



## Teaching case

# From products to product-service systems: IT-driven transformation of a medical equipment manufacturer

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### Abstract

Meditec is a German manufacturer of instruments for surgeries. The company is quality leader in this sector and supplies many German and international hospitals. However, the opportunities for differentiation against competitors decrease continuously. New competitors from emerging markets are challenging the market position of established companies in this industry. Meditec is therefore forced to change its strategy and business model in order to survive in this novel competitive environment. The management of Meditec has decided to traverse from a pure product manufacturer to a customer-centric solution provider. This transformation requires the development of new processes, competencies and capabilities – especially with respect to IT and IT services. This teaching case helps in understanding the role of IT in product-service systems (PSS) and PSS-based business models. Therefore the case illustrates why IT is necessary to establish a PSS-based business model and why a customer-centric view is important for this kind of business model.

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### Introduction

‘Sally, compared to your competitors, your products are well above the average price for surgical equipment. You know that in recent years, the medical engineering industry, and especially the surgical equipment sector, has seen a number of new international companies on the scene which have grown to significant players on the domestic market. Furthermore, serving as the head of medical equipment procurement for our institution, I increasingly have to initialize open competitive bidding processes directed by the German state government and the European Union to guarantee fair bidding,’ says Tim, head of medical equipment procurement at the public mid-sized Marien Hospital in Northern Germany.

Sally works as a manager in the sales and distribution department at Meditec, a national leading manufacturer of surgical instruments, and supplier of Marien Hospital. She counters with, ‘I know about the governmental regimentations on competitive bidding processes, especially in the public sector and the recent developments within the medical engineering

industry. We have formed a task force to closely monitor the development within the industrial branch and product portfolio of our top five competitors. I have to admit that in comparison to close competitors, our products are priced high, but there is one justification for this high difference in pricing, and, Tim, you and your surgeons know it is the best quality – quality made in Germany!’

Tim nods and says, ‘I agree, quality of surgical equipment is not only a differentiation factor to competitors within the medical engineering branch and plays a significant role in decision making in competitive bidding processes, but it is also fundamental for the medical treatment of our patients and the basis for an excellent national health care system. Nevertheless, I have observed immense enhancements in product quality of international medical engineering companies, especially from emerging markets, during the last few years of attendance at the Medica and CompaMed international trade fairs. On my last visit, I talked to Mr. Chen, product manager of the surgical

equipment division of South Korea-based Hangyong, who recently assumed the management position for their Western and Eastern Europe business unit, about offers on specific surgical equipment that is featured in your product portfolio. Sally, you have to admit that companies like Hangyong have caught up to national quality standards and generated sound cost and performance ratios. Additionally, the municipal and state funding on expenses and investments is stagnating, the hospital management board has introduced stricter conditions for procurement activities, and Sally you can see my hands are getting more and more tied.'

After discussing minor points in existing contractual arrangements, Tim takes leave of Sally, but inwardly continues the conversation. 'You do not solve my problems, Sally. All vendors just want to sell their newest products. What we are searching for are solutions to our business and treatment process needs, and not just new products embedding the newest technology. Actually, we need to concentrate on our core competencies – the healing of and care for patients! We should focus more on treatment and care processes. Further, we are looking for solutions to increase cost transparency for our surgical instruments. It is hard to appraise the real costs and to assign them to specific treatments or patients. In addition, many of the instruments that we sterilize are prepared for surgery but are not used. Instruments that were prepared for surgery must be cleaned and sterilized whether they are used or not. With an intelligent solution we could save time and money, and still boost our efficiency. If you could offer me a solution that would help me solve these problems, I would welcome you with open arms!'

This kind of discussion and contractual talk is not new to Sally. Several customers of Meditec have increased pressure to reduce prices of offered products, especially because of increased competition from other, mostly low wage, countries. The situation changed last week when Meditec lost one of its most important customers, a hospital from Southern Germany, because of a cheaper offer on a competitive bidding process to Hangyong. In a specially scheduled meeting, board managers and business unit managers of Meditec then discussed the latest events and critical situation. The participating managers have now identified multiple factors that have led to this critical situation. The main factors are: the substitution of existing high-quality products with cheaper products driven by privatizations of German hospitals, and constrictions of public financial funding. The health-care sector sees an increased number of private investors that act as sponsors within the German hospital market. The market is also dominated by mergers and acquisitions of private hospital organizations. Private investors therefore strive for cost reduction and increase in profit. One option to decrease expenditure is the procurement of lower priced surgical instruments while quality characteristics of products are increasingly invariable. This evolution forces managers of Meditec to react to and initiate innovative product development processes as essential survival strategies.

