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3-D :
A REVOLUTION IN MANAGEMENT

by

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Report by Thomas Paris
Translation by Rachel Marlin

Overview

For the past twenty years, Dassault Systèmes has been inspired by both the dream and the conviction that an industrial revolution is taking place. The industrial world has begun its process of virtual dematerialisation using new tools for development and for managing the life cycles of products in 3D – The value chain will be transformed. This revolution concerns primarily product design, but also affects, broadly speaking, the entire industrial system in both manufacturing and maintenance. Today, many companies have committed themselves to this technology with remarkable results. Bernard Charlès shows how Dassault Systèmes was the catalyst in this revolution. He explains that the success of his company is due as much to the innovation at Dassault Systèmes, as to the company and management model. This model will also revolutionise company management.

TALK : Bernard CHARLÈS

As managing director of Dassault Systèmes, I often feel as if I am the head of a start-up. And yet today the company employs four thousand six hundred people in twenty-two countries. It has a turnover of one billion dollars, a capitalisation of five billion dollars, an operational margin of a little under 30 %, seventy thousand clients throughout the world and between five and six hundred partners.

I graduated with a PhD from the Ecole normale supérieure of Cachan. Thereafter, I decided that my future would be researching the integration of different types of technical, historial, philosophical and human behavioural knowledge. I joined Dassault Systèmes as a scientist in 1983 by chance, (replacing my military service), thinking that I would not stay there long. At that time, there were thirty employees. I was asked to work on the long-term development and future of the company. A year later, in 1984, I decided to stay for a few more years, and I am still there.

The dream and the revolution

The story of Dassault Systèmes began as a dream : 3-D would enable one to conceive, design, invent, learn, produce and so on. Thanks to its modelling and simulation functions, it would allow the physical product to be created and to materialise at the very last moment. This dream was not written in stone but it has become our ambition. It is an ambition, based on the conviction that a virtual dematerialisation of industry is under way and that it will change the rules of the value chain. Monetary dematerialisation has enabled financial transactions to become more fluid. The same phenomenon is currently taking place in the manufactured goods industry with much more impact than one might think. In the long term, the value of industrial companies will lie principally in the intellectual capacities of its employees, their *savoir-faire*, the company organisation, and so on. Factory installations, which already figure in the cost-line of financial analyses, are only valuable to those who exploit them. Today, Dassault Systèmes is an important force and catalyst in this transformation. On a macro-economic level, I think that we should see this redistribution, positively, linked to globalisation and try to establish a new equation for sharing value.

Many different products have been created thanks to our CATIA software. These range from shampoo bottles to satellites, as well as aeroplanes cars, mobile telephones or the Guggenheim Museum in Bilbao. Before appearing physically, all these products existed virtually – in perfect 3-D, thanks to our software. These virtual representations allowed us to design a concept, share the design and production methods, anticipate the problems, manage resources, and so on before the physical structure was built.

The important moments in Dassault Systèmes' history

Dassault Systèmes was created at the beginning of the 1980s as a result of a wager on a part of a programme developed within Dassault Aviation to make model wind tunnels. It was not possible to lay out flat the body of an aeroplane since it was deformed and twisted.

How could it be illustrated so that people could visualise it as it could be ?

How could one make a small model wind tunnel rapidly?

The necessary software was created as a result. It has no existing basis : the company began with a great deal of technology, and an idea, but nothing that was not known before.

Marcel Dassault thought that the software was brilliant. On the screen, he could see a product which did not exist, but he did not understand how the company could sell it. "*I don't have faith in your project",* he said, "*you are going to lose money, but since you are so sure of yourselves, go ahead, but you take a share of responsibility in the capital".* Charles Edelstenne contributed 10 % of the capital, about two million Euros.

Dassault Systèmes is thus an alliance between an innovative team and an *avant-garde* venture capitalist, Charles Edelstenne, who decided to provide the necessary means to create a company and develop it. Not only did he suggest how to profit from this idea, but more importantly, he also drew up the project of a company which develops and markets software solutions on a worldwide scale. Such a company would be made up of an independent team which has shareholders who have a carefully well defined role. Independence is a fundamental aspect of his project. It plays an essential role in the existence of the company today ; were this not the case, the company would have disappeared on several occasions because too many people wanted to be part of it. Dassault Systèmes is neither Dassault, nor the legacy of Dassault Aviation.

