Applications of Artificial Intelligence in Quality Assurance and Assurance of Productivity

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ABSTRACT

Probabilistic intelligence is vital in current management and technology. It is simpler to persuade readers when a management or engineer reports connected difficulties with objective statistical data. Statistical data support the evaluation of the true status, and cause and effect can be induced. The rationale is proven using deductive logic and statistical data verification and induction. Quality practitioners should develop statistical thinking skills and fully grasp the three quality principles: "essence of substance," "process of business," and "psychology." Traditional quality data include variables, attributes, faults, internal and external failure costs, etc., obtained by data collection, data processing, statistical analysis, root cause analysis, etc. Quality practitioners used to rely on these so-called professional qualities to get a job. If quality practitioners do not keep up with the steps of times, quality data collection, organization, analysis, and monitoring will be confusing or challenging. Increasingly, precision tool machines are embedded in various IoTs, gathering machine operation data, component diagnostic and life estimation, consumables monitoring and utilization monitoring, and various data analysis. Data mining and forecasting have steadily been combined into Data Science, which is the future of quality field worth worrying about.

Keywords: Artificial Intelligence, Data Science, Big Data, Quality Assurance, Productivity

INTRODUCTION

Artificial Intelligence (AI) is the technology that artificially realizes human wisdom. But no technology can match human intelligence, and most AI can only solve a single problem. From an academic perspective, the following unique scenario combining Western magic and Eastern martial arts may be more persuasive (Kuan and Perng, 2019). AI is the Lord of the Rings of Information Science (Ragi et al., 2021). Generations of Information Science scholars have invested in these difficult problems. Whether for profit or courage, Information Science researchers have advanced bravely in this discipline. Without ever opening the door, many people have lost their entire lives in vain (Adusumalli, 2018). People who want to start getting into AI theory often get lost before reaching the door, what about the others? There was no way out once inside.

"Gazing up is high, drilling is powerful, looking forward, abruptly behind," says Confucius, but I think it applies to "Artificial Intelligence." It's not uncommon for researchers to learn that their previous solutions were simply dreams. When the task looks so simple, there is a fairy or monster waiting for you behind the door (Ahmed, 2021). This is where they plan to kill you. People that become lost in AI are usually not eaten by monsters, but baffled by beautiful fairies. Finally, they thought they were in heaven but were actually in hell (Adusumalli, 2019). Follow me to find where this fairy is. AI researchers may be more like the characters on Jin Yong's Xia Ke Island. They are attracted by the superb martial arts secrets and refuse to return to the original arena. They have spent their lives studying martial arts in vain. The characters on Xia Ke Island can only see the words in the secret script, but not the iconic martial arts hidden in the writing strokes. Maybe AI researchers have the same issue. So they can't see how the overall wisdom is generated since they are concerned with several allegedly powerful algorithms. I'm afraid this is a researcher in the AI field, future issues (Pasupuleti, 2016b). The three waves of AI, so the authors can visualize the above-mentioned AI novel scenario (Figure 1).

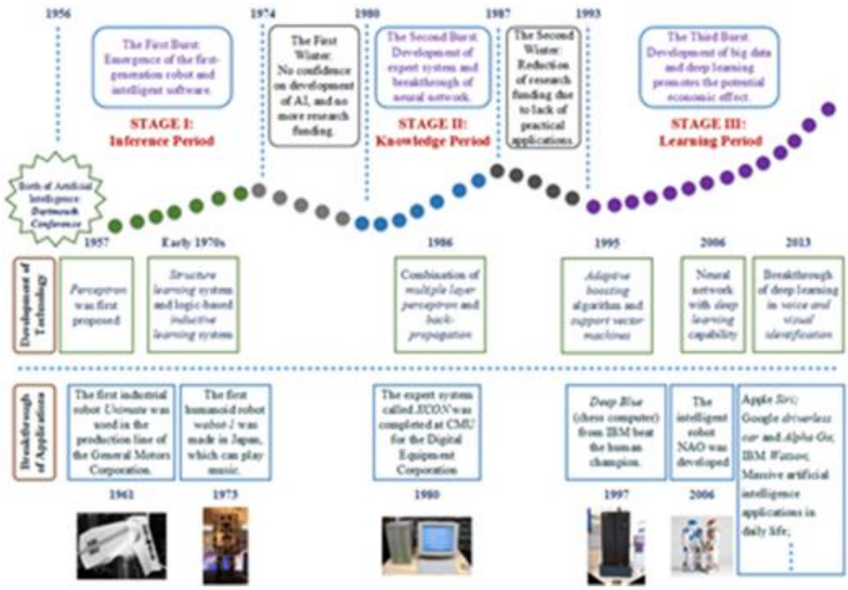

Figure 1: The three waves of AI.