Sally is on her way back to the headquarter offices when she realizes that the conversation with the client calls for a reaction to the current situation of Meditec. She acknowledges that the current product portfolio is excellent in terms of quality standards and diverse product ranges. Nevertheless, products no longer guarantee a differentiation from competitors, particularly from those residing in emerging countries.

This results in offered products becoming more and more replaceable. Meditec is in need of innovatively optimizing its product portfolio and going beyond product improvements. She knows their products are the best in class, but the offered products do not yet provide an overall solution for the clients' problems. *What would be an integrated solution around the set of surgical instruments?* Sally spends some time pondering this question.

Sally's enthusiasm surges as she considers the new plan, 'I know that the hospitals are currently not searching for new instruments. As Tim mentioned in the client meeting, our instruments are embedded into several processes, such as preparation, cleaning, sterilization, quality management, documentation, inventory, storage and so on. We should help our customers with an integrated product service system in order to ease their underlying processes. Perhaps we can support them in managing or executing one or more of these processes? Maybe we can help our customers with the quality inspections for our instruments? This could include an inspection of our instruments for proper operation, like the inspection of the sharpness of scalpels. We can offer this service in the hospital with field workers, or we can pick up the instruments and inspect them in our own laboratory. I should ask Peter from the product development team, given his product experience, to help us define some interesting services for our customers. He could give us information about what instruments would be interesting for inspection, and tell us how expensive they are.'

Many more ideas arise in Sally's head as she thinks about the big potential for new business opportunities.

### Meditec

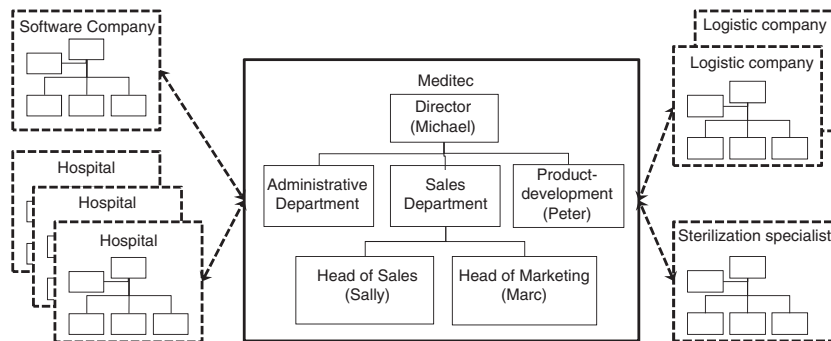
Meditec, founded in 1898 and maintaining its corporate headquarters in Hamburg, Germany, has grown to a national leading manufacturer of surgical instruments. The company develops and markets a product range, including surgical instruments for minimally invasive surgical (MIS) approaches (e.g., vascular surgery), implants, as well as sterile containers (Figure 1). In order to create innovative solutions around the handling of instruments, the company has initiated the integration of clinical partners in its research and development activities.

MIS procedures feature multiple advantages in comparison to standard surgical procedures, for example, prevention of transactions, decreased loss of blood, cooling and exsiccation during the surgical process. In addition, MIS procedures decrease the level of manipulation of viscera and generate multiple advantages for patients, for example, decreased postoperative pain, rapid postoperative anastasis, resumption of homely- and work-related tasks and sport activities. MIS procedures achieve better cosmetic results and prevent infections and incisional hernia by causing minimal and marginal scars.

Meditec positions itself as the quality leader in the MIS product sector in Germany, and focuses on technology-oriented strategies in product development. The organization maintains a strong customer base composed of multiple mid- and large-sized German hospitals. The company distributes its products in over three countries (Germany, Austria and Switzerland), and is certified in accordance with multiple ISO<sup>1</sup> standards to consistently guarantee the high quality of products. By 2009, the company had employed 380 employees and was running subsidiaries in three national locations, where two locations served as manufacturing sites in Northern and Southern



**Figure 1** Product portfolio of Meditec.



**Figure 2** Current organization and partners of Meditec.

Germany. Figure 2 graphically depicts the organizational divisions and units of Meditec, as well as its ecosystem.

