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THE PAX PROJECT
OR HOW MICHELIN REINVENTED THE WHEEL

by

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Report by Thomas Paris
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Overview

The Pax system might become the catalyst for radical change at several levels for Michelin. It may spark off a revolution by becoming the norm in place of the traditional tyre. The way in which the project was carried out by the company may be followed by others and trigger off real change. In terms of the tyre industry, the arrival of the Pax was an innovation. For the car industry, it could be the occasion for the subcontractors to redefine their relationships with the car manufacturers. With respect to car manufacture, the Pax could be an integral part of generating real change.
Managing a project of such a scale in a world as well organised as that of the tyre industry was only possible by a radical change of approach. The Pax exists because phrases such as 'creating value for the client', 'a global approach', and 'initiatives for partnership' typify it.

TALK : Thierry SORTAIS

I am going to talk to you about Michelin's project, the Pax system, of which I was the director. I do not want to bombard you with my beliefs or preach to anyone : this talk is an account of our experiences during which we discovered many practical things which were already widely known. Firstly, I will describe the Pax product itself. Next, I will present the circumstances which gave rise to this innovation, in order to show that the Pax was not merely the haphazard result of some crazy researcher's findings, but the successful outcome of a sophisticated approach which enabled us to take our competitors by surprise. Finally, I will conclude with a word about where the project stands today.

The Pax : a new way of looking at tyres

As far as the pneumatics are concerned, research aims to improve performance at different levels including the roadholding ability, the fuel efficiency, the maximum weight possible and the comfort. The aim is to improve one or other of these characteristics, but above all not at the expense of the others. It is this which the Pax system achieves.

Performance and safety

The sides of the Pax tyre are lower than those of regular tyres. This means that the vehicle performs better in terms of steering. Furthermore, whereas traditional tyres are less easy to handle and waste energy by heating up, tests show that the Pax tyres freewheel and are capable of covering a distance ten to fifteen percent greater than the best tyres currently available under the same test conditions.

The downside of this is that reducing the height of the tyre results in a reduction in the flexible part of the sides thereby decreasing the ability of the tyres to absorb shock. Additionally, the Pax protects this zone and makes changes to the upper part of the tyre. In traditional designs, the role of this more rigid zone is to maintain the tyre on the wheel-rim as is done during the assembly of the wheel. It is difficult to do without this unless the whole assembly system is reconsidered. This is exactly what the Pax is - a completely redesigned wheel. Grooves on either side allow the tyre to be clipped in. Once it is assembled, it cannot move. When the tyre is fully inflated or during driving, a system ensures that the tyre is completely dependent on the whole wheel. In the unlikely situation of a tyre coming off the rim, tests show that the Pax system still stays in place.

Space gain

The asymmetrical profile of the wheel makes it possible to insert a support which ensures that the wheels will still turn in the event of a burst tyre. A warning light comes on to show that the tyre needs to be repaired, but it can still run for more than 200 kilometres at 80km/hour. This means that a spare tyre is no longer necessary and therefore more space is available.

There is also a gain in space thanks to the domed style of the Pax system which allows it to carry the same weight as a traditional tyre while at the same time being smaller in size. Despite the same weight capacity and speed rating, the Pax system takes up less space than a traditional tyre. There is more space inside the vehicle and, additionally, with smaller wheels

at the front, the vehicle has a better lock. It is also possible to keep the same outer diameter of the wheel creating more space inside the wheel for the breaking system, the suspension, transmission and propulsion components. Thanks to the removal of the spare tyre, one can even have different sized wheels at the front and back which give even greater freedom for the design of new vehicles.

The Pax and the value it brings

At the beginning of the Pax programme, we conducted a marketing study in order to identify consumer demands with respect to the pneumatics and to work on these. This study shows us the areas in which the Pax brings value to the client.

