

factory of the future

Connecting data, machines, people and processes to deliver the next generation of manufacturing



A new generation of Manufacturers are upon us.

Manufacturers whose operations are integrated end-to-end. Manufacturers with a time to market that leaves competitors in the dust. Manufacturers who can accurately predict demand and alter production to suit with ease.

This new generation of Manufacturers are operating a Factory of the Future and they are doing it now.

In this Factory of the Future Positioning Paper we will discuss the key trends and drivers behind this shift in the Manufacturing sector as well as provide insight into the critical considerations that you will need to make in delivering your very own Factory of the Future.

At Atos we are dedicated to playing a key role in harnessing these developments both for and alongside our Manufacturing clients.

We are happy to share our vision of the future in this thought leadership paper and we hope you find it the ideal guide to provoke thought and debate in your company.

Welcome to the Factory of the Future.

New business trends in manufacturing

Customer Centricity

Making-to-stock is now a thing of the past with Make-to-Order or even Make-to-Individual the production model required as customers and local, national and international markets demand much more of manufacturers.

Customers want more models and variants, specific to their individual requirements, and they want them now. There is zero tolerance for quality issues and competitors are ready and waiting to step in should a manufacturer slip up.

The Factory of the Future requires improved connectivity, greater adaptability and increased responsiveness. They must also become more customer-centric, delivering products that meet individual needs whilst driving new user experiences.

This requires an accelerated time-to-market achieved through improved execution accuracy and more efficient and accurate processes which will in turn ensure quality levels are maintained whilst delivery is sped up.

This improved accuracy of execution and processes comes from increasing interconnectivity at every level of the manufacturing value chain. Manufacturers that are able to collaborate and communicate more effectively across their entire operations will be better positioned to respond to competitive pressures, shorten product lifecycles, and meet fluctuating levels of demand.

The Convergence of IT and operational technology (OT)

The autonomous and independent leveraging of relevant information will be a cornerstone of the Factory of the Future. Central to this is having real-time data available to connect the virtual world with the real world.

This opens up possibilities for entirely new business models based on the convergence of physical devices and IT known as cyber-physical systems (CPS). Through CPS, physical entities can be controlled fully through IT with device functionality not defined solely by physicality but by software. Currently

used throughout aerospace, automotive, infrastructure, energy, and transport CPS are increasingly critical to manufacturers and the Factory of the Future ecosystem.

CPS will affect the way factories are constructed and run and will play an ever-bigger part in the way that products, machines and operators work together. These CPS platforms will be the basis to connect people with the 'internet of things' and the 'internet of services'.

Gaining end-to-end visibility across plants and disciplines

Manufacturers need to be able to visualise increasingly complex production scenarios. For maximum flexibility, dispersed plants need to be controlled or at least overseen from a single, central vantage point. This requires unified governance and line of sight over every aspect of strategy and operations. Each individual plant should be looking to contribute to the health and performance of the system as a whole.

Factories must be harmonized with the business, so that they can be monitored, measured and managed in the same way. Uninhibited information flow leads to holistic, efficient resource management across all plants. To deliver this, Manufacturing Execution Systems (MES) and Enterprise Resource Planning (ERP) must work together, giving central coordinators a clear picture of plant activity and capacity.

More open relationships must be enabled and encouraged between departments to drive information flows and collaborative working more freely across design, engineering and production planning, marketing, sales and customer service teams. The Factory of the Future must be centrally coordinated and governed, but able to work independently. This combination will enable it to respond more rapidly to change and incorporate new learnings and ideas on how to improve products and processes more effectively and from across the entire organisation.

Factories must stop being seen as boxes, and be viewed as open, cooperative environments. Greater co-operation along the value chain

leads to better-quality products, fewer iterations, faster time to market, and thus competitive advantage.

Deploying 'anywhere' manufacturing

Global production and value chains need to be leveraged for success. This means that products need to be reproducible across the entire factory ecosystem, with factories able to 'make' anything the organization needs to make anywhere. This means the ability to resource flexibly, for instance, re-routing orders depending on local constraints and demands.

Embedding intelligence

Putting in place real-time intelligence and sensors at every level of the factory and production cycle, manufacturers can see everything that's going on throughout production lines. This will increase their ability to take immediate actions to produce more output when needed and ensure higher quality, thus supporting operational and business agility.

Achieving real-time decision support, guiding product development and steering operations requires the availability of reliable, efficient and constant data streams, made possible through advanced IT. Naturally, it also demands that manufacturers have the ability to combine and analyse the high volumes of complex data being delivered through multiple, dynamically interrelated sources.