Meditec also offers a variety of product-related services. On the one hand, Meditec offers specific training for physicians when they buy new instruments. This training helps physicians with the application of complex instruments. It is especially important for instruments used in MIS, which change the whole process of surgery intervention. Before physicians are able to execute MIS, they need special training to become familiar with these novel techniques. Meditec also provides a wide range of manuals and further information on its website for registered customers. This knowledge base contains the long-time experience of Meditec and of its customers. On the other hand, physicians have the possibility of introducing new ideas and requirements into the innovation process of Meditec.

### The IT-based PSS

After Sally arrives at the headquarters of Meditec, she immediately schedules a meeting with Marc from the Marketing Division. Marc has recently joined the company as Head of Marketing. His experience and knowledge of products, especially in the medical engineering industry, have been incorporated into a new innovative product line at Meditec. Sally is keen to discuss her thoughts and ideas for new and innovative service offerings with him.

'I visited a client this morning and ran into the same kind of trouble we've had before,' says Sally. 'Our customers are totally satisfied with our products in terms of quality and performance, but they cannot afford our new product series, because, as you know, our offer is more expensive compared to our closest competitors. And now our competitors have started a discount campaign in order to increase their market

share. As a matter of fact, it is more and more complicated to differentiate our products from our main competitors.'

Sally explains to Marc how in reaction to the situation, she has started to outline requirements for future products together with clients. In discussion with her clients, they have jointly brainstormed on new and recently emerging needs. The clients have suggested that product improvement should not only consider the products, but should additionally consider the processes that products are embedded in. Specifically, the clients explained to Sally that they were looking for possibilities to reduce the complexity of their non-core processes.

Sally turns to Marc and says, 'So I came up with the idea that we should try to create and offer new appropriate services around our product lines in order to ease our customers' processes. On my way back from meeting with the client, I had some ideas for new services that would support our customers in focusing on their core processes and strengthening core competencies, but I would like to hear your opinion on these novel services for sophisticated quality management. For example, we could offer continuous quality inspections that follow regulatory standards for our product lines. This would ease the management of our products by our clients, enabling them to focus on their core competencies. What do you think?'

Marc answers excitedly, 'This sounds interesting, but when I think about it, just focusing on processes would not do the trick. In order to deliver customized offers, our starting point in creating new offers needs to be the lifecycle of our products! Let's think about it for a moment – changing the perspective would turn Meditec upside down!'

As a product-oriented company, Meditec has always been driven by innovations and improvements of products. The company claims to be one of the quality and technology leading companies. The entire business and product

development processes are aligned to this strategy. Meditec has introduced existing services around their products only as an addition to offered surgical instruments. The development process of services is initiated by the marketing department after the research and development department has introduced a novel product line. Within the existing approach, the development of products and services is not conducted in parallel, nor is it done in an integrated way.

A lifecycle-oriented perspective on products would revolutionize the existing business model and innovation management process applied at Meditec. Innovations would no longer be driven exclusively by technical functionalities of products only, but by demands along the entire lifecycle of products integrating customers' business processes.

This approach would change a product-centric development process to a development process focusing on the usage of the product and results of usage. Customers do not necessarily intend ownership of products, but they want to use products or technology in an appropriate way within their business processes in order to achieve specific results. With this change, Meditec could establish novel business models in which clients would pay for the lease or rental of products, and thus only for the actual usage of products. In the realization of such a business model, the product does not shift in ownership: the product vendor owns the product along the entire product lifecycle, but additionally takes on responsibility for maintenance, repair and control. In addition, novel business models could be realized that are based on a pay per use principle that have been successfully adopted in other health-care sectors, that is, vendors of expensive magnetic resonance tomographs. In this case, the customer would only pay for the result – correct scans – and not for the underlying technology – the magnetic resonance tomography. This business model would open new possibility for the underlying payment model with applied IT and an adequate information management (IM).

