Chapter 5
Opportunities and PLM

PLM enables companies to take advantage of the many opportunities available at the beginning of the twenty-first century. Some of these opportunities are the result of new technologies. Other are due to social and environmental changes, and macroeconomic forces such as globalisation.

5.1 Opportunities of a Growing Market

Globalisation has increased the number of potential customers for many companies. The world headcount continues to grow by more than 100,000 per day, promising even more customers in the future. The world population is expected to rise from 6.8 billion in 2010 to 9 billion in 2050. That's an awesome number of customers, but most of them are in faraway locations. PLM will be needed to keep control of the products they acquire.

New markets create new opportunities. US Census Bureau data shows that out of a 2010 US population of 310 million, 40 million were aged 65 and over. The 85 and over population was about 5 million in 2008, and is expected to rise to nearly 20 million by 2050. As the population of elderly people increases, so does the need for special health products and services.

The population of overweight and obese people has grown rapidly. About one-third of US adults are overweight, another third are obese. The percentage of children and adolescents defined as overweight doubled in the last quarter of the twentieth century. The market for weight reduction products is over $100 billion worldwide.

Concerns about health create new markets for pharmaceutical products and medical equipment in developed and developing countries. In the UK for example, in 2003, on average each person was expected to take about 14,000 pills, tablets and other forms of medication in their life.

There's a growing market for drugs for domestic animals. For example, in the USA, the market size for drugs that relieve arthritis in dogs is more than $100 million.

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New markets create opportunities. As the average working time drops in developed countries, the leisure market expands. As populations move away from subsistence living, and disposable income increases, the market for products such as cosmetics expands.

5.2 Technology Opportunities

New technologies open up new markets and lead to new products. The transistor, which was invented in the late 1940s, led to a seemingly endless stream of electronics and communication products throughout the second half of the twentieth century. The invention of the computer led to other new products such as software applications. Biotechnology appeared in the early 1970s, leading to countless new drugs.

Towards the end of the twentieth century, new technologies such as nanotechnology, the control of matter at the nanometre level (1 nanometre $= 10^{-9}$ m), appeared. They opened the way to even more new products. Down at the nano level of individual molecules, matter can be arranged and assembled to make products such as new drugs, plastics and electronic circuits.

Existing technologies such as electronics, computing, telecomms, robotics and biotechnology continue to offer scope for new products. For example, designer drugs will be developed to match an individual's particular genetic make-up. Intelligent clothes will change performance as the weather changes and the wearer's mood changes.

The Internet, the World Wide Web and the Grid all offer opportunities for new products and services, and new ways to develop, sell and support products. The Global Positioning System (GPS) underlies many new products. Mobile telephony offers new opportunities, as do portable computers and other portable devices. Further developments will create and meet needs that hadn't even been thought of before.

Cyborg technology (part human, part machine), with electrodes that pick up brain activity and control the machine part of the cyborg's body, offers new possibilities. Direct brain implants of memory and processing power will increase human performance. People will have their individual Web address. Sensors implanted in the body will monitor organ performance. Results will be automatically transmitted and viewable in real-time on personal Web-sites. Initially, uses will be passive, for example showing heart beats and brain activity. Later cyborg behaviour will be controlled directly by changing parameters on a web form or from a mobile device.

RFID technology allows products to be tagged with chips that can provide information about the product when they are scanned. This allows products to be tracked throughout their lifetime. RFID offers opportunities to get a better understanding of the way products behave over their lifecycle. Many products will have their own Web address, with performance data and feedback being available online.

Environmental requirements and the desire for sustainable development will open up new opportunities, in particular for a product's end of life.

Business models will change, with more and more services being offered around products. PLM will enable the development and support of new products and services.

5.3 Smart Product Opportunity

Smart Products, also known as Intelligent Products, are products that can sense and communicate information about their condition and environment. In addition to their primary functionality, they have functionality to decide or communicate about their situation or environment. A washing machine has primary functionality to wash clothes. A Smart washing machine, equipped with a scanner, can read the labels on clothes, and select the most appropriate washing and drying cycle. Packaging can be Smart. For example, labels in transparent foil around meat products can change colour from blue to red when the temperature rises above the safety limit. There are several types of smart functionality (Fig. 5.1).