Big Data Thinking

Statistical thinking is vital in current management and technology. It is simpler to persuade readers when a management or engineer reports connected difficulties with objective statistical data. Statistical data support the evaluation of the true status, and cause and effect can be induced. The rationale is proven using deductive logic and statistical data verification and induction. Quality practitioners should develop statistical thinking skills and fully grasp the three quality principles: "essence of substance", "process of business" and "psychology". One is Big Data thinking, which is written as follows: With Big Data, businesses will become data providers rather than business providers. Massive data of customer behavior appears chaotic, yet there is a potential rationale behind it. Product inventory and pre-sales data can be used to make market assessments and change products and operations based on Big Data (Adusumalli, 2016).

On the network, users create data, behaviors, and relationships. These data help organizations predict and make decisions (Azam et al., 2021). In the age of Big Data, data has become an enterprise asset, if not a core asset. Big Data's worth is in its mining and forecasting ability. Data assets become essential competitiveness, and small businesses must have Big Data as well. Traditional quality data include variables, attributes, faults, internal and external failure costs, etc., obtained by data collection, data processing, statistical analysis, root cause analysis, etc (Pasupuleti, 2016b). Quality practitioners used to rely on these so-called professional qualities to get a job. If quality practitioners do not keep up with the steps of times, quality data collection, organization, analysis, and monitoring will be confusing or challenging. Increasingly, precision tool machines are embedded in various IoTs, gathering machine operation data, component diagnostic and life estimation, consumables monitoring and utilization monitoring, and various data analysis (Pasupuleti et al., 2019). Data mining and forecasting have steadily been combined into Data Science, which is the future of quality field worth worrying about.

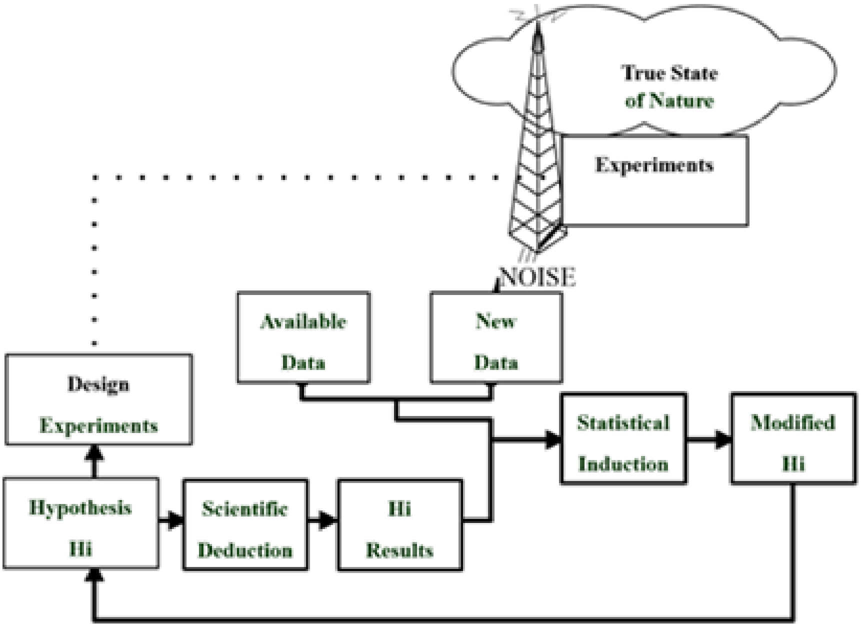

Figure 2: Data generation and analysis of scientific research.

DATA SCIENCE AND QUALITY TRILOGY

Dr. Chien-Fu Jeff Wu delivered an inauguration speech at the University of Michigan in November 1997, shortly after being appointed as the H. C. Carver Chair Professor of Anthropology. "Statistics = Data Science" was the topic of discussion. In this lecture, he framed statistical work as a trilogy consisting of three stages: data gathering, data modeling and analysis, and decision-making (or problem solving). To summarize his work, he developed the present phrase "Data Science" and argued that Statistics should be renamed Data Science, and statisticians should also be renamed data scientists (or data scientists). Later, as part of the P.C. Mahalanobis Memorial Talk Series, he delivered a lecture titled "Statistics = Data Science" in 1998. A memorial to Indian scientist, statistician, and founder of the Indian Institute of Statistics Prasanta Chandra Mahalanobis will be delivered in this lecture.