We never asked for money again and every year, after the first two years following its creation, we had and to this day still have an operational margin of between 25 and 45 % and pay the shareholders a third of our profits. No more, no less : this is part of the simple principles on which we are founded.

In the process and purely by accident, we made the French State richer in a remarkable way, since the company was created at the outset for practical reasons as a subsidiary of Dassault Aviation of which the State was a shareholder. The sale, a few months ago, of its 15 % stake in Dassault Systèmes made a large capital gain for the State.

Boeing 777 : Takeoff

Between 1981 and 1985, we signed an important agreement with IBM which stipulated that IBM would commercialise our products. Today I am convinced that IBM only signed in order to promote its computers since the software initially did not sell well and was even given away. We restructured this partnership in 1986 for two reasons. Firstly, we wanted to sell our product on its own merit and no longer simply as a piece of software attached to the sales of computers. Secondly, and most importantly, in 1988, Boeing decided to launch its 777 programme and wagered that they could develop and sell the aeroplane without the creation of a physical prototype. This represented a real revolution in the history of the aviation industry and a considerable industrial risk since an aeroplane is made up of three million parts and has a construction programme which costs several billion dollars. This meant that all teams taking part in the 777 programme development were forced to embrace a new way of working. For all those who had taken part in projects before, scale designs on paper had always been a guarantee of the finished product. Now, with the project's representation in 3-D on a computer, what guarantees were there?

We signed a fifteen-line paragraph with the Chairman and Managing Directors of IBM and Boeing in which we agreed to undertake this programme. I will never forget the Chairman and Managing Director of Boeing who predicted a premature end to my career if this programme did not work, before asking me "Is it going to work ?" I did not know how to answer this question : we were going to be confronted with problems of scale and volume which we had never encountered before. The first model of the aeroplane represented 3 terabytes of data which at that time was the equivalent of several truckloads of disks which IBM had delivered to Boeing every month.

This project marked an important period in our history. When it started, our objective was to reduce the number of engineering changes, in other words, correcting errors cited in the programme before the first delivery by 90 %. We did even better than this : the first assembled aeroplane was even more accurate than the 747 products which had twenty-five years' experience !

Between 1992 and 2000, the growth of Dassault Systèmes was essentially based on the conquest of other sectors. One day, the Chairman and managing director of Volkswagen, Ferdinand Piech, said to me "*Why can't we do what the aeronautical engineers do ?"* Gradually, the design of a digital model was considered to be an innovative element and a radical change for the industry in the broadest sense.

Stock market flotation in order to become global

Our clients have always been precious allies or partners. When there have been problems, we have taken decisions together. For me, this is a basic principle of management : decisions concerning our clients should not be taken behind closed doors at Dassault Systèmes but out in the open.

In 1996, some of our important clients helped me to convince the shareholders that it would be to our advantage to float the company on the stock exchange in order to be more transparent and visible. We were becoming a strategic element of the information systems for some important global groups, and it was fundamental for them to be reassured of the quality of their supplier.

Therefore, 18 % of the capital was floated on the NASDAQ and the Paris Bourse in June 1996. Today, 48 % of the capital is in the stock exchange and the rest remains in the hands of the Dassault family and the management. This operation was decisive for the company. At that time, we had competitors who were well placed and the software market was not dominated by Europe. The stock exchange flotation introduced a new type of network to our ecosystem, that of merchant banks, investors and analysts : this is an essential element in the development of a company on a global scale and thanks to this, we have been able to embark on major change through external growth.

A precise acquisitions strategy

Our first acquisition, in 1992, took place under rather unusual conditions. The company CADAM, a rival in design systems, belonged to Lockheed. When it was put up for sale, IBM, in order to prevent its competitor Unisys buying it, bought it and then sold it to us. We kept the original client base, unusual in our acquisitions methods, and this purchase was determined by our desire to remain exclusive in our partnership with IBM. In fact, it was important to counterbalance our structurally unequal partnership by extracting those products which did not rival those of IBM and whose value and offer were very different.

This acquisition was the first in a series which began in 1997 and still continues to this day. To outsiders, it appeared to lack coordination, but in fact it corresponded to an extremely precise strategy. Firstly, we wanted a portfolio with various brands (including CATIA, ENOVIA, DELMIA, SmarTeam and SolidWorks) as a means of comparison with each of our competitors, with a clear strategy, a defined team and a very precise distribution system. Secondly, we were determined to maintain our top-of-the-range position.

