

overproduction, overprocessing, and underutilized workers. Lean production, lean manufacturing, or simply "lean", were introduced to the West in 1990, but developed under TPS creators Sakichi Toyoda, Kiichiro Toyoda, Eiji Toyoda, and Taiichi Ohno [36]. As Sakichi Toyoda was working in the textile industry, he invented a loom that was motor driven with an integrated utensil that would make a mechanism stop if a thread was broken. Later, it was this mechanism that pioneered Jidoka, automatization with human intelligence [36]. Lean became a systematic method for minimizing waste within a manufacturing system without sacrificing productivity, which can cause problems. As a follow-up to the TPS, the lean is addressing the waste caused by *overburden* (muri) and *unevenness* in workloads (mura), to improve customer value [9].

The main goals of implementing lean manufacturing are improving quality and staying competitive, eliminating waste, reducing time in finishing activities from start to finish, and reducing total costs. A Lean Six Sigma is widely used and often combined into Lean Six Sigma [37]. Furthermore, hybrid Lean and Six Sigma principles are used to enhance sustainability studies, whereas it is being implemented in research and practice. The most used method in implementing Six Sigma starts with acknowledging a sustainable project, preparing a sustainability performance assessment, and then improving sustainability using Lean Six Sigma tools [38]. Furthermore, due to the increase in demand for the implementation of sustainability practices in architecture, construction, and engineering, lean practices are also implemented in all these fields to increase the sustainability rate [39].

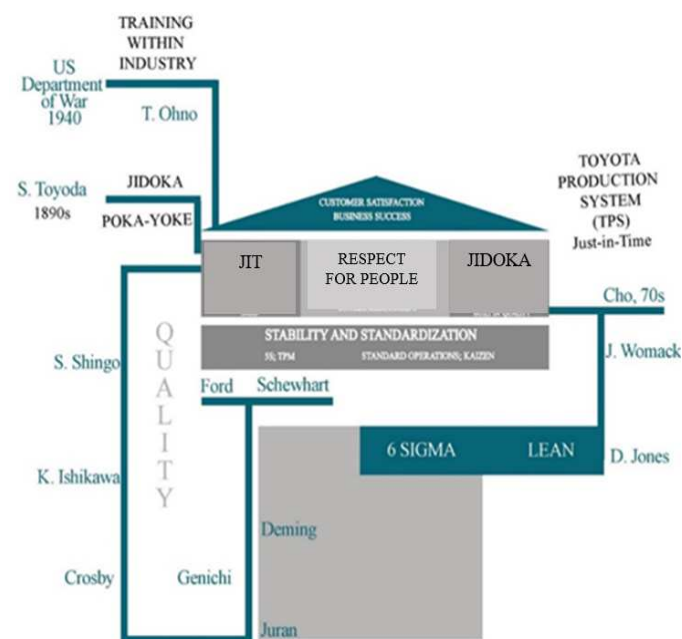


Fig. 2 Individuals that contributed to the development of lean

Nevertheless, the scope of applying lean manufacturing concepts is reaching to communication and information sectors [40], environmental practices, finance etc. The Toyota Motor Corporation started implementing the Lean process in the late 1940s. Lean was connected to customers' demand in real-time and supplemented the required materials so that the

exact number of needed products was produced at any given moment. Similarly, the Just-In-Time production paradigm changed the traditional "delivery-and-demand" model for a more efficient, faster model of "demand-then-delivery".

shows the most important individuals who have contributed to developing the Lean concept in all production and service provision spheres.

Lean production is based on creating value for customers with as little funds as possible. Among lean tools that companies adopt to increase productivity and eliminate waste are just-in-time (JIT) delivery, quality, and cost. Toyota's management has recognized that the effective Lean flow must be directed from inside to eliminate waste by dealing with a reduction in inventory, downtime, transport, costs, etc., but externally focused on meeting customer demand. This helped to achieve the flexibility that Ford did not have.