Dr. Chien-Fu Jeff Wu's foresight, which occurred 20 years ago, is interpreted by the authors, who have inadequate statistical understanding. As a result of the current classic statistical trilogy's development, he believes that statistics will undoubtedly become one of the instruments used in other fields in the future. Data collection, data modeling and analysis, and decision-making are all part of the statistical triad (Pasupuleti, 2017). The Quality Trilogy, as proposed by J. M. Juran, is a universal strategy for managing quality that includes three steps: planning for quality, controlling for quality, and improving for quality (also known as the Quality Trilogy). Originally proposed by J. M. Juran in 1986, this viewpoint has since gained widespread acceptance throughout the industry and served as the foundation for Quality Management (Figure 3, 4).

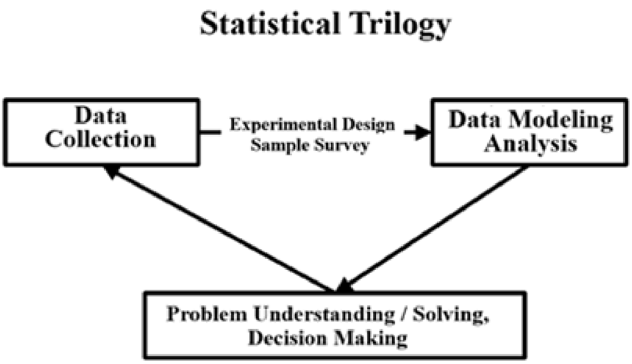

Figure 3: Statistical Trilogy.

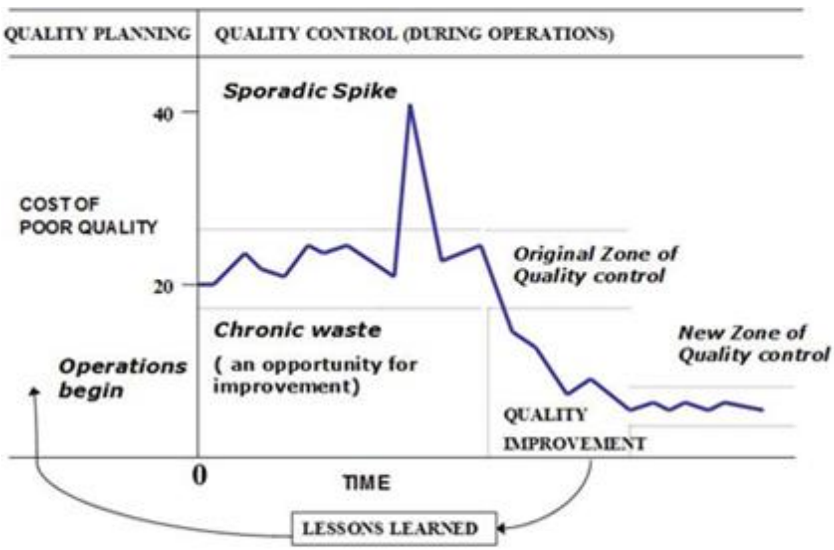

Figure 4: Quality Trilogy.

In recent years, Data Science has emerged as a field that makes use of data in order to gain new information. Its purpose is to create data products by extracting useful information from large amounts of data. This field combines theories and technologies from a wide range of fields, including Applied Mathematics and Statistics, Pattern Recognition and Machine Learning, Data Visualization and Data Warehousing, High-performance computing, and so on (Adusumalli, 2017b). Statistical technology is one of the most well-known applications of this field. By utilizing a variety of relevant data, data science assists both professionals and non-professionals in understanding the problem. Data Science and technology can assist us in accurately processing data and in conducting study and investigation in the domains of engineering science, biology, social science, anthropology, and other related fields, among other things. Furthermore, Data Science is extremely beneficial in the context of corporate competition. Essentially, it is the same as Quality Management, except that Quality Management is related to the fields of science, engineering, management and other disciplines such as sociology, law, education, and so forth (Pasupuleti, 2016a). They are one of the general disciplines because belonging to one academic discipline is difficult, which indicates that they are not one of the specific disciplines. Generally speaking, knowledge can be separated into two categories: professional knowledge and general knowledge of individual courses. Professional knowledge must be of high quality, and general knowledge must be comprehensive.