Many different types of smart products and smart packaging are available and they carry out numerous tasks. For example, a smart lawn mower can be programmed to cut the grass for you. Its sensors see if there are any obstacles, identify the height of the grass, and switch on its motors to go down the garden and cut the grass. Smart vacuum cleaners have similar functionality to make life easier for their owners. A smart microwave oven can identify the food to be cooked, then set the timer and the temperature. A smart water softener can identify the hardness of incoming water, and treat it as required by its hardness and the intended use.

As well as working independently, smart products can also work together. For example, smart home appliances such as an electric blanket, a toaster, a coffeemaker, a bathroom scale and a blood pressure monitor can be networked together to make life better for their user.

Voice applications include the scales that speak your weight and the voice in your car that reminds you to fasten your safety belt. Smart security devices can listen to your voice and look into your eyes before giving you access to a secure zone.

"seeing", "feeling", "reading" and monitoring	with various types of sensors
"speaking"	with a voice synthesiser
moving	with motors
locating	with GPS
showing information	on a display
"thinking and calculating"	with a microprocesser
remembering information	with a memory
self-identification	with a memory
sending information over a network	with a transmitter

Fig. 5.1 Smart functions

Smart products have many applications. They can work in dangerous areas to render them safe. They can identify End-of-Life parts and materials that can be reprocessed or reused.

5.4 Opportunity of Global Products

Global Products provide huge opportunities. They allow billions of people to benefit from products to which they previously had no access. They allow companies to offer products to a global market of more than 6 billion customers and users. The resulting opportunities for sales and profits are enormous. So are the potential risks.

For most companies it's only recently that such opportunities have been available. In the 1990s, although many companies were international, or multi-national, only a few were able to offer a product throughout the world. Others were limited, for one reason or another, to smaller markets. There are several reasons for the changed situation (Fig. 5.2).

As a result of the changes, the potential market for most companies is no longer a few hundred million customers for the product in a local regional market, but over 6 billion customers worldwide. Which means that, for many companies, the potential market is already more than 20 times larger than before. And the market is expected to grow to 7 billion by 2012, 8 billion by 2025, and 9 billion by 2040.

The unit of measure for use of consumer products is now the billion. There are more than a billion PCs in use. There were over 4 billion mobile phone users in 2009, more than 5 billion by mid-2010. In early 2010, there were more than 2 billion Internet connections. In 2006, the world's airlines carried more than 2 billion passengers. Billions of items of clothing and footwear are sold each year. There are more than a billion vehicles (cars, trucks, buses, motorcycles, and bicycles) on the world's roads. More than a billion people wear a watch. There are more than a billion copies of word processing software. Only founded in 2006, by the end of 2009 Twitter enabled more than a billion tweets per month.

One Laptop per Child, a non-profit association, aimed to develop a $100, robust, low-power-consumption computer that connects to the Internet. There are billions of potential users throughout the world.

Nearly 10 billion embedded systems were produced in 2009. These are the very small devices, usually with computing, control and communication capability, that are built into more and more products to provide new functionality.

Fig. 5.2 Some reasons for the changed situation

the end of the Soviet Union in 1991
economic reforms in China that started in 1978
economic reforms in India that started in the 1980s
reduced trade barriers
improved travel, transport and telecommunications

There is nothing to stop a company taking a slice of the billion-customer market. For example, in the early 1980s, US manufacturers dominated the world market for large civil aircraft. Yet 20 years later, Airbus, which is part of the European Aeronautic Defence and Space Company (EADS N.V.), had taken a 50% share. The most successful Airbus product family is the A320 family (which includes the A318, A319, A320 and A321). By mid-2010, more than 6,500 aircraft of the A320 family had been ordered, and more than 4,000 delivered. With a catalogue price of about $50 million, that's trillions of dollars of sales.

In 2006, sales of the BMW brand, at nearly 1.2 million vehicles, were close to double the figure of about 700,000 recorded in 1998. BMW's home is in Munich, Germany. It only started producing vehicles in the USA in 1992. By 2006 it manufactured at 22 sites in 12 countries on 4 continents.

Toyota's annual vehicle sales in the 1970s were about 3 million. They grew to 4 million in the 1980s, and 5 million in the 1990s. Production rose to over 8 million vehicles in 2008. Toyota began exporting to the USA in 1957. In 2006, Toyota had manufacturing companies in 28 countries, design and R&D centres in 5 market regions (North America, Europe, Australia, Asia and Japan), and marketed its vehicles in more than 170 countries and regions of the world.