This includes the data coming in via increasingly 'social machines' - connected cyber-physical systems that deliver greater connectivity between machines, operations and planning functions. These Social Machines enable a manufacturer to achieve real-time decision support, guide product development and steer operations.

Factories therefore need to support an operating model based on computing being embedded at every point, which is key to real-time planning and mapping of production as well as to the evolution of products. This approach is the best way to turn data into intelligence, and then into value.

The keys to the future: connection and real-time intelligence

Meaningful decision making based on greater amounts and higher quality real time information and insight will be the linchpin of the Factory of the Future.

The convergence of planning systems and production lines, between machines on the shop floor and their operators, will ensure that machinery can be an autonomous participant, affecting every key consideration within the factory and in the manufacturing ecosystem.

This new ecosystem will be built upon a foundation of better Connected Processes, Machines & Applications, People and Plants.

Connected Processes

The greatest gains in manufacturing over the next 5 to 10 years will be made by companies that understand the value of integration across function, department and process. Only integration can deliver the actionable intelligence needed for enterprise-wide collaboration. That collaboration is the key to the reduced time-to-market and greater flexibility needed to satisfy customer demand.

IT is the enabler for integrated manufacturing, but for successful implementation you must align processes, organisation, and culture.

Future growth is driven by not accepting the disconnected functional silos. The best and most advanced companies are taking the tough, but rewarding, route of integrating, redesigning and streamlining processes and systems into one unified business platform. Technology will enable smooth integration of the full value chain and operations; product development (PLM), production planning (ERP) and production execution (MES / MOM). Systems that used to be called 'MES' (Manufacturing Execution Systems) have now evolved into all encompassing, integrated solutions for the shop floor - Manufacturing Operations Management (MOM) solutions.

Connected Machines & Applications

Manufacturing machines and equipment will be connected, and able to talk to each other and share information in real time, ensuring that each can access all the necessary data to prepare for what's coming next.

The Factory of the Future will automatically re-route work, pre-empt bottleneck, identifying areas of underused capacity, customise production, enable predictive maintenance and operate

continuously and at unprecedented levels of efficiency. Machine information from outside specific plants will be accessible, enabling remote control of manufacturing units and services. Machine controllers will be able to access user profiles from anywhere enabling predictive maintenance to be carried out more effectively.

We will move towards the merger of minds and machines thanks to electronic sensors that allow them to see, hear, feel. These machines will increasingly become not only more 'intelligent' or 'smart' they will become brilliant, self-aware, predictive, reactive, self-healing, self-improving, and social.

We are already seeing technology, in some areas, being able to outperform humans in complex tasks. In 2011, IBM's 'Watson' computer won against the best human player in the game show Jeopardy. Since 2012 Watson has been preparing to take the entrance test for admittance into the University of Tokyo. Its development team believes it will succeed before 2021. Today, we can imagine that the new generation of machines will become as important as all of today's non-brain like software.

Connected People

Despite the increasing intelligence of machines, people will remain the heart of the factory. Humans will retain the fundamental control and decision-making function. Human-centric plant strategies will enable a flexible and proactive production environment. Intelligent, self-aware machines will liberate operators to focus on optimising production and planning. As well as this, cross-functional communications will be enabled along the entire value chain, from design through engineering, production, sales and service. Work will thus aggregate around 'communities of practice' or 'communities of interest' not just within functional silos.

It is predicted that in the next 5 years, a middle-class worker will have 10 devices connected to the network. Internet and mobility, as well as personal and professional worlds, will converge at any time, in any place, for anybody and on any device. The tablet that did not exist five years ago has already become the device of choice for a whole generation. Permanent access to applications along with live information feeds and automatic alerts from the machines to mobile devices will allow operators, managers and engineers to move around more safe in the knowledge that they will always have access to the latest status information, and be able to make decisions from wherever they are.

Touch and voice entry become the norm and people now expect to be able to switch or swipe information from one device or person to another. In a world where people no longer work fixed hours, from a fixed PC in a fixed location manufacturers need to understand and enable their people's dynamic and continually changing 'digital mesh'. Younger workers will be able to communicate easily in the ways that they are used to, through social channels and open networks, with everyone contributing and without hierarchy. This will not only make manufacturing more attractive to upcoming generations, it will speed up continuous improvement through incorporating contributions more easily and effectively.

Where digital and electronic components merge with textiles "smart clothing"; a futuristic form of clothing that can function as an active device, is created. The idea of joining textiles and electronics has already become a reality, starting in sports and leisure as well as in military environments. Smart Fabrics and wearable technology is a real way forward, making worker's life more convenient, efficient and secure by providing interactive and communicative clothing suitable for the plant floor.

