the people in the Technical department and the market is during the sales launch of a new product when a few meetings with the dealers, the authorised garages and often with the client are organised. Obviously the principal aim of these appointments is to inform and highlight the features of the new product. This is evidently a first step towards learning about the market, with the help of those people who deal with clients every day, and reducing the distance between the technical development areas and the firm's external environment.

A second, and much more important, equilibrium level exists which concerns Fiat Auto globally. If the objective is to render Fiat Auto a firm which is more and more concentrated on market development, the clients' needs, with a wider view of the changes taking place, and platforms are judged to be the ideal organisational instruments to elaborate a company response, consequently it is necessary to align the development of all the various company areas with the matrix platform model. The revision process undergone by the Technical department will have to be undergone by the other departments.

Some of the classical aspects of the functions will persist because functions are best at playing the role of know-how incubators. Matrix structures will have the task of managing the key development processes.

Signals of this change are already perceptible in Fiat Auto. The widening of the responsibility of the platforms to cover the improvement and maintenance of the new product on sale shows the successive step towards an integrated management of the entire product life cycle within a single organisation.

The stable presence of factory representatives on the platform core team or the transfer of the Process Manager to the management of the plant where the production will be carried out bears witness to the path undertaken by Fiat Auto.

Product development and production tend to see themselves as a circular mega-process, conceived by marketing for product planning and returning to marketing for commercialisation, in which the specific processes of simultaneous engineering, integrated factory, logistics, order management, purchasing etc. are integrated.

Thus platforms become a basic part of the company and no longer only of the Technical department.

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