In technological sectors, teams constitute a fundamental element of success, maybe even more so than the technologies themselves. Flotation on the stock exchange revealed another : it was very important to persuade those teams who had been targeted to join Dassault Systèmes. In 1996, in Boston, I met a team of fifteen people who had a brilliant idea. It was a start-up called SolidWorks which had a turnover of eight million dollars. It was losing money and wanted to be floated on the stock exchange. Over a period of six months, I went to see them every month

to deter them from launching the flotation and joining us instead. My efforts finally paid off : in the end, we paid three hundred and twenty million dollars. Convincing the board of directors to buy a company worth forty times its turnover was quite easy as a result of the quality of our discussions and the trust we had built up. Everyone said that we were going to lose money with this company which offered a market entry product, and which had a global distribution system which was different to that of IBM etc. Today, SolidWorks has an operational margin of 30 % and a growth of 20 %. It is the world number one in its sector and it enabled us to keep Autodesk, our competitor in terms of volume, at bay. Above all, we managed to preserve the company and its identity. Nobody left. It is a good example of the fruit of our management model. After SolidWorks, we made about twenty other acquisitions. All these companies were integrated successfully with our brands CATIA, ENOVIA, DELMIA, SmarTeam, Spatial and SolidWorks.

A new language for the industry

Today in France, we still teach our children industrial design. It is a totally useless language, a heresy when one is familiar with 3-D and the simplicity of its representation. 3D enables us to see all pieces, to understand them and to fit them into the required environment. Our efforts are fully concentrated so that the transition to this new language happens as quickly as possible. For example, we have just released a 3-D modelling game for children, called Cosmic Blobs. Its aim is to promote this language and its functions rather than to make money.

3-D changes our way of working. In each partner-company participating in the design projects, everyone involved in the process sits around large screens to discuss the conception of the product. In this way, everyone sees the same thing, regardless of where they are : in the workshop, the engineering department or the analysis office of the company.

PLM : from products to processes

Our approach goes well beyond product design. It affects the whole production system, the industrial pattern. We model every product or every part, in all the stages of its life, from its manufacture to its integration into a technical system. In this way, we touch on problems related to industrial performance and we are in a position to propose new types of services, and no longer do we just provide software components. We provide much more.

We have christened this approach 'Product Lifecycle Management', or PLM. There has been a great deal of talk about ERPs (Entreprise Resource Planning) and huge amounts of money have been spent on them purely to reduce costs and to manage the existing structure. PLM transforms business and realises ideas. Some important manufacturers, like Toyota as well as some SMEs (Small and Medium-sized Entreprises), have understood the concept, but we still have a great deal of work left to do in getting it across to others.

Today, all the aeroplanes and cars in the world, with the exception of General Motors, are made with the help of our software. We have a total of seventy thousand clients in electronics, consumer goods, shipbuilding, plant construction, and so on. Toyota became our client two years ago. It was a major milestone in our success because Toyota is the benchmark in the industrial world. It took us four years to convince them, but from the moment they took their decision on March 26th 2002, it took only a year-and-a-half to produce the first CATIA-designed car on September 29th 2003. In the space of just eighteen months, they had trained people, redefined their processes, designed the vehicle and marketed it ! Their 2003 annual report devotes several pages to the digital reform made possible by our products. Since 2004, all Toyota new programmes are made with Dassault Systèmes software. In all Toyota factories throughout the world, they have installed a room for virtual communications allowing everyone involved to anticipate and give an opinion about the ongoing improvements in techniques.

The PLM revolution

Another example can be taken from the first aeroplane programme in the world to have embraced the PLM revolution, the Falcon 7X. Transformation at Dassault Aviation, as in every engineering company, was hard. It was only possible with constant management participation.

The aeroplane construction schedule was changed. Manufacture of the parts was delayed by a year by comparison with the norm, but contrary to what many people thought, this delay gained us a great deal of time. After a certain time, people were anxious to see the finished physical product, in case the deadline would not be met. However, this year was used for digital validation of all the functions and production processes. Everyone was able to verify precisely if their professional input and duties were valid before the project started. When we moved over to the physical mode, everyone knew what was going to happen even before they saw the parts physically. The first assembly took just a few weeks. A record had been set and people on the production sites still talk about this experience with a great deal of emotion.