There are similar examples from other industry sectors. In 2005, sales of the Coca-Cola Company reached 20.6 billion unit cases. That's nearly 500 billion servings. The Coca-Cola Company sells more than 400 brands in over 200 countries. The geographical sales split in 2005 was 28% North America; 6% Africa; 9% East, South Asia and Pacific Rim; 16% European Union; 25% Latin America; 16% North Asia, Eurasia and Middle East.

The opportunities of Global Products aren't limited to just a few large companies with thousands of employees. The opportunities are also there for small and medium companies, with tens or hundreds of employees. There are millions of these companies throughout the world. The smaller company may sell its product direct to end users and consumers worldwide. Alternatively it may supply its product to a larger company, operating worldwide, that will include it in the products it offers to its customers.

5.5 Social and Environmental Opportunities for Products

The world faces increasing social problems. Society has always had an impact on manufacturing industry. Years ago, among the most highly visible effects of manufacturing industry were the factory chimneys and coal-burning fires that polluted cities. From the 1850s, London, England suffered from smog, a mixture of fog and smoke resulting from the combustion of coal. In 1952, a smog led to 4,000 excess deaths. This was a key event in environmental history. Laws were passed requiring the use of cleaner fuels. Nevertheless, as late as 1962, London experienced a smog with 340 excess deaths. For a time, London then had cleaner air, but it now suffers from photochemical smog which occurs when sunlight acts on

nitrogen oxides in vehicle exhaust gases to form ozone. In addition, incomplete combustion of fuel leads to the production of carbon monoxide, a colourless, odourless, poisonous gas. Having removed industrial pollution from their cities, advanced industrial countries now introduce laws concerning emissions from cars, disposal of cars, and disposal of electric and electronic goods. Other effects of manufacturing industry that are of concern to society include acid rain, global warming and the ozone hole. Initially, in the name of Progress, much is accepted, but eventually society catches up and legislates against dirty, poisonous products that kill and pollute. PLM will play a key role in addressing all these issues because it provides the opportunity to get control of products across their lifecycles.

Sustainable Development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" by the Brundtland Commission in 1987. It's a holistic concept that aims to unite economic growth, social equity, and environmental management. The problems it addresses, and the ideas for their solution, aren't new. Over the years, population growth, lack of disposal sites, and scarce natural resources have led to all sorts of reduction, reutilisation, recycling and recovery programs. As far back as 1958, Iceland started to extend the fishing exclusion zones around its coasts to prevent over-fishing, particularly by UK trawlers. In 1975, Iceland extended its exclusion limit to 200 miles from its coastline and a "Cod War" ensued. The UK deployed about 40 ships, including more than 20 warships, to protect its 40 trawlers. When Iceland threatened to close a NATO base, the UK agreed to Iceland's requirements. In 2011, the fishing grounds around Iceland are among the few in the world that aren't dangerously over-fished. Worldwide, 90% of major fish species are fished-out. It's easy to over-exploit natural resources such as oil, water, farmland, fishing grounds, forests and minerals. It requires more thought to use them in a sustainable way.

5.6 More Opportunities for Products

5.6.1 Unsolved Problems

The world has many problems in need of solutions (Fig. 5.3).

Area	*Problem*
Environment	Global Warming, threatening the flooding of many cities and states
Poverty	More than a billion people living on $1 per day
Unclean Water	More than a billion people living without safe drinking water and electricity
Slums	In 2000, about a billion people lived in slums, but according to current trends the number will rise to 3.5 billion by 2050
Disease	Thousands of people die each day of curable diseases and illness. For example, every day, 6000 children die from diarrhoea, usually caused by lack of clean water In 2009, according to the World Health Organisation, about 1 billion people were affected by Neglected Tropical Diseases such as schistosomiasis and trypanosomiasis
Accidents	According to the World Health Organisation, road traffic crashes kill more than 1 million people, and injure more than 50 million, each year. The annual global cost of road traffic crashes is estimated to be over $500 billion

Fig. 5.3 Problems in need of solutions

5.6.2 Future Changes

Although many problems have not been solved, new and enhanced approaches to product development and distribution have appeared. They include Shareware, Open Source, microcredit and microsavings, generic products, and Fair Trade for exports from developing countries to developed countries. The role of non-governmental organisations (NGO), foundations and associations has greatly increased. For example, the Bill & Melinda Gates Foundation has committed billions of dollars in global health grants to organisations worldwide.