Sally and Marc consider that all of the new business models are now based on the necessary transformation of existing business processes. The vendors are in need of monitoring process quality because they are not only responsible for products, but also for the entire processes embedded in the customers. For instance, pay per use business models call for tracking and tracing solutions for used products that are facilitated in processes. Vendors therefore need to gather, analyze and manage process information that generates new challenges. In addition, the vendor needs to build up new competencies and skills, especially in the context of IT as an enabler for almost all of the mentioned business models.

Sally continues the discussion with Marc, 'Our products are embedded in complex processes within hospital organizations. Of course we know some of them, but, in general, we focus on surgical methods. This means that our product developers have never considered the entire lifecycle of instruments but have focused on surgical methods.'

'You are absolutely right,' adds Marc. 'All our marketing activities are oriented to the needs of physicians. They are our key customers.'

'But solutions around the lifecycle of our instruments will also have to consider new customers, like administrative personnel. We therefore have to include the organizational entities participating in the entire sterilization process that includes nursing staff, instrument cleaning teams, the

inventory, as well as the IT department. This is totally new for us, and seems to be a big challenge. On the other hand, this could also be a great opportunity for us! We can design new kinds of product-service systems and generate additional value for our customers. These bundles would increase customer retention and open up new opportunities to generate turnover.'

'So let's organize a workshop with our most important clients. First, we have to invite representatives from every stakeholder who is in contact with our instruments along the entire lifecycle,' suggests Marc, 'and then we have to invite representatives from all involved departments at Meditec in order to immediately discuss and evaluate our ideas.'

Both Marc and Sally realize that their plan will not be easy for Meditec. They need the input from their customers in order to gather requirements and to understand the lifecycle of used products within the hospitals. They also realize that IT would be a key competence in delivering integrated PSS. Although the instruments do not build on and nor are based on IT, the instruments are embedded in IT-based processes at the hospital, for example, the documentation, logistical and inventory processes. Sally and Marc further realize that the delivery of an integrated PSS will require specific IT capabilities that are not available at Meditec.

### What the customers want

In the following 2 months, Sally and Marc organize multiple workshops with important clients. In addition, they convince Peter, Senior Product Manager at Meditec, to join the workshops. Peter brings in his strong technical background and gives feedback to the feasibility of innovative ideas. The workshop participants generate requirements, discuss possible solutions and specify the most promising ideas. Today, the workshop team will present all results and findings to Michael, who has served as Director of Meditec for 5 years. Peter from the Production Development Team is also in attendance.

Sally initiates the meeting. 'Today we want to talk about new business opportunities for Meditec in order to generate additional turnover. As you all know, our product sales have stagnated. Differentiation from our main competitors is becoming more and more difficult. Our main national and international competitors have caught up in functionality and quality, and some of them offer their products much cheaper than we can, which has resulted in steadily decreasing margins. The reality is that we have already lost some of our best customers. This means we have to think differently in order to break new ground. What we now recognize is that we need to detach ourselves from a pure product centric perspective. We have to think in a holistic way – no longer in a purely product-centric way. Our products are brilliant and known for the innovative features and quality in the market, but this is no longer sufficient. Hence, we have organized several workshops with our most important customers in order to get a better understanding of their needs. Note, however, that we did not ask them for product improvements, but for improvements along the lifecycle of our products! With this approach, we preached to the choir. In the workshop setting, we have already identified many opportunities for improvement.'

Peter adds, 'In doing so, we also identified the sterilization process carrying the biggest potential to ease the life of our customers. All of our customers have mentioned complaints

about this complex process. Achieving the optimum in hygiene turns out to be a complex challenge for them. Specific requirements exist for the disinfection of surgical instruments previous to a surgical intervention. We know that instruments have to be absolutely clean. Unfortunately, a variety of factors influence the results of this cleaning process, which then complicates the control of the entire sterilization process. If instruments are not absolutely clean and disinfected, they increase the risk for infections. A possible reason displays a wrong configuration of the cleaning program of the disinfection automat.'

'But the sterilization process is only one module in our proposal,' adds Marc. 'Surgical instruments have to pass a complex sterilization process underlying governmental regulations, and you know that German hospitals are restricted to a single usage of surgery instruments by law. That means that used surgical instruments must be disinfected, cleaned and sterilized immediately before they are approved for the reuse cycle. The whole process must be controlled, and documentation is essential by government regulations. Even for mid- and large-sized hospitals, the sterilization of surgical instruments is highly complicated and expensive, with the end result that investments in specific sterilization machines are high and require long-term planning, employees for the sterilization process need to undergo special training, and documentation of the entire sterilization process is obligatory, time-consuming and complex.' Marc turns to display his presentation slides, and the underlying cleaning process of surgical instruments appears (Figure 3).