The first point is the ability to continue driving with a flat tyre. We studied consumers' expectations and we discovered their willingness to pay for each one of these expectations. The ability to drive with a flat tyre emerged as an important factor for 60 % of people surveyed who cited it for various reasons : the safety, the fact that the vehicle is not completely immobilised by a flat tyre, and the possibility of deciding where and when the tyre will be repaired and who will repair it. There was therefore a need to be able to drive with a flat tyre, but market research also showed that consumers were not ready to compromise traditional performance in order to meet this need. They wanted to be able to drive with a flat tyre, but there was no question of lowering performance as far as traditional criteria were concerned. In the end, the Pax improves the performance in the following ways : in the running of the car ; there is less noise while driving (this was a lucky by-product); there is less resistance during driving ; the Pax system can be recycled, to name but a few. We therefore satisfied this need not only without making any compromises but also by improving performance : this is the second source of value.

The third source of value is the freehand given to architects in vehicle design. Gradually, we have become convinced that this is the key to the success of the Pax, and that it is this factor which will determine the speed of the development of the Pax. This freehand is partly due to the increased space created by reducing the axes of the wheels by 25mm, and partly due to the removal of the spare tyre. The use of different sized tyres at the front and at the back divides the weight much more evenly throughout the length of the vehicle. It is an architect's dream !

Pax : a complete system and not just a tyre

The Pax system is not a tyre but a system made up of four components : the tyre, the wheel, the support and the pressure detector. It is a system for several reasons. Firstly, because the overall performance is the result of the interaction of different elements, that of the tyre and the wheel, that of the tyre and the support, and so on. Secondly, it is a system whereby sufficient mechanical progress is made resulting in a review the rest of the vehicle. Thirdly, it is a system in terms of maintenance. Changing a tyre is a relatively common procedure, but changing a part of the Pax tyre requires skilled, trained technicians. As far as tyre manufacturers are concerned, four components instead of one, is a real revolution.

The Pax project

A global approach

At Michelin up to five years ago, three teams worked side by side : the safety team, the team dealing with mechanical efficiency, particularly thermodynamics, and the team which did some research on the area of driving with a flat tyre. Research on the mechanical efficiency of the tyre helped us identify two problem areas associated with lateral constraints between the tyre and the wheel. The tyre is held on the wheel by pressure exerted on the interior, and this pressure generates important and significant constraints on the wheel. In addition, there are semi-rigid attachment zones (where the tyre is clipped on to the wheel-rim), which in mechanical terms, are not ideal : an 'average' rigidity, not too little nor too much, uses up energy to no end. The rational solution to these two problems consists of moving the zone where the tyre is clipped onto the rim closer to the centre of the rim (cf. the side of the rim).

At the same time, in our research on driving with a flat tyre, we quickly came to the conclusion that we were unable to get a satisfactory result from just one element - the tyre - in both an 'inflated' and a 'deflated' state. Up till this time, all the subcontractors' work on "self-carrying" tyres was designed to create a reasonable performance in the inflated mode, and a performance which was optimal in the deflated mode. They all came to the same conclusion that such a compromise would create poor performances in both modes. We therefore needed a particular element for driving with a flat tyre : the support. However, a problem which we were unable to resolve prevented us from using this support : it was essential for it to be installed by car mechanics and the car had to have asymmetrical wheels. And we did not know how to make them !

The solution to the problem came from analysing the whole system. By changing the position of the clipping zone, the tyre functioned better mechanically. The problem of the tyre coming off the wheel-rim was resolved, and the lateral constraints of the wheel were eliminated. This allowed us to manufacture asymmetric wheels and thus to be able to use supports which furthermore were put to best effect.

In conclusion**,** the Pax concept did not come about overnight. It is a collection of ideas which function together as a system, and which were firmly established in the company having been the object of an earlier study. It is this which misled our competitors. When we launched the Pax in 1997, they imagined it was just a marketing idea without any future.