Many problems remain to be solved, creating many opportunities for product developers. It's to be expected that, in coming years, many other opportunities for product developers will result from technological advances and from customer demands. Of course, it's possible that the future won't be so rosy. World trade patterns could change radically, for example because of wars, revolutions, terrorism, epidemics, global warming, and/or increased radiation disrupting communication systems.

5.6.3 Balance of Power

In early 2007, the G7 countries of Canada, France, Germany, Italy, Japan, the UK and the USA accounted for about two-thirds of the world economy, and 10% of the world population. Assuming though, that progress continues along a similar path as in recent years, by 2040 the seven countries with the largest economies will include China, India, Brazil, Mexico and Russia. They will have a combined population of nearly 4 billion, over 40% of the world population. Meeting the needs of large populations of poor people may seem more important to their governments than sending profits to foreign companies. They may have the economic power to change the rules of world trade to better meet their needs. For example, they may change the rules protecting property rights that render many products unavailable at prices that people throughout the world can afford. They may consider that true innovation should be justly rewarded, but people shouldn't die because of laws overly protective of past activities in other parts of the world. They may find that state-owned manufacturing companies can be as effective as privately-owned profit-driven companies at producing mature "human rights products" and commodity products.

In such a scenario, with NGOs and state-owned companies developing and manufacturing basic low-cost products for a large part of the world's population, foreign privately-owned companies could be led to focus on developing new, advanced, highly complex, high-value-adding products. They would still be offering products globally, and the need for PLM would be similar. There would still be the need to collaborate, for the development and manufacturing of products, with different types of organisation worldwide. And they would still need to be in total control of their Intellectual Property.

5.6.4 Increased Regulation

As products are so important to customers, governments and investors, it's likely that regulation, certification and audits will increase. Company performance in areas as diverse as community contribution, environmental performance, pollution, sustainability and R&D performance could be a target for new or enhanced regulation or certification.

Currently, many characteristics of a company, such as the financial figures, and the compliance with quality standards, are audited by external organisations. However the value of a company's products isn't audited in a standard way. As PLM becomes increasingly important, and more and more standard processes are used, the company's products will be seen as central to its value. They'll be audited for the good of users and investors. Auditors could report on the expected future value of a company's product portfolio, a useful figure for investors. PLM will play a key role in this valuation.

The different requirements and regulations in different countries and trade zones will complicate the activity of compliance. PLM will continue to play a role in keeping all the activities and documents under control.

5.6.5 Better Managed Product Companies

In the global product environment, the potential for problems with products is magnified. (For example, Toyota recalled about 8 million vehicles in late 2009/early 2010.) In response to the increased risks with global products, more emphasis will be put on risk management activities. They'll be needed to help avoid major losses and to assure major benefits are achieved. Product development projects will be managed better to be sure that products get to market on time. The Product Portfolio will be managed better to maximise product value.

In the 1990s and the early years of the twenty-first century, many companies made good progress with Lean Manufacturing in production. Increasingly they will look to make similar improvements in white-collar areas. Targets of 50% reduction seem likely. Standard processes, applications and documents will be used wherever possible to cut down on waste.

Increasingly, society is expecting producers to take responsibility for their products. In coming years, companies can expect to have to take more responsibility, which will mean getting more and more control over the product lifecycle. The penalties for problems resulting from products, and their related processes and services, will probably increase.

In the early twenty-first century, there is little automated feedback from products. In coming years, products will send back much more information to their manufacturers. It will be used to support product use and disposal, and to develop new generations of products.

Increased counterfeiting is one of the effects of globalisation. Companies will manage their product IP better to reduce the risks of IP theft and counterfeit products. Unique identifiers for products will help improve traceability, IP protection and customer support.

5.6.6 Multitude of New Products

Bundling existing products together and offering them as an easy-to-use solution is one way to meet customer requirements. It can be a quick way to bring new products to market.

Tens of thousands of new products will be developed each year. With about a million engineers graduating each year from India and China, more and more products will be developed in Asia.

Companies in the West will have to improve their product innovation capabilities, and their potential for collaboration with companies in Asia.