Connected Plants

For maximum plant efficiency, networks of plants need to be treated as exactly that - a single, connected entity that can be orchestrated as one. Facilities are no longer fixed and silo-driven but flowing with intelligence, adaptability and the ability to dynamically reconfigure.

Manufacturing will decouple from specific plants. Software and activities will decouple from specific hardware. Future planning models will be much more dynamic and flexible, making best use of machines and global capacity, responding to demand and opportunities.

Each contributing facility should be benchmarked against central standards. They must be comparable with each other (you must be able to directly compare the performance and processes of one factory with those in another) and learn from each other. Factories will increasingly be part of a network of factories. A single fluid, self-managing and constantly interacting asset. In some ways, we can imagine the new generation of factories as 'living'. They will bring together machines, minds and advanced analytics to make better decisions, use ubiquitous sensors to see, hear and understand and generate and make use of prodigious amounts of data for better and more meaningful decision making.



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Developing a roadmap for change

Organisations face so many opportunities and challenges that often identifying where and how to begin is the biggest obstacle. The answer is clear road-mapping of the journey, from where they are now to where they need to be. This is vital if successful transformation is to be achieved. The Key steps in developing your own roadmap are:

1. Begin with a clear transformational goal

The starting point of the journey must be to decide what the destination is. Beyond the new requirements that are already visible (the need to become more customer-centric and to accelerate time to market, for example), manufacturers must also cater for the many unknowns. Customers' priorities can change overnight, and it only takes a surprise move from a new entrant to disrupt a whole market. It is crucial then that manufacturers build adaptability into their technology strategy and wider planning for factory and production evolution. This makes consultancy and analysis of ambitions a crucial part of the first step.

2. Prioritise cultural & organisational issues

Connecting machines, applications and products only works if people and the organization are also connected. Organisational fluidity and dynamism will need to be central objectives of any initiative. This means considering the people elements first - for example, how the company will motivate managers and employees to think beyond their

current roles. Once the workforce is on board, the company can begin to look at how it will align processes and IT systems to support its employees in new ways of working - and work out the complicated ways in which IT changes will affect other systems.

3. Make innovation a central process

To compete, factory ecosystems must play an active part in innovation rather than being involved only in the execution phase. This will involve putting in place the people and processes to involve plants with the wider business and encourage and discover new ideas.

4. Overcome silos

Many companies (and their factory ecosystems) have operational, technological and organisational barriers in place. These are less suitable for today's faster, more dynamic and complex manufacturing environment. Manufacturers should look to adopt ways of working that avoid boundaries of hierarchy, functions and roles - and drive collaboration, communication, and information sharing everywhere.

5. Transform in the medium term

Don't look too far ahead; instead, aim for a transformation over the next 3-5 years. Following development of the vision, manufacturers can start planning pilots, beginning with concrete steps such as improvements to PLM and MES/MOM capabilities.

6. Act holistically

Manufacturers will have to manage their network of production facilities as a unique virtual factory that consolidates the number of different manufacturing plants in terms of resources, processes, and products. They will also have to gain a greater level of real time visibility across the global network of operations and more centrally managed supervision and coordination of execution activities.

7. Offload complexity

Remote hosting of technology platforms could help achieve centralised visibility, and provide the scalability needed to cope with data from multiple plants and areas of operation. Factories also need good filtering and reporting tools to drive relevant and timely intelligence back out to local planners and operators. Specialist cloud-based services may be a practical option for large-scale data processing and analytics, while managed business process services could help companies take advantage of new revenue models based around connected products.

8. Keep refining the strategy

Once the building blocks are in place, the priority should be to create a defined, clear vision and strategy to aim for. The steps you take towards this horizon can be evolved, as new opportunities and challenge emerge. This means continuous reassessment of tactical responses towards a clear goal, and looking outwards to see how other manufacturers and other industries are adapting and innovating.





Further considerations to bear in mind

As new operational and technological scenarios begin to shape strategy and enable the Factory of the Future, other considerations must be borne in mind to maintain efficiency and support business direction.



CIO Governance

CIOs will require new governance models and support structures in order to maintain effective information flow, technological support and product development processes. New supply chain and production models will depend upon efficient resource use, collaborative working, and strong global IT governance and compliance.

Information security

Manufacturers often face distributed shop floor IT architectures. Each will have a high requirement on availability and integrity whilst operating in a 24/7 environment where creating time for service slots for patching and repair is not possible. Companies also have to ensure connection to the industrial controls network (ICS) with appropriate protection mechanisms in place to prevent the misuse of IT.