He explains, 'After the surgery has used the commodity like bandages or single-use components, they have to be disposed of properly. All instruments are carried to the cleaning area with the help of special trolleys and cases. A disposal elevator helps to transport these trolleys to the cleaning area which is normally on another floor and part of the hospital or outsourced to an external partner. When the instruments enter the cleaning area, instruments are preprocessed in a special cleaning process to be prepared for the sterilization process. In parallel, used trolleys and cases are cleaned. After a successful pre-sterilization cleaning process and cleaning process of extra equipment, such as trolleys and cases, both types of entities need to pass a checking process. Trolleys and cases which successfully pass this check are stored and stocked for their next use. After a successful sterilization, the surgical equipment is identified and either prepared for storing and commissioning or charged to appropriate trolleys and cases to be transported to the surgery area. Several additional activities are linked to the entire process, in particular the documentation. Every hospital is responsible for implementing a risk evaluation, recording all cleaning activities, and ensuring a continuous documentation. You can see this entire process here' (Figure 3).

'The sterilization process is not only labor-intensive, but hospitals are also challenged by complex logistical requirements in which surgical instruments need to be collected, tracked and moved in multiple steps of the process. Finally, all process steps must be documented by law.'

'Asset management and inventory information within the lifecycle process of surgical instruments play a critical role. But normally, IT systems used within the sterilization process and the implemented hospital information systems (HIS) are two separate systems. For this reason, inventory data are not

accessible for hospital employees in real-time, which can lead to redundant and inconsistent data sets about the status of the surgical instruments. The IT architectures of many customers, especially those of public sponsored hospitals, have grown over many years and are very heterogeneous. An integrated asset management could synchronize all data stored on instruments across various IT systems.'

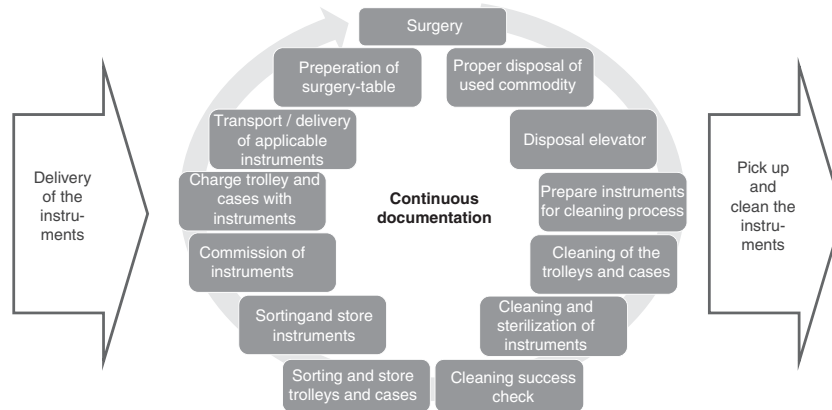
'Finally, the type and number of instruments used for every surgery is usually known. In normal cases, more instruments are available for physicians than are necessary. This fact impacts the sterilization process in two negative ways: the number of instruments running through the sterilization process is not optimized, and the more instruments that are available, the more complex the decision and search activities to find the correct instrument during the surgery. If worse comes to worst, the physician loses too much time or makes a wrong decision. Usually, 70 to 80 instruments are prepared on the surgery table, but only 30% to 40% are actually used.'

'This PSS sounds promising!' admits Michael. 'Although we have to develop many competencies, processes and routines that are needed for this PSS, I can see this as a very important step for Meditec. Our PSS could be a big opportunity for us! This calls for developing a sustainable business model.'

### IT challenges

New challenges arise for a product-centric company like Meditec if it wants to deliver an integrated PSS around their existing product portfolio. It is clear that Meditec is not able to assume all tasks and activities of the PSS, but they do want to play a key role within the potential new business model. IT capabilities play a critical role for managing PSS. Orchestrating just-in-time processes in providing specific instruments for surgical interventions and steering logistical partners is not feasible without sophisticated use of IT. The project team at Meditec soon realized that the company needed to establish an adequate IM, which controls all underlying information flows within the value network and between institutional entities for a successful introduction of the new business model. However, the challenges for an adequate IM are numerous.