There are millions of searches on Google website using Data Science as a keyword, whether in Chinese or English, and a slew of Data Science pictures and article advertisements, especially this article: "Data Scientist: The Sexiest Job of the 21st Century," which I'm not sure how many articles in newspapers and magazines have mentioned it since it was first published in 1998. The so-called new technologies, such as Data Science, Big Data, Artificial Intelligence, and the like, on the other hand, are rarely discussed, despite the fact that they are inevitable byproducts of the successful development and application of information and communication technology after accumulating a large amount of diverse knowledge over a long period of time. A summary and reiteration of the teachings of Dr. Chien-Fu Jeff Wu are provided in the next paragraph (Figure 5).

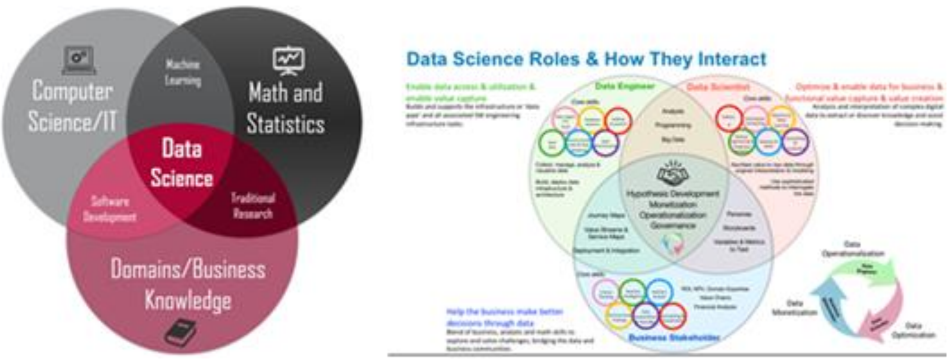

Figure 5: Data Science pictures and article advertisements.

Scientific research is an iterative learning process that takes place throughout time. Inference can be accomplished through the use of both deduction and induction. The goal of statistical approaches is to increase the efficiency of this learning process as much as possible. Statistical inference is based on the findings of experiments or observable objective phenomena, that is, data, and it is used to draw conclusions that are closer to the truth by using estimation, comparison, and prediction to arrive at conclusions that are more accurate. This is referred to as the "induction method." The deductive technique makes use of current conjectures, models, and theories, i.e., hypotheses, to derive hypotheses that are more closely related to the truth through a professional deduction process that adheres to scientific logic and is conducted in a controlled environment (Adusumalli, 2017a). This iterative learning process improves the completeness of knowledge, as well as the generation and analysis of scientific data in scientific research (Figure 5).

INTEGRATION OF SCIENCE-TECHNOLOGY-UTILIZATION

For the purpose of discussing the process of the development of modern quality management, we refer to a paper that is in accordance with Management Sciences. We provide an excerpt from the paper that discusses the relationships between the sciences, technologies, and utilizations in Management Science, in order to discuss quality related science research, technology development, and application promotion.

It has been about a hundred years since the beginning of the twentieth century that the field of modern quality management has been growing and developing. A striking parallel may also be drawn between the integration of sciences, technologies, and applications in the creation of "Management Science" and this process. Engineering and Industrial Statistics was formed in response to the achievements of statistical science such as Control Charts, Sampling Acceptance and Orthogonal Experiments in the early days of modern quality management (Pasupuleti & Amin, 2018). This branch of statistical science later became known as Engineering and Industrial Statistics. Statistical approaches and thinking methods are key tools in the solution of quality problems; nevertheless, the methodologies of essence of content, business process, and psychology must be integrated as well. As a result of years of professional integration in a variety of fields, the quality management system has gradually evolved into a multi-value organization team work mode that emphasizes continual improvement, organizational leadership, objectives-based management, full participation, a common language, technology sharing, problem solving, adaptability to change, cultural heritage, and people-centeredness. Statistics, management, engineering, system science, information science, and psychology are all incorporated into the field of statistics in order to improve the overall quality of human existence. Quality professional development and promotion are not generated in a vacuum; they are a result of a collaborative effort (Pasupuleti, 2020). As a result, it would be produced in conjunction with the current situation of a community, a society, a country, a region, and worldwide domains, such as the development of politics, economics, society, and technological advancement. In particular, the defense sector, international trade, management systems, business models, production systems, communications, computers, data processing, and the living conditions of people are all being studied in detail (Adusumalli & Pasupuleti, 2017). The future development and promotion projects in the so-called "third wave of AI" should be examined by the quality professional sector today. What projects should be examined are those that are worthwhile undertaking.

