Enhancing Productivity through DXPO

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The Asian Productivity Organization (APO) is an intergovernmental organization that promotes productivity as a key enabler for socioeconomic development and organizational and enterprise growth. It promotes productivity improvement tools, techniques, and methodologies; supports the National Productivity Organizations of its members; conducts research on productivity trends; and disseminates productivity information, analyses, and data. The APO was established in 1961 and comprises 21 members.

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PREFACE

The P-Insights, short for "Productivity Insights," is an extension of the Productivity Talk (P-Talk) series, which is a flagship program under the APO Secretariat's digital information initiative. Born out of both necessity and creativity under the prolonged COVID-19 pandemic, the interactive, livestreamed P-Talks bring practitioners, experts, policymakers, and ordinary citizens from all walks of life with a passion for productivity to share their experience, views, and practical tips on productivity improvement.

With speakers from every corner of the world, the P-Talks effectively convey productivity information to APO member countries and beyond. However, it was recognized that many of the P-Talk speakers had much more to offer beyond the 60-minute presentations and Q&A sessions that are the hallmarks of the series. To take full advantage of their broad knowledge and expertise, some were invited to elaborate on their P-Talks, resulting in this publication. It is hoped that the P-Insights will give readers a deeper understanding of the practices and applications of productivity as they are evolving during the pandemic and being adapted to meet different needs in the anticipated new normal.

INTRODUCTION

The concepts of productivity go back to the beginning of the Industrial Revolution when businesses sought to increase the output of machines. Basically, the productivity of a machine increases if it can produce more output by using the same amount of inputs.

The understanding of productivity has evolved over time, reflecting changes in work environments, technological advances, management philosophies, and societal expectations. With the expansion of the industrial age came the growing need to scale up manufacturing operations. Of course, expansion of capacities increased the output, but not the productivity, because output increased but so did inputs of raw materials and labor.

In the USA, this was noted by Fredrick Winston Taylor, an American mechanical engineer, who was working in a factory. He made what is said to be the first scientific study of factory management [1]. He argued that the best way to increase labor productivity was scientifically managing how the work is done, not how hard workers work.

The focus on process productivity gained significant attention with the emergence of quality management principles and methodologies in the mid-20th century. As organizations began to prioritize quality improvement and operational efficiency, the concept of process productivity came to the forefront.

Similar to productivity of a machine, efficiency can be interpreted as producing the same output with fewer inputs than before. This relationship between input and output would make productivity and efficiency closely related, which Taylor believed, saying that improving efficiency would improve productivity. This argument can be generalized by replacing the "machine" with "process." Quality gurus Edward Deming [2] and Joseph Juran [3] did just that with the introduction of process-based productivity, sometimes also known as process productivity.

One pivotal event in the discussion of process productivity was the introduction of total quality management (TQM) principles by Deming [2] and Juran [3]. These quality management approaches emphasized the importance of

understanding and optimizing processes to achieve higher levels of quality, efficiency, and productivity.

The Toyota Production System (TPS), developed by Taiichi Ohno [4] and Shigeo Shingo [5] at Toyota Motor, looked at the entire automobile production system and emphasized waste reduction, continuous improvement, and a focus on process efficiency. It became the basis for lean manufacturing and lean management, which prioritize the optimization of processes for productivity and customer value.

The rise of business process reengineering (BPR) in the 1990s also brought process productivity into focus. BPR aims at radical process redesign to achieve significant improvements in productivity, efficiency, and customer value [6].

The recognition of service productivity as a vital concept grew throughout the 20th century as the service sector expanded. The importance of productivity in services became apparent as organizations sought to improve operational efficiency, customer satisfaction, and financial performance, all of which, in one way or other, can be addressed by improving productivity. In the late 20th century and early 21st century, discussions around service productivity gained more attention.

With advances in ICT and the digital transformation, discussions of process productivity expanded further. Concepts like business process management (BPM) and process automation gained prominence as organizations sought to optimize processes through technology-enabled solutions [7].

I advanced the concept of optimizing the productivity of a process by introducing the digital transformation-driven process optimization (DXPO) framework after noting recent developments in digital transformation (DX) and how both manufacturing and service industries had adopted it as a business strategy [8].