In future we will see increasing security requirements through the relocation of shop floor control activities to the cloud and machine-to-machine communication. Internal attackers or external attacks that can penetrate to the ICS network, can cause significant damage to production facilities.

Consequently, safety and security cannot simply be broken down into functional components but should instead be approached as a holistic process across the entire IT landscape. With proactive behavior and sufficient monitoring of risk indicators put in place information security can be guaranteed.

Compliance

As manufacturers expand their operations across borders national and international compliance must be navigated as data is moved between sites in different territories. Different regulatory frameworks are in place in different countries so these need to be fully complied with, without questions and without slowing down the business or impeding operational effectiveness.

Sustainability

Sustainability is becoming key to the manufacturing agenda and will be on the top 5 topics on the agenda of 60% of CEOs by 2015. Linking environmental and operational excellence means aligning with international responsibility charters to develop innovative and sustainable solutions. Factors such as fabrication directly to the end customer, new

sustainable materials and products and a move away from 'planned obsolescence' towards built-in re-use, re-manufacturing and recycling will all contribute to a more sustainable and effective manufacturing business

Workers' roles

The future of manufacturing is people-centric and this has never been more critical to success. For the first time in history, we have 4 generations of workers working together with very different education, styles and aspirations. Some roles may disappear or fundamentally change, but skills and knowledge will intensify in importance. Automation, faster decision-making and rapid production will mean that all workers must become, and remain, expert workers. In this context, supporting a new people scenario and realigning roles will be more fundamental than ever. Considerable organisational and cultural work will be needed to engage and motivate traditional workers by aligning traditional expertise with the needs of the changing production environment whilst also attracting younger employees used to a more open and collaborative way of working.

Conclusion

The speed of change occurring in the manufacturing sector is unprecedented.

In this environment, where the 'future is happening now', the only safe strategy is to be ready for anything. In this new manufacturing revolution the customer is in the driving seat, steering the direction manufacturers must go through their demands. Manufacturers will have to constantly deliver against customers higher-level demands, while driving even more organisational efficiency and productivity benefits.

Effective factory managers will be those capable of rapidly adapting and scaling their activities, assets and infrastructures to exploit the evolution in technology. And in doing so they will become more responsive to the changing global markets and closer to their customers.

Accelerated flexibility at a plant level will depend on smarter, real-time intelligence. This means that effective data capture at every stage and level of the factory and production cycle is crucial, and is an area in which compromise should not be made.

The global plant floor – where personalised, made-to-individual products and services can be designed anywhere, produced anywhere, and sold anywhere – is emerging as the operations model that will allow companies to fulfill customer-specific requirements from multiple emerging and global markets.

To run their global plant floor effectively, manufacturers will operate a network of specialised production facilities that blend into a single virtual plant. Centralised coordination of this single virtual plant will be based on the real-time data and information now being captured.

On the technical side, innovation will continue to raise new standards. We are now at the start of new revolutions in biotechnology, 3D printing, robotics, nanotechnology and artificial intelligence. They will continue to transform our lives – as well as the factory ecosystem.

The greater long-term benefit will be the ability to run autonomic or self-healing processes.

When the Internet of assets reaches maturity, the interconnected devices of the global plant floor will be able to react autonomously to a broad range of events. They will request each other to perform actions to avoid the bottlenecks that human plant operators who, overwhelmed by the necessity to quickly make thousands of decisions, would be hard pressed to avoid to maintain system performance.

Alongside this, the manufacturing sector will have to attract younger skilled workers, realign roles and create an inspiring environment for each generation of workers.

Smart assistance systems release workers from having to perform routine tasks, enabling them to focus on creative, value-added activities.

In light of the impending shortage of skilled workers, this will allow older workers to extend their working lives and remain productive for longer.