ARTIFICIAL INTELLIGENCE IN QUALITY ASSURANCE AND PRODUCTIVITY

Returning to the subject of "The Applications of Artificial Intelligence in Quality Technology." In recent years, the writers have steadily built the "Quality Philosophy" and "Core Values" that they believe are essential for success. Based on the "Quality Philosophy," which emphasizes continuous improvement, leadership, management by objectives, full participation, a common language, technology sharing, problem solving, response to change, cultural heritage, and people-oriented practices; and based on the "Core Values," which emphasize practical application as the goal, system integration as the means, pragmatic benefits as the inducement, and sustainable development for good fruit and a healthy environment (Fadziso et al., 2018). The process of brewing this issue necessitates serious consideration and arduous effort on the part of the participants. Since the phrase "Industry 4.0" has become widely debated in the industry, the authors have been able to concentrate solely on the development of individuals in the quality professional field and have developed no countermeasures (Rahman et al., 2019). Not only that, but the Taiwan Administration has initiated Productivity 4.0 in response to global manufacturing trends such as those described above. Productivity 4.0 is a continuation of the historic long-term plans that began with production automation as productivity 1.0, progressed to industrial automation as productivity 2.0, and eventually expanded to industrial computerization as productivity 3.0. Productivity 4.0, which is based on intelligent automation and makes use of the internet of things, intelligent robotics, and Big Data, in conjunction with lean management, would aid in the upgrading and transformation of domestic manufacturing industries (Figure 6).

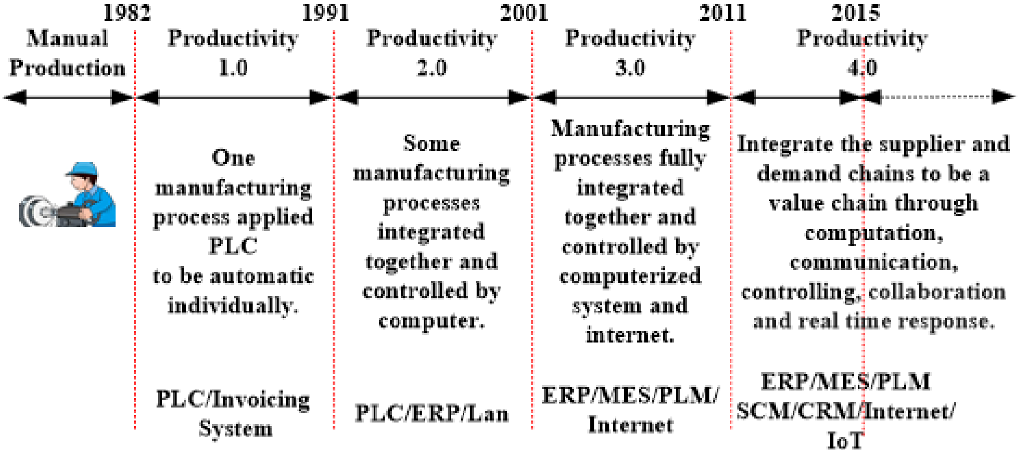

Figure 6: The historic long term plans of Productivity 1.0 to Productivity 4.0.

Table 1: The related application of AI

Simulation behavior	Related applications
Perception	Voice Recognition (ears), Image Recognition (eyes) (Hossen et al., 2021), Handwriting Recognition (eyes), Fingerprint Recognition (eyes)
Reasoning	Expert System, Computer Games, Computer Chess, Medical Diagnosis (brain)
Understanding	Machine Translation, Conversation System (brain)
Learning	Computer chess, expert system, medical diagnosis, identification (brain)
Action	Robot Soccer Game, Autonomous driving, Commercial robot, Smart Controller (hands, feet and body)