The thinking behind the Pax

A certain number of major guidelines led to the Pax, most of which were based simply on logical reasoning. Ever since the beginning, we considered the Pax as a potential standard and not as a Michelin product. In so doing, we benefited from the company's previous experience… About ten years ago, Michelin created a product, the TRX, which performed remarkably well but it had been launched as a specifically 'Michelin' product. It was a total flop and today it has taught us that we cannot change norms by ourselves. Moreover, this unfortunate experience left a big mark on Michelin, to the extent that today one of the major factors holding back the use of the Pax is the in-house element, linked to the memory of the failure of the TRX. However, from the outset our first strategic plan as far as the Pax was concerned, was to take the risk of presenting it as the potential standard and to open it up to our competitors.

The initial concept of the Pax, with its asymmetric wheel and its support, emerged in December 1992. While we were putting the finishing touches to it, we made some initial presentations to car manufacturers and competitors in order to have their opinions and generate a reaction. The decision to launch the product on the market was made in January 1998, and in January 1999 Pirelli made its support of the standard official, followed by GoodYear in June 2000. The tyre market is a monopoly where power is in the hands of a small group. It is divided between three “gorillas” - GoodYear, Bridgestone and Michelin - and three “chimpanzees” – Dunlop, Pirelli and Continental. In this context, making an alliance with one competitor automatically accounts for 40 % of the market. For us, however, this type of alliance was a totally new.

Our second premise was to consider the Pax as a generic product and not as a niche product. Moreover, in terms of profitability, we can confirm that today the product has its place in each of the sectors.

Our third and decisive premise was that we should open up the market, despite being severely tempted to monopolise it. We decided to favour competition, notably in the tyre replacement market, thereby taking the risk that if our product had a certain value, this would be enough to sustain it. We did not want to corner the market !

The system approach was another important premise : we always worked on the system as a whole, as opposed to the sum of its parts. Finally, we decided to act quickly by cementing partnerships rather than by trying to develop everything by ourselves.

Pax and partnerships

The involvement of our competitors seemed to us to be a decisive factor. The agreements we made with GoodYear and Pirelli cover several aspects. In particular they consist of a licence which allows them to provide systems to the car industry. As far as we were concerned, it was important to protect the system in its entirety in terms of safety and indirectly of image, so that the Pax could be associated with Michelin as an innovative product concerned with safety. We concluded a bipartite agreement with GoodYear and we therefore took out patent licences with GoodYear who had worked on the “self-carrying” tyres. In addition, we made a joint venture with them to pool our resources and develop our work on the concept of driving with a flat tyre, which will still involve a great deal of time and resources.

Finally, the contracts include a support agreement on the after-sales service, to ensure that the networks and the training given are compatible and that the components are interchangeable.

The current situation

The Pax brings value to the client in all three sectors : safety, mobility and the degree of freedom given to the car manufacturer. However, we were not able to create this value by using a traditional approach. The Pax does not create any value if we treat it like a normal tyre.

Necessary co-operation

Effectively, we are in an unfavourable situation with regard to car manufacturers, inasmuch as we are forced to start the manufacture of the Pax by fitting tyres to cars on the production line. It would be too complicated to try to replace traditional tyres on vehicles with Pax tyres. Car manufacturers occupy a critical position as far as the development of our innovation is concerned. Therefore, it is important to move from a 'head-on' position, which would imply sacrificing its profitability to launch our innovation, to a co-operative position, in which we manage to share fairly the value created for the client.

Another limitation of the traditional approach is that it implies that tyres have become a commodity. They bring less and less value and cannot command important profit margins. Moreover, a money-spinning strategy, which consists of positioning oneself in a niche and making a big profit margin out of a small series, is not feasible since it is not acceptable for the car manufacturers who insist on keeping at least two suppliers, even in one niche.

Taking all the factors into account

Finally, the natural approach which uses all the components ideally gives us the average margin of profitability of each component. However, our margin on tyres, when assembled on production-line cars, is already quite small as it is on the wheel and the supports. Therefore, it is not possible to make a profit if we use this approach. In the tyre market, the traditional business model is based on the combination of two very different markets, the assembly of tyres on cars in the production line, and the replacement of tyres on existing models which has a better profit margin. In the case of the Pax, this second market would only come about in two, three or four years. Considering the investment and going from five tyres (four plus spare) to four, the project could not show a profit for seven or eight years. Therefore the Pax is only viable if we take into account the whole system.