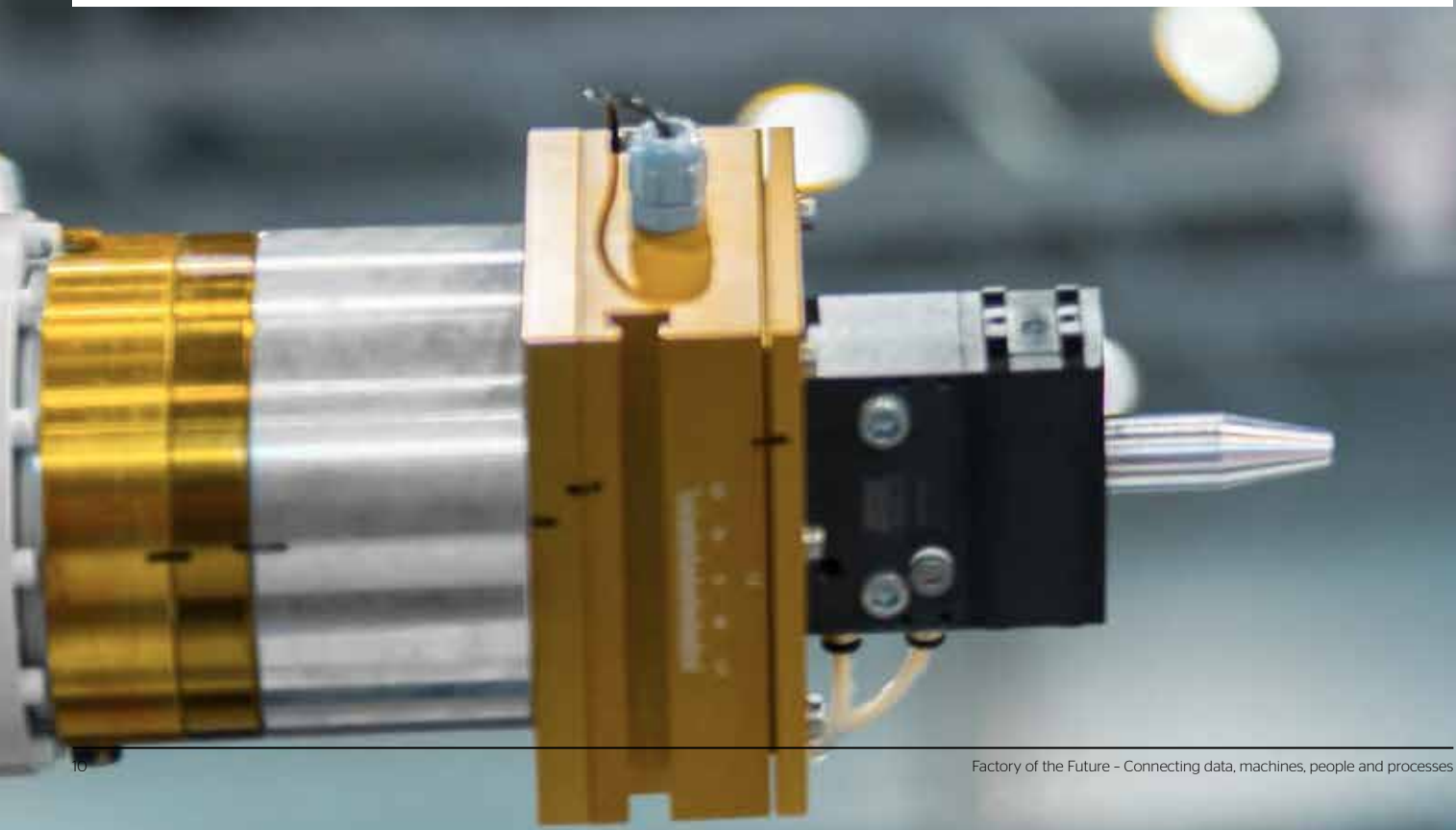
The Factories of the Future that are already beginning to appear are employing a completely new approach to production.

Smart products are uniquely identifiable and can be located at all times, know their own history and current status as well as alternative routes to achieve their target state.

Embedded manufacturing systems are now vertically networked with business processes within factories and enterprises as well as horizontally connected to dispersed value networks. This all means they can be managed in real time, from the moment an order is placed right through to outbound logistics, from any point across a manufacturers network

This increasingly interconnected, autonomous and factory can then take the next step. To become the truly intelligent, connected, next-generation factory that all thriving manufacturers will rely upon, and drive competitive advantage through.

This is the Factory of the Future.





About Atos

Atos SE (Societas Europaea) is an international information technology services company with 2013 annual revenue of €8.6 billion and 76,300 employees in 52 countries. Serving a global client base, it delivers IT services in 3 domains, Consulting & Technology Services, Systems Integration and Managed Services & BPO, and transactional services through Worldline. With its deep technology expertise and industry knowledge, it works with clients across the following market sectors: Manufacturing, Retail & Services; Public sector, Healthcare & Transports; Financial Services; Telco, Media & Utilities.

Atos is focused on business technology that powers progress and helps organizations to create their firm of the future. It is the Worldwide Information Technology Partner for the Olympic & Paralympic Games and is quoted on the NYSE Euronext Paris market. Atos operates under the brands Atos, Atos Consulting & Technology Services, Worldline and Atos Worldgrid.

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