C. Trends of Quality Control in the Recent Period

During the last three decades of 20th century, quality reflected different quality control philosophies, including quality practices that changed the flow in quality control development, such as standardization and inspection that further influenced the establishment of TQM and satisfaction of explicit customer needs. Explicit customer needs are articulated and present what customers want or expect from a product or service. Recently these needs have been upgraded with latent customer needs. Latent needs are those that customers are unaware of, not requested by customers, or not served by the market. However, satisfying these needs provides a huge benefit to the business. Unlike explicit customer needs, latent needs are not easy to articulate because they are not obvious and because customers are unaware of them [41]. To identify them, qualitative and quantitative research must be done to identify unsolved or emergent customer needs based on macroeconomics, rapidly shifting lifestyles, and socio-demographics. Latent customer needs can lead to major innovations. There are different methods for latent customer needs elicitation based on customer observation methodology [42] or analogical case reasoning [41].

The best example of satisfaction of latent customer needs in the recent period are numbers of well-accepted innovative Apple products. When Apple increased sales, it became understandable that satisfying the explicit customer needs was insufficient. Therefore, the explicit customer needs were upgraded by the process of identifying and fulfilling customers' needs that are unsatisfied and latent. These needs are further connected with the emotional responses of the customers [43], [42]. The philosophy that Apple is applying is further supported by different studies, that also argue that satisfaction of customer cannot provide loyalty, whereas the new focus should be switched to customer's emotional response and attractive design able to provide customer's delight [44], [45], [46]. Customers delight was provided by Apple by establishing strong customer support and service department [47]. With the production of new, innovative designs: iPod, iPad, and iPhone, the quality concepts have changed as well. Nowadays, quality is strongly justified by the 'customer delight', 'attractive design' and 'innovative design'. 'Delight' is often described as the emotion of 'joy' or 'surprise', and satisfaction of the latent needs of customers. All these recent processes influenced the quality development

beyond the TQM, established on the concepts of ‘innovation’ that has become the key force for achieving quality and increasing sales.

The main tool for obtaining quality control nowadays lies in the relationship between a customer and a product, whereas satisfaction is rooted deeply in the unconsciousness of the customer. To be declared a product of quality, a brand must be able to fulfill internal emotional needs and evoke a strong positive reaction. This is further enhanced by an innovative and attractive design. Consumers have more choices today than ever before [44]. Customer satisfaction can be defined as a product of a series of experiences that a customer has.

Nowadays, closing the gap between what customers expect and the experiences following this must be closed. Companies need to know much about the emotions and thoughts that occur via interaction with different products to control quality. Since dissatisfaction that customers may experience is widespread, it becomes dangerous. Schwager and Meyer conclude that companies possess information on habits, incomes, and other characteristics for classification, and they need to satisfy customers' latent needs and evoke sentiments [44]. Cumulative information of quality control methods is represented in TABLE I, whereas quality concept evolution is represented graphically in Fig. 3.

TABLE I.
THE QUALITY CONTROL METHODS TIMELINE

Epoch	Year	Key features	Quality enablers	Quality concept	Quality focus	Focus
Pre-industrial revolution	Before 1784	Muscles / water as power source Craftsmanship	Skills	Inspection		Product focused
INDUSTRY 1.0	1784	Steam engine Mechanization	Standardization	Inspection	Defined by skilled masters	
	1870	Electricity		Inspection		
	1870-1924	Assembly line		Inspection		
INDUSTRY 2.0	1924	Mass production Electrical motor	Standardization. SPC; PDCA; Seven Basic Quality Tools	Shewhart's Control chart - Sampling inspection - to have fewer defective products	Statistical process control (SPC) Conforming to the standards and specifications of a product	Process focused
	1957			Juran's Quality Assurance TQC - Total Quality Control - Product quality needs to be implemented at all stages of the product life cycle	Quality is zero defects Quality concepts pursuing the zero-defect culture and executing the task right first time	
INDUSTRY 3.0	1959			TQC - Total Quality Control	Wide quality control	
	1969	Automatization PLC Automotive production	Soft TQM tools & Hard TQM tools	TQM - Total Quality Management; Six Sigma; Lean	Work culture, customer focus, integration of the quality system with business goals Hard tools, soft tools	Customer focused
INDUSTRY 4.0	1980s	Computers & Electronics Robotics				
INDUSTRY 4.0	Today	Cyber IoT Big Data	Creative research: Qualitative Quantitative	The identification and fulfilment customers' unmet latent needs	Customer's emotional response. 'Customer's delight'; Innovative product/service	