Two key success factors

The successful outcome of the project depended on at least two key factors : the attitude of the car manufacturers who wanted competition for the product, and the challenge of reducing the weight. Maintaining the competition has probably been achieved : the competitors are currently putting the finishing touches to their products, and we have overcome the problem of the weight. We had a fundamental constraint which was not to weigh down the vehicle. The four Pax wheels ought to weigh less than five standard wheels. If this were not so, then the project could not succeed. However, we had another criterion with regard to the dynamic weight, that of the weight of the rotating parts for suspension reasons. This important criterion took us the last eighteen months to overcome working partly on the tyre and on the wheel. Also a great deal of time was spent on the supports. Three years ago, we had a support weighing eight kilos. We learnt to make the most of this component, in particular thanks to our partner Dow, with whom we investigated other materials such as polyurethane to decrease the weight significantly.

The pump is primed

As well as the Mercedes Class S armoured car which we already equip very satisfactorily for the client, it was announced in 2000 that the Cadillac would be the first vehicle which we would equip commercially. In February 2001 it was announced that the first production line

vehicle would be the Renault Scenic. The pump is now primed, as in the past year we have noticed a net progression to the implementation of the system by the car manufacturers. They all know the Pax and many have started pilot projects with it. The car manufacturers prefer not to risk missing the boat if the Pax becomes the norm. It is safe to say today that the project has started well. We now have to reach the objectives which we set ourselves. These are, in descending order, equipping an entire series with the norm, being profitable for shareholders by 2010, and in terms of communication in the long term, that Michelin having been known as the inventor of the radial tyre should now become known as the inventor of the Pax.

Conclusion

The Pax is a system which has an advantage for the client and which has appeared at the right time in terms of market openings. Two key factors have greatly favoured this opportunity : a unique place on the original equipment market, and a world-wide implantation. Together with GoodYear and Bridgestone we alone had the capacity to put into place a sufficiently extensive world-wide network of approved mechanics.

The Pax goes hand in hand with the movement of Michelin towards a culture which is more open to partnerships. The future development of co-operative models can be envisaged where we work with another manufacturer, especially in joint ventures. We developed this scheme with respect to wheels, supports and systems related to the Pax. Our view, in terms of our openness to partnerships, has changed, and it will not change again.

The Pax has strengthened our relationship with car manufacturers. It is not a ready-made product, but the result of a joint development. It has changed our way of looking at the market. We have worked a great deal on the marketing side. It was not enough just to have a vague idea : it was confirmed by the use of very sound means. In the same way, our relationship with the retail sector has changed since only trained people have expertise to assemble the Pax tyres. From now on, the relationship involves training and accreditation. This encourages a reinforcment of professionalism in the retail sector. In communication terms, the Pax is not managed like a Michelin product but like a potential standard : 60 % of our communication budget goes on stands or in partnership projects with GoodYear and Pirelli, rather than on exclusively Michelin stands in car fairs.

DISCUSSION

No spare tyre, no salvation ?

Question : *I wonder about the way in which the client welcomes this innovation. One might prefer the safety of a spare tyre and the freedom which that entails, rather than the ability to drive with a flat tyre over 200 kilometres, which implies finding an available mechanic. Not having a spare tyre might be alarming. In what ways have you looked at the client and his preferences and the anticipation of his needs ? Maybe he will insist on keeping a spare tyre.*

Thierry Sortais : You're right. The analysis of the value showed that consumers were prepared to pay more than the price of being able to drive with a flat tyre simply in order to keep their spare tyre. However, by looking at the examples in the United States and Europe, we were able to estimate the time necessary to overcome and accept this initial resistance. It will take four to five years of publicity to get the message across. Naturally we communicate : our publicity department and the media have started work on explaining it. Moreover, this consumer suspicion obliges us to offer a maintenance service of irreproachable quality from the start. We are in the process of putting this service into place, by involving the car manufacturers. We are using the networks of car manufacturers, we are adding to them and we are supporting them with back-up logistics teams and a call centre service. We are quickly reaching the critical mass which will allow us to guarantee assistance within two hours following the incident. In this day and age, this associated service forms an essential component of our innovation.