5.6.7 More Web-Based Product-Related Services

A first phase of product-related services on the Web led to on-line sales and auctions of products and services. As the Web evolves to Web 2.0, and becomes more and more ubiquitous, all the functions associated with a product will need to be available over the Web, leading to Web-Based Product Lifecycle Management. Ideas for new products will be generated over the Web. New products will be developed over the Web. Production information will be available on the Web. The product will be serviced over the Web. And the Web will play a part when the product reaches the end of its life.

5.6.8 Breakthrough Computer Aided Product Development

With a need for faster innovation of products, applications to suggest new products will appear. Although products that will appear in 5 years may be unknown today, it's sure that they will exist. Companies need to find ways to identify them sooner.

With products becoming increasing complex, there will be an increased need for simulation of a product's physical and financial performance before large sums are invested in its development.

5.7 So Much Opportunity

PLM has the potential to solve the problems in the product lifecycle and in new product development (Fig. 5.4). It also enables companies to seize the many market opportunities for new products in the early twenty-first century.

The number of opportunities opening up in the twenty-first century seems boundless. Perhaps it was too risky to pursue them when the product development process was out of control, production runs in faraway countries had unexpected problems, and customers complained continually about product problems. But that was before PLM. Now PLM's here, allowing companies to develop and support tiptop services and products across the lifecycle.

Surely, with so much opportunity, new products should be rolling off the production line at an ever-increasing rate. And revenues should be going through the roof.

5.8 Response to Opportunity

PLM opens up a huge number of opportunities and benefits. But resources will have to be applied to achieve those benefits. And they will have to be organised effectively.

Companies need to understand which opportunities and benefits are relevant for them. They have to make sure they don't miss out on a potential benefit, or aim for the same benefit twice. Their response to the opportunities has to be matched to the benefit they want to achieve. If they make no response, they'll get no benefits.

The opportunities are similar for all companies. The achievements of different companies will be very different, ranging from great success to the opposite.

Airbus sales grew in a market against competition from aircraft such as the Boeing 747, the McDonnell Douglas DC-10 and MD-11, and the Lockheed L-1011. In 1997 McDonnell Douglas became part of The Boeing Company.

Imagine	*Define*	*Realise*	*Support/Use*	*Retire/Recycle*
	Projects on time	Reduced energy use	Fewer failures	
	Fast time to market	Trained workers	Better customer info.	
	Data under control	Efficient machine use	Add-on modules	
	Clear processes	Less rework	More customers	
Support applications	IP under control	Green logistics	Happy customers	Lean processes
Supportive culture	Motivated people	Green production	Refurbishment	Re-usable materials
IP under control	Clear requirements	Optimal shop layout	Services revenues up	Re-usable parts
No bureaucracy	Customisation	Less inventory	More services	Environment-correct
Clear process	Clear decisions	More part re-use	Lower service costs	New applications
Breakthrough ideas	Reduced costs	Less scrap	In-service upgrades	Disassembly time cut
Imaginative people	#1 product family	Strategic suppliers	Liability costs cut	Fewer fines
More ideas	Standards adherence	Lower material costs	Warranty costs cut	Better compliance

Fig. 5.4 Gains from PLM across the product lifecycle

MD-11 production stopped in 2001. The L-1011 was the last large civil aircraft built by Lockheed. In 1995, Lockheed became part of Lockheed Martin. Boeing is now the only US producer of large civil aircraft.

Sales of BMW and Toyota vehicles more or less doubled in a decade. Ford Motor Company's worldwide vehicle unit sales of cars and trucks stood at 6.6 million in 1995, 6.8 million in 2005.

The Good News about PLM is that it offers companies the opportunity to address larger markets, to develop a great product, sell it to billions of customers and users, and rack up huge profits.

The Bad News about PLM is that developing and supporting products worldwide isn't easy. There are a lot of questions to be answered, a lot of choices to be made, and a lot of decisions to be taken. Once these decisions have been taken, all sorts of problems can occur. Products can take a lot longer to develop than planned. The wrong product can be developed. Problems can occur during manufacturing. When the product is in the market, a competitor may bring out a better product that will eat into sales. And problems can occur during use, all the way through until the product's end-of-life, where there can be even more problems waiting.

However the Best News, for some, is that their companies will understand the opportunities, questions and potential problems of PLM. And then they'll develop appropriate responses for their products. And for their capability to deploy those products to customers throughout the world.