The MRP (Manufacturing Process Resources), a subset of ERP disappeared at Dassault Aviation. The software was taken away because there was no longer any reason to model the work in a complex language when one can watch a film which explains what to do. Since then, everyone has access to this film on his computer terminal at work.

Finally, the 'tool revolution' has taken place. By digitally optimising techniques, the majority of costs linked to tools was removed. There are virtually no more tools and the assembly process is very different from the way it was previously carried out. Parts simply arrive and are assembled.

Digital technology has enabled engineers to think in detail about production because they are able to visualise it. In traditional design methods, designers do not have a clear view of all the areas concerned and the production people have to explain certain things to them. There is a big difference between the actual physical organisation and how each person understands it. There are also complex products which we cannot easily understand. Digital technology, however, allows one to understand everything visually ; one can even see things, generally not visible in the physical world. Open the bonnet of a car and see how congested it is. Imagine the difficulties before the product can be produced, the number of people who worked on it at a distance so that it all fits, and the number of mistakes which were made. Not to mention the tools which were not right and which had to be loaded back into the trucks and sent back …

A management system created by successive crises

Management at Dassault Systèmes went through three successive phases. The first was the start-up phase, marked by a pioneer philosophy. The strategy was reworked every Monday morning according to the latest clients we had met. From the outside, it appeared to be chaotic and one even questioned how this all worked. We went through four or five years like this.

The quality of operations and management according to objectives

The second phase was marked by concentrating on technologies and the quality of operations. Software development was a craft industry. We had to change the scale and industrialise it and this was not an easy process.

Thus, in 1988, when we committed ourselves to the Boeing 777 project, we found ourselves in a major crisis concerning quality. Given such complex projects, our products did not meet our clients' expectations. One week-end, I called our five biggest clients and I set up an audit board of all our processes. This was a shock for the team and for our president as I was asking our clients to assess the functioning of our company ! Nevertheless, I went through with it and I even suggested to our clients to take stock of the situation every month with us. This audit allowed us to benefit from a first-rate service with considerable resources. This is what saved

us. Dassault Systèmes would never have survived these problems had we not carried out radical transformations which we would never have been able to do without external help. Our clients allowed us to get over the hurdle in terms of the technical and managerial plans, the processes, the methods, the tools, and so on. I realised that the quality of the partnerships with our clients was extremely beneficial. We adopted this principle in the critical phases of the company and we have kept to it ever since.

We came through a second critical period from 1993 to 1994. A key Boston company, Parametric Technology (PTC), had created a revolutionary technology which we had not anticipated, concerning the parametrisation of parts. They were a very experienced team that had covered all possible angles of possible problems with the technology. Their results were extraordinary and they started taking our market share in all sectors. Once again, our clients felt they could trust us. Our product, the digital scale model, was much more ambitious. In comparison, their objective was more modest, namely offering a tool which was very easy to use. They won over the users, but we had the company management on our side.

This episode led us to rethink the way in which we analysed competition and the action which we should take as a result. We had to invent and implement all the systems which a company involved in global competition needs, such as the establishment of benchmarks, analysis of the competition, reverse engineering, etc.

As far as management was concerned, the second phase was based on management driven by objectives. Everyone knew who was responsible for each project, what their objectives were, and what measurement systems were used. In companies, there is no measurement system which exists which is not linked to an objective. In addition, we changed our reporting logic. Staff put their indicators on-line which became accessible daily to everyone. No special presentation was made for meetings whose aim was to make sure that everyone saw the same thing, and shared the same view based on these daily indicators.

This was a key element. In this way, we cut costs considerably. Between 1995 and 1996, we crossed out all the functions involved with pure coordination and gave employees operational functions instead.

Ecosystem and interaction

At the present time, we are in the fourth year of our third phase which is focussed on the ecosystem. Our system of management is no longer based on a management target for each person, but a system based on interaction and the way communication takes place. We have built a managerial model as well as complete training tools around the idea that team performance results from the quality of interaction between individuals. Our main aim is constantly to improve and invent management methods which allow everyone to understand how our methods of communication on an individual basis influence our relations. It is about improving understanding : in the same way that our products allow our clients to communicate better, our management system allows us to optimise our relations within the company whereby everyone sees and understands at the same time.