A change in strategy

Q. : *This market is dominated by a small number of players of which there are three gorillas and three chimpanzees. How might it be advantageous for one of these actors, in this case Michelin, to change the game ?*

T. S. : In this sort of environment, contrary to what one might think, the actors can be very inventive and creative. This is true, for example, of Pirelli and I think it is also true of the three gorillas. Despite this, there is a real restraint on innovation which is linked to the car manufacturers. Admittedly it is their job to exert pressure on prices, but not so that this results in a deadlock. If the equipment manufacturers co-operate with the tyre manufacturers we can find a satisfactory solution. Without this co-operation, the innovation is limited since the increasing demands of profitability and return make it difficult to pay off the research and development costs. In these conditions, as far as the equipment manufacturers are concerned, either they do nothing and resign themselves to the fact that the car will effectively 'die', or else they implement joint solutions. If one innovates, one is forced to open up the market so that the virtuous circle begins.

Q. : *Won't your economic model, which is based on both the fixing of new Pax tyres in the production lines and the replacement of tyres have to change if you opt for systems which are increasingly durable ?*

T. S. : Certainly. We have to change our economic model for a model where the fixing of tyres in the production lines has to be profitable in itself. The whole economic problem is to find a balance between the value which is brought to the process and sharing it in a feasible way with the car manufacturers. Essentially it is a case of finding a means of discussion so

that we can agree about the value which is effectively created, and share it out satisfactorily. In these conditions, the existence of competition is a guarantee for the car manufacturer. It is for this reason that we have opened up our product. It is reassuring for a car manufacturer to know that he can turn to our competitors. Our transparency, prompted by the opening up of our product, is a guarantee for the car manufacturers.

An innovative project

Q. : *How did you go about managing such a project when it was known to have upset a certain number of in-house customs at Michelin ?*

T. S. : At the beginning of the project, about four years ago, we did not start off with a theory of management innovation but with a concept which was only shared by six or eight people. This project was backed by the management and that was a key factor. Without this, the project would certainly have failed. Next, when we decided to go ahead, we met around a table and we debated how we were going to handle it. If we had proceeded as we normally do, the project would have certainly failed. Today, even though we have resolved our latest problem - that of the weight - and we have signed the initial agreements with the car manufacturers, our main challenge is still in-house.

We have built a small team project where we have brought together various talents : technical people, sales people and so on. I was in charge of piloting the project and especially motivating the teams in a non-hierarchical way.

Q. : *Did the transfer of power from father to son in the Michelin family play a role in this project ?*

T. S. : Both of them strongly backed it, and the support each one brought was complementary.

Q. : *As a project manager, to whom did you report ?*

T. S. : To the director of the «World-wide Passenger Cars and Light Trucks» product line. However, the project began in the heart of the technology centre and was backed by a core of people which formed around our Chairman and Managing Director, Édouard Michelin, as well as a small team which had the advantage of cutting across different groups. The project was supported at the top but it was not just a project led by managers. I am convinced that this double-sided aspect of support at the top and of the involvement of different hierarchical levels was fundamental.

The beginnings of a change

Q. : *In view of the resistance which the project encountered in-house and the importance of the associated service element, did you ever think of creating a subsidiary purely for the Pax ?*

T. S. : It was debated whether we should create a new structure or subsidiary, purely for the Pax. We did not do it. In fact, today we are in the process of ‘letting go’ : our team is disbanding and we are integrating the project structures into those of the company. It is a bit difficult. However, we decided not to make a specific entity so as not to create a division which might damage and bring down one of the two bodies. We preferred to concentrate on

integration, the logic being that this would this would enable the company to develop from the inside. The outcome which we see today regarding the good working of the project confirms this. People are starting to accept the project and to change their opinions.