5.9 From Opportunities to Detailed Benefits

It's great to talk of awesome opportunities on a global scale. It's equally important to be able to detail the resulting benefits for a particular company.

Type of Increase	*PLM Involvement*
increase the number of customers	by developing and supporting new products
increase the product price	increasing product quality enables justifiable price increases. New functions and features can justify higher prices. Being first to market enables pricing premiums
increase the range of products that customers can buy	for example, by improving product structure management, PLM enables more customer-specific variants. It enables companies to expand the size of their product portfolios. It enables breakthrough products that can create new markets
increase the number of products of a particular type that a customer buys	by increasing product quality, PLM allows customers to dispense with second sourcing
increase the re-ordering percentage	by increasing product and service quality
increase the buying frequency	by getting products to market faster and more frequently
increase the service price	by using PLM to improve the quality of existing services
increase the range of services	by using PLM to develop and support additional services
get customers to pay sooner	by developing and delivering products faster
increase sales of new products	by introducing innovative new products
increase sales of mature products	by lengthening the life of a product. Make more frequent product enhancements, product derivatives, niche offerings, and add-ons to product platforms. Offer simple enhancements to mature products

Fig. 5.5 Revenue increases with PLM

One way to understand the benefits of PLM is to focus on the revenue increases it can provide. Revenue increases can be achieved in many areas (Fig. 5.5). Another way of understanding the benefits of PLM is to focus on the ways it helps cut costs. Costs can be reduced in many areas (Fig. 5.6).

Type of Reduction	*PLM Involvement*
reduce direct labour costs	Specialists across the lifecycle, for example in engineering, production and the field, waste a lot of time on data retrieval and management activities. PDM applications, which are components of PLM, can do this work for them, leaving them more time for value-adding activities. As a result, fewer specialists will be needed
reduce overhead costs	In an effective, "joined-up" PLM environment, a lot of the paper-shuffling, data re-entry, data formatting, and administrative work that is currently carried out by many people (such as administrators, supervisors, coordinators, assistants, gofers, checkers, filing staff, data entry clerks, inspectors, documenters and BOM conversion staff) across the lifecycle will be eliminated. As a result, fewer people will be needed for these tasks
reduce material and energy consumption costs	In the PLM environment, people will have better information, allowing them to take better design, engineering and purchasing decisions that will lead to reduced production costs. Digitally simulating production facilities and production processes for all the possible configurations of a new product will reduce costs
reduce the cost of purchased goods	More accurate and more detailed information will be available with PLM, allowing people to negotiate better prices for purchased products and services
reduce the cost of quality (COQ)	PLM will reduce the number of errors made along the marketing / engineering / production / delivery / service chain enabling a reduction in scrap and rework, non-compliance costs, penalty costs, warranty costs, recall parts, erroneous order and production of parts, obsolete parts, product liability costs
reduce costs of storing information	Information will be stored on low-cost, compact media rather than on space-eating paper
reduce costs of communicating information	Information will be transferred quickly and cheaply by electronic means rather than by the slow and expensive transport of paper documents
reduce the cost of space used	Once all the information currently stored on paper has been transferred to electronic media, the buildings, rooms, vaults, cupboards and drawers currently used for paper storage can be used more usefully. Once headcount has been reduced, fewer offices will be needed
reduce costs of holding finished inventory and work in progress	PLM applications can enforce use of standard parts and catalogues, enabling a reduction in stocks. Examination of the detailed descriptions of all the existing parts and products in use will show many similarities and a high potential benefit from rationalisation
reduce costs of equipment and tooling	Examination of detailed descriptions of all processes and machines in use will show many similarities and the potential for rationalisation
reduce IS costs	A PDM application can act as a central repository and infrastructure for the company's product data. As a result, some of the company's existing applications will no longer be needed. Many of the interfaces between these applications and other applications will no longer be needed
reduce costs of product development projects	PLM helps make project progress clearer. Action to prevent increased costs can be taken earlier
reduce costs of customer acquisition	Requirements Management applications, which are components of PLM, help clarify exact customer requirements and reduce costly changes to requirements
reduce costs of product support, repairs, upgrades and service visits	PLM applications maintain knowledge of the exact configuration of the product. Service engineers don't waste timing finding out what needs to be serviced. They don't proceed by trial and error, but get it right first time

Fig. 5.6 Cost reductions with PLM