The future according to Dassault Systèmes

Dassault Systèmes has changed : it started with 3-D, then it was models, after that making a film of the product and finally the industrial pattern. This is what we do today with our five brands : CATIA, for design ; DELMIA, the digital factory ; ENOVIA, to create a collaborative environment for working at a distance; SolidWorks, a market-entry solution for 3-D modeling; and SmarTeam, a technical management product which accompanies ENOVIA.

Our objective is simple : all physical goods should be produced digitally with tools which allow management optimisation and definition in the physical world. 3-D simulation should help create better products for man and the environment.

Today, it is not possible to understand Dassault Systèmes without understanding the idea of the ecosystem and interaction. We have partners who have signed agreements with us whereas they could have signed with our competitors to benefit from more advantageous financial conditions.

In the future, our company will fit into a network in which the managerial system, the measuring system, prospective and strategic communication, decisions and the implementation system on a global level will be extensively shared. We are committed to this challenge and the companies using our software also have the resources to commit themselves and to become more competitive.

Our future is built on this vision, on a system of values, specific brands and the desire to innovate.

DISCUSSION

Question : *What does CATIA stand for ?*

Bernard Charlès : Computer Aided Three-dimensional Interactive Application, but we prefer calling it by its acronym CATIA. Originally, it was just CATI.

Change in companies

Q. : *What are the real implications of the integration of your software in your clients' companies ?*

B. C. : It all depends on their needs. In the most basic circumstances, we suggest practical tools, which are easy to put into place and which operate using personal computers. This means that they can start designing quite quickly : this enables 3-D to become more accessible and helps people realise its possibilities. These tools constitute an important element in our strategy.

At the other end of the scale, the PLM brings with it a transformation of the functioning of the company, provided one rethinks the organisation and the measurement system. One can no longer judge a team which does engineering detail on the number of designs it produces. Companies therefore orchestrate the arrival of this type of tool with a managerial approach, but not a technical one, since it is a problem of work organisation, redefining duties, and functioning and coordination between the functions. It is fundamental : on a global industrial level, differences in terms of competitive advantages increase with the control one exercises over the process of transformation.

Q. : *Among your partners, are any of them companies – such as consultancies – whose job is managerial transformation.*

B. C. : We are starting to have clients who do this sort of work. In the Dassault Systèmes strategy of "constructing for tomorrow ", we sell licences to consultancies that will be at the heart of these techniques. The majority of companies met so far are not very interested today, since they have positioned themselves in a well defined market such as the ERPs. Very few build new techniques.

Today, we work a great deal with IBM Business Consulting (IBM BCS) on the Dassault Aviation 7X programme, and on a greater scale on the 7E7 programme, to put this global collaborative environment in place by relying on our entire ecosystem.

Transformation of companies

Q. : *What distinction do you make between your clients and your partners ?*

B. C. : Sometimes the distinction can be blurred. Relationships with our clients vary. Some do not want to commit themselves to a partnership. But the future of Dassault Systèmes is also to be a supplier of contents and not just of applications. For example, our software is sufficiently intelligent today to be able to optimise a car's body. This dimension of our job forces us to integrate specific knowledge and therefore to have a close relationship with clients. We are no longer in the business of only selling a piece of software.

I have the feeling that the difference between companies which graft new tools onto old methods, and do not look after the transformation of their organisation, and those tackling the problem from an overall perspective is widening. The Embraer example is striking. This Brazilian company entered the market of business aeroplanes and regional transportation ten years ago and is now well on the way to becoming world number three. In a sophisticated and technologically very advanced field, they have achieved this by implementing a radically new industrial model based on a network of extremely strong partnerships. We were at the heart of their revolution.

Q. : *Were there implantation failures of your systems with your clients ?*

B. C. : Never. At the worst, the return on investment may be disappointing for the client. In twenty-five years, a negligible number of clients have left us.

The Dassault Systèmes culture

Q. : *Is there a Dassault Systèmes culture which is a key element in your company's success ?*

B. C. : There is a very strong culture which we share with many of our partners. It is characterised by a desire for innovation, a shared dream, preoccupation by engineers for business matters, and an extraordinary level of mutual aid. This last point, due particularly to our managerial system, systematically strikes our young recruits.