The following paragraphs have always served as the author's guiding principle when discussing "Industry 4.0": "From the standpoint of micro-industry development, it will produce many different types of new business models through personalized design and marketing." This system can integrate all processes to form a value chain from the supplier chain: purchasing, production controlling, incoming materials, production, and shipping to the demand chain: ordering, logistics delivery, retail, and maintenance service (Hossen et al., 2021). It does so by combining computation with communication with controlling, collaboration with collaboration, and real-time response. This cross-company information system, which operates on an internet platform architecture, facilitates engineering collaboration as well as logistics collaboration. Collaboration in engineering: This process allows for two-way interaction between customers and suppliers, and customers can request the engineering information they require from suppliers. This helps to speed up the quality analysis, quality improvement, and design improvement processes for customers, as well as reduce the time it takes for them to go from pilot run to mass production (Yannan et al., 2021). Customer-supplier collaboration in logistics: "Provide a more transparent and complete information interface for customers and suppliers, from the customer's order to production schedule, from production order to lot number status status, from the outgoing quality control to the shipping, customers can get the information from the system and analyze it in advance, allowing them to solve the common problems of both sides immediately." The scenario described above represents the vision of Industry 4.0 for the management of production activities. Some advanced firms have already demonstrated the ability to self-improve to this level; however, small and medium-sized enterprises (SMEs) do not possess this capability. It has been established that the manufacturing management system hierarchy will be described by the MESA / ISA-95 standard. For the most part, SMEs may realize the vision of Industry 4.0 operation by following the steps shown in Figure 7: Smart Factory Operation Schematic to increase the quality of information about internal operations one step at a time (Figure 6, 7).

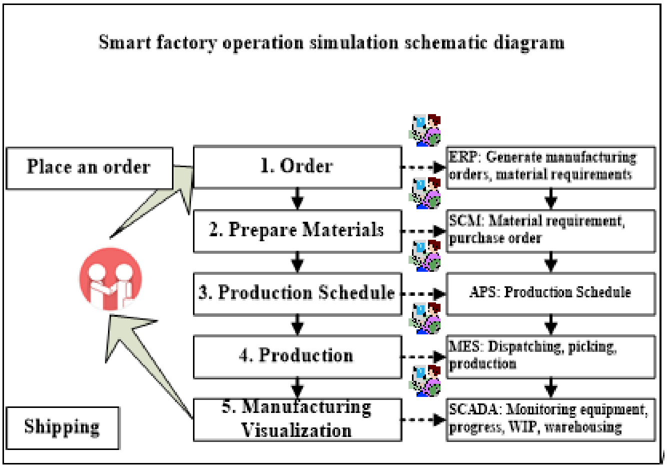

Figure 7: Smart factory operation schematic diagram.

The quality professional field, whether it is theoretical or practical in the Manufacturing Management System, is not a mainstream system in the Manufacturing Operation Management system (Pasupuleti & Adusumalli, 2018). Customer complaint processing is a voucher for sales returns and allowances in the ECM system; Incoming Quality Control (IQC) is a voucher for accounts payable in the ERP system or is attached to the SCM system (Madding et al., 2020). In Process Quality Control (IPQC) is a voucher of salary in the ERP system or is attached to the MES system; and Outgoing Quality Control (OQC) is a voucher for accounts receivable in the ERP system or is attached to the CRM system; for example, quality planning is an attachment It is impossible and useless to have a Quality Information System (QIS) that is independent of other systems. In the quality professional field, however, it may be possible to use the model of quality management system (ISO 9000 series) to dominate the management system, by utilizing system integration technology as required, to digitize the quality control processes as part of the digital transformation from productivity 1.0 to productivity 2.0 to productivity 3.0 and eventually to productivity 4.0. This will be a more practical and feasible option in the quality professional field.

Conclusion

The author believes that the creation and promotion of Quality Assurance and Productivity Assurance should be tailored to the needs of each organization, not only AI. Production automation as productivity 1.0, industrial automation as productivity 2.0, and industrial computerization as productivity 3.0, will help enterprises upgrade and transform. For example, "from supplier chain: purchasing and production control to demand chain: ordering, logistics delivery, retail and maintenance service" can be integrated into a value chain through computation, communication, control, cooperation, and real-time reaction. The productivity 4.0 value chain's quality needs would be much more visible. A better product and service will be required as the demand chain grows. The product and service design, produce, alter, transport, maintain, recycle, and trace will be easier. In the future, quality practitioners should focus on the technologies of all value-added processes, especially system integration engineering. It focuses on software-hardware integration. There are several steps involved in value-added integration. Quality practitioners must recognize that the growth of AI in network information technology-related software and hardware knowledge is developed through a market economy business model. Its "core value" is the market economy: practical application, system integration, pragmatic benefits, and sustainable development of competition and collaboration. This knowledge can improve quality of life, product, service and environmental quality. The authors created a curatorial platform for innovation and quality management knowledge. Practitioners of AI should have the following knowledge and technology.

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