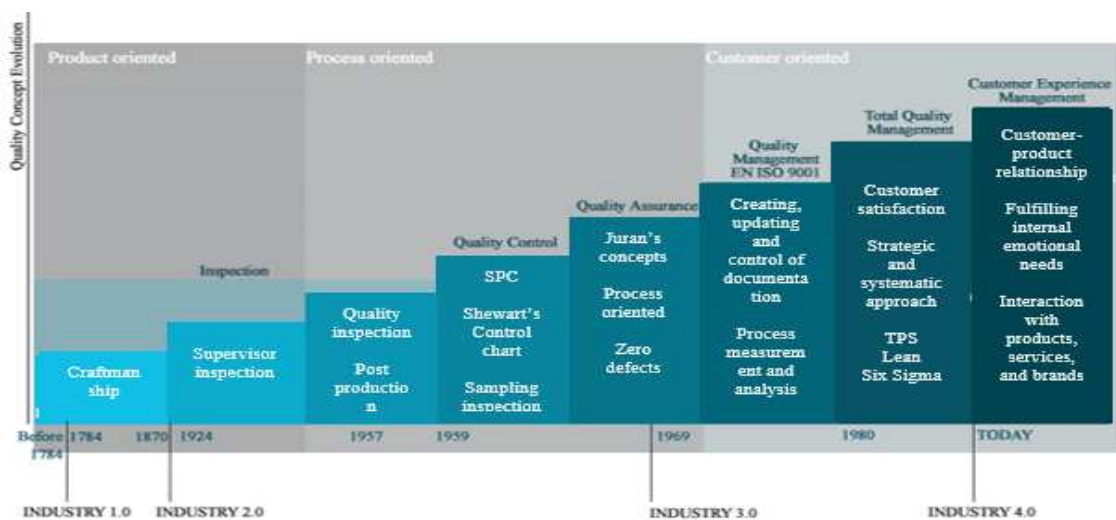


Fig. 3 Timetable Quality Concept Evolution

IV. CONCLUSION

This research paper examined the development of quality and provided a comprehensive summary of the complex and long-term process of the evolution of quality. It is based upon research analysis and literature review and follows the most important steps in enhancing quality, from the initial phases when quality started to be established and all further steps following milestones such as the industrial revolution, standardization, establishment of the assembly line, etc. Furthermore, this research paper reflects the evolution of quality methods in written form and diagrams. While there is a need for further development in the field regarding the grading and analysis of the TQM, which is still a mostly implemented paradigm, this paper also presents the data introducing more recent quality management philosophies and proposes.

This research showed that quality management moved to meet explicit and latent customer needs, connected with the emotional response (delight) to the product or service. The innovations in design by Apple Inc became the paradigm in quality management that reflects a different need in the domain of customer-oriented services in the era of Industry 4.0. Particularly, they introduce means to investigate the latent needs of their customers, with the main goal of creating a design that is capable of evoking sentiments and emotional reactions. As this philosophy is currently being followed by a limited number of companies but with huge success, the following period will represent a switch from current ad-hoc transitions to a new paradigm of Customer Experience Management (CEM). All processes of implementation and grading their success will demand a new wave of research in the field.

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