Our managerial tools are also part of this culture since they are often adopted. Today in companies, people ask about our "*colonnes de gauche*" (left-hand columns). This is a phase 3 tool of our managerial system which aims to review all the implicit dimensions of interpersonal relationships : in meetings between two people, one person notes what the other has said and the other notes what he has understood and then they compare notes to establish the difference. This tool is very efficient in improving relationships between individuals.

A multicultural company in France

Q. : *You have a presence in twenty-two countries, although it is increasingly usual that countries and large regions in the world work at developing their competitiveness. How do you position yourself on a geo-economic level ?*

B. C. : Today, Dassault Systèmes is multicultural and very explicit. Every global company needs a certain number of devices to ensure unity between all employees. This is even more so the case at Dassault Systèmes because our employees have profiles which are very much in demand on the market, because they have an average age of thirty-one, because they have a particular relationship with the administrative functions of the company, and so on. We have had to find the capacity to integrate and bring together entrepreneurs and managerial teams which cannot be represented by the French managerial model.

I am a French citizen and proud to work for a company whose headquarters is in France and which plays the role of a French company in a globalised economy. However, above all I am a European. Therefore, we stand aside in French debates. In order to change something in

France, one has to start working outside France : it is a rule in the company, and it was the basis of our success. Furthermore, less than 15 % of our turnover is generated in France.

Q. : *Do you have contacts with management schools ?*

B. C. : Yes, American, Japanese and European schools.

Choosing staff

Q. : *How do you choose your teams ?*

B. C. : Throughout the world, we have many close contacts with engineering schools, in research, training and recruitment. We make our selection according to professionalism, and then according to human factors, and especially communication skills. We give priority to potential. From then on, we have faith in human nature and in the capacity of people to adapt and flourish in the environment which we have created. We also make sure that there is a large diversity in culture and knowledge.

Q. : *How does the idea of sharing show itself in the objectives of your staff ?*

B. C. : The management system incorporates a sense of motivation to share objectives. The person in charge of the sector should carry out a definition of his products, his schedules, his business models and his measurement systems with his partners. This definition has to be validated before it can be accepted.

Visibility is another factor : everyone's plan must be known. For example, we launched a plan more than two years ago which will terminate at the end of 2005 and which was summed up by three aspects : a turnover of one billion, one million users, and a 30 % operational margin. This plan is devised on all levels by objectives, and it can be monitored permanently by everyone in the information system. The result is that employees come spontaneously to ask about your ability to meet your objectives and offer their help. This is because you are linked to everyone else's objectives. This changes the very nature of relationships in comparison with an engineering culture which favors perfecting plans before sharing them.

Q. : *How do you share the value of the company, created with your employees ?*

B. C. : We have involved our staff in stock-option plans. Today, the new accountancy rules are less favourable to the practice despite the fact that 52 % of the shares are in the hands of families who are in favor of its continuation. Limiting the number of stock-options makes sense when the shareholding is restricted, but the system had some advantages.

The vision

Q. : *You attach considerable importance to the idea of vision : seeing, seeing together, understanding by seeing things, and so on. It is a considerable cultural transformation which harks back to the past before logic was a tyranny : indeed, the thirteenth century marks the passage from vision to reasoning and technology. In the Middle Ages, the façade of a cathedral could tell a thousand stories : today, we look at it from the edge of the square to grasp the logic of the entire building.*

B. C. : We are extraordinarily lucky to be able to give some sense to what we do, such as contributing towards creating better products for man and for the environment. It is very inspiring.

I am very touched by your comment. Recently, at a conference, Bill Gates invited me to talk about our activities, I said to him with a smile that if Microsoft was the Gutenberg of the 21st century, then Dassault Systèmes' ambition was to become today's Da Vinci. We make huge investments in research and development to create jobs, new ideas, to develop the company,

and so on. Virtual dematerialisation can bring a new answer to the social problems of globalisation.

Presentation of the speaker :

Bernard Charlès joined Dassault Systèmes in 1983. Having managed teams in charge of new technologies and created a department devoted to strategy and research in 1986, he became R & D director in 1988. He was nominated managing director in 1995. He introduced change in Dassault Systèmes with the view to help companies develop, simulate and optimise the life cycle of their products. This included the development of the CATIA-CADAM architecture, development of the PLM portfolio with the creation of DELMIA, ENOVIA and SMARTEAM, and a vast access to 3-D with the acquisition of SolidWorks and Spatial. He is a graduate of the Ecole normale supérieure (Cachan) and is still a member of the teaching staff there.

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