Q. : *Can this project gain a following at Michelin, in terms of the way the company is managed ?*

T. S. : It is already gaining a following on two levels. On the one hand, we have installed smaller team projects for the new ranges while on the other we have changed our attitude to partnerships. This experience has convinced enough people to help us move towards a co-operative style of approach.

Essential partnerships

Q. : *Has the importance of the partnerships become apparent at a level other than the strategic one ?*

T. S. : Yes. The Pax involved a great deal of team work. This was the key word in the project. People from Michelin worked day and night - sleeping on camp beds - at Renault. Both companies shared this strategic desire which corresponded to a state of mind in the technicians who felt the need to work together to accomplish their project. I am now convinced that one can create team spirit beyond the mere boundaries of companies.

Q. : *With regards to your partners, it is very clear to see how you generate interest among your competitors for the project and one supposes that this is the same for suppliers. That leaves the car manufacturers : how do you manage to motivate them for the initial phase of your projects ?*

T. S. : Among our partners, you have omitted the customer, who is essential, and the media. One must mention the media since communication is one of the fundamental aspects of this project. An important aspect of this communication is the coming together of the different types of people involved. There is no point getting the suppliers interested unless the car manufacturers are also interested in the project…

In the case of a standard which was coming to the end of its marketing life, our contacts with the car manufacturers had been limited to sales, the research department and the test department. With the Pax, we contacted these people again. To achieve this, the marketing team really supported the project. Similarly, we got to know the architects and the risk managers. However, we needed a great deal of time to mobilise the car manufacturers. With regards to our project, there were three types of car manufacturers : the ‘first movers’, the ‘first followers’ and the ‘followers’. Thus, in the time between the GoodYear agreement and the announcement of the launch of the Scenic, we could see that the first followers changed their attitude radically. They were really waiting for something to happen.

The management of a standard

Q. : *In the management of a norm, what choices do you make in terms of intellectual property of the Pax ?*

T. S. : Firstly, we place the greatest importance on the protection of the system, which in itself is an intellectual property. Michelin owns the patents on the tyres, the wheels and the

assembly, in other words the simple idea of putting the support in the tyre and then the whole thing on the wheel. For example, with regards the after-sales service, to ensure that the tyres are looked after properly by qualified people in the first six or eight years, we will approve certain stockists, making sure by clauses included in our agreements, that the different networks are equivalent. A stockist approved by GoodYear will be equivalent to a stockist approved by Michelin or Pirelli.

The licences on the system which we gave to our partners are only, in the case of full-blooded partnerships, one element of quite complicated *montages*, each one negotiated separately. By means of these *montages*, we allow them access to the patents, provided they are used to produce systems which are without territorial restrictions world-wide. In particular, these agreements include reciprocal transmission clauses concerning improvements to the system. Over five years, we will inform our partners of all the possible improvements and they will do likewise with us. In addition, even if the Pax brand name belongs to us, we will open it up in order to share it with Pirelli and GoodYear.

As far as future licence holders are concerned, no-one will be excluded but they will not be treated in the same way, since the project does not need them in the way in which we needed our initial partners.

Q. : *Safety has to be one of the key factors with regards the image of the Pax. Since the Pax is a standard, how do you think you will be able to manage the quality of that norm, in particular the parts which are not made by Michelin ?*

T. S. : We will only grant licences to brands which have sufficient know-how and reputation. In this way, the company is committed and puts it name to the quality of its products and services. From that moment onwards, we do not envisage having to resort to a sort of policing system and we will not check up on our licence holders.

Nevertheless, in the case of agreements, a system for certification has been set up for the interim period before independent organisations and regulations are established for the new norm.

Presentation of the speaker :

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