First, Meditec has to ensure that used instruments are picked up from the customer, transported to a central sterilization service provider and brought back to the dedicated hospital. The go-and-return logistic service is a new process because until now the company has only produced and sold instruments, thus providing a one-way delivery service to the customer. For the newly offered PSS, the company will then have to track and manage complex movements of instruments to multiple clients. The project team early decided on integrating the external partners that are specialized in logistics. In this case, Meditec must now ensure an adequate information flow between Meditec, the clients and the partner providing the logistical services. This includes information about the sender and receiver, time specifications and delivery orders, including the identification of every instrument provided to the client. In addition, the sterilization specialist needs access to the IT system in order to enter delivery orders, which are shared with the logistics partner. Finally, the sterilization process must be documented. The documentation contains details about the entire cleaning program, temperature and duration of the sterilization process.



**Figure 3** Underlying cleaning process of surgical instruments.

As described above, a number of parameters and aspects have to be considered in turning Meditec from a product manufacturer to a solution provider. Some aspects are static in their nature, thus creating a basis for the PSS that is valid for every customer. Other aspects have to be customized for different customers and allow individualization in providing the PSS. For example, every physician uses a slightly different set of instruments for a specific surgery. The PSS could consider this aspect and deliver the preferred set of instruments to every physician.

The IM efforts taken must also consider the integration of HIS. Every hospital operates its own HIS that handles information on upcoming surgeries, and lists documentation about the cleaning activities, as well as location and status data of surgical equipment. In addition, personnel in the client hospitals must be trained in new functionalities of the HIS, for example, to trigger a delivery order. Hospital personnel have to undergo special training on changed HIS functionalities. Interfaces have to be implemented for the communication between the systems.

However, IT is not only important for handling the complexity of the business value network. With the help of gathered information, Meditec is able to deliver totally novel and innovative services for their customers. Comparable to almost every copier vendor, Meditec could offer a pay per use model for instruments. Hospitals usually do not buy copiers but only pay for each copy. The vendor is responsible for the quality of the copier and the availability of all consumption items, such as toner and paper. This is only possible with the help of counting and communication functionalities of the copiers. In the back-end, the vendor has to manage collected data and relate them to each customer. This business model could also work for Meditec. Hospitals would not buy instruments any longer, but only pay for the use of sterile and high-quality instruments. This would increase cost transparency for the hospitals and ease the mapping of costs to a treatment or patient.

Finally, the analysis of information flows allows Meditec to identify patterns of use of the instruments. These analyses help to optimize the flow of instruments and could give input for the product development. For example, patterns of wasting and erosion could flow in research of materials and could be helpful for the processing of materials.

## Conclusion

The management of Meditec wants to transform the company from a product-centric toward a customer-centric company. An important step is to gather requirements from its customers on the lifecycle of instruments and their processes. The core competency of hospitals is to provide high-qualitative health care for patients and not to manage surgical instruments. Meditec has traversed the mentioned changes to solve this problem for its customers. The company therefore has to formulate an adequate business model and find appropriate partners. However, the most critical aspect is to be found in managing IT, which not only increases the efficiency and effectiveness of processes, but also enables specific aspects of the new business model.

It is time for an IT-driven transformation. The journey has just begun!

1. How can PSS be categorized, and what are exemplary concepts for each category? Think about examples between pure product- and service-oriented offers. Please discuss the specific role of IT in each case.
2. Which steps and activities are necessary for the IT-driven transformation of Meditec? Why does an organizational change program or a pure IT project not work for Meditec?
3. Which risks and challenges result for Meditec from its IT-driven transformation because of the duration, complexity and uniqueness of the project?
4. Compare a sequential and a prototyping approach for this IT-driven transformation. Which criteria have to be considered to choose an adequate approach?
5. Model an IT system with all relevant components for the PSS-based business model at Meditec. Please use a UML component diagram.
6. Describe the new relationship between Meditec and their customers in the PSS-based business model. In your answer, please consider that Meditec is no longer selling instruments and medical equipment but delivers integrated solutions as a long-term partner.

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## Note

1 International Organization for Standardization.

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