This article supplements the video explanation in my APO P-Talk with updated developments. It also identifies ways for applying the DXPO argument to improve not just productivity but to accomplish any strategic objectives related to customer growth or cost efficiencies.

DIGITAL TRANSFORMATION VIA DIGITAL PILLARS

When talking about productivity improvement, our first thoughts go to "the productivity of what?" In a business, be it manufacturing or service oriented, things get done through various processes or operations. Take the example of a company making shoes. Shoe production needs raw materials, such as leather, resins, rubber parts, elastic, shoelaces, etc. To acquire these supplies, the company must have a process to find suppliers, then a process to place purchase orders, receive and store materials, etc. These processes extend to the manufacturing aspect, sales, etc.

When we talk about "productivity" we mean the productivity of these processes. The machines used by a company also are processes. DX refers to transforming the processes in order to improve productivity as well as efficiency. To obtain a full perspective on DXPO, it is worth taking a historical overview of the dual relationship between DX and productivity, as summarized in Table 1.

TABLE 1

EVOLUTION OF DX AND FOCUSES OF PRODUCTIVITY.

Period	Hardware	Software	Data	Information	Knowledge
Pre-1990	Mainframe dominance ending PCs, notebooks, networking, internet emerging	Software spreads to PCs and is application oriented DSS software (ERP, SCM, CRM) emerging	Data expand to application areas: accounting, operations, marketing Databases become critical	Data converted to information Computer-generated information spreads	Knowledge expands from the technical few to operational level

(Continued from the previous page)

Period	Hardware	Software	Data	Information	Knowledge
1990–2020	Internet, mobile phones, tablet computers, data centers, the cloud, IoT, and expansion of robotics and automation	Cloud software, e-commerce software expanding Emergence of big data and data analytics	Data become more strategic in nature The cloud makes data storage cheaper	Spread of real-time information becoming critical for decision-making	Knowledge expands to senior executive level with spread of intangible assets
Now	Cloud services, 5G, 6G, IoT, and intelligent robots expanding	Machine learning, deep learning, AI, and automation software take center stage	Big data usage expands with the IoT, SNS, and connected networks	Information available in real time and is data and AI driven	Knowledge expanding with spread of deep learning and AI tools

It is important to note that the concept of DX has evolved over time due to constant advances in the "pillars" of technology, consisting of hardware, software, data, information, and knowledge, as drivers of DX. In response to technological advances in those digital pillars, businesses found advantages in adopting them strategically, not only to improve productivity but also to devise means to become more competitive.

The overview of the major stages in the historical progress of DX shown in Table 1 help in understanding the developments better. The first column identifies key periods in the digital landscape based on major technological changes. The remaining columns identify the digital pillars and major transformations that can be attributed to each.

The first computers were developed in the mid-20th century, marking the beginning of the digital era. Initially, computers were large, expensive, and primarily used for scientific and military purposes. In the business context, computers, known as hardware, were primarily used for data processing and automation of routine tasks, thereby increasing the productivity of certain types of work.

Mainframe computers gained popularity in the 1960s and 1970s, providing centralized computing power for large organizations. This era saw the implementation of business automation systems like enterprise resource planning (ERP) and material requirement planning (MRP) to improve efficiency in various processes involved in the manufacturing and service sectors.

ERP systems often include modules for quality control and management. These modules track quality-related data, such as defect rates, nonconformance, and corrective actions. This helps manufacturers identify areas or processes for improvement, implement corrective actions, and maintain consistent product quality. ERP has now become a widely used software type.

AI algorithms and software can analyze data from various sources, including production processes, sensor readings, and quality records, to identify patterns and potential causes of defects or quality issues. This aids in identifying root causes more efficiently, allowing manufacturers to address underlying problems and prevent recurring quality issues.

A similar transformation has occurred in the traditional data analysis-based customer relationship management (CRM) domain as well. Natural language processing (NLP)-based AI systems can analyze customer feedback, reviews, and support inquiries to extract insights about product quality. This helps both manufacturing and service organizations to understand customer needs and concerns better, enabling them to make necessary improvements and deliver products that align with customer expectations.

NLP-based AI systems have created tremendous productivity and efficiency improvements in processes involving marketing and CRM operations. For example, NLP-powered chatbots and virtual assistants can handle customer queries and support requests and other interactions autonomously. These AI-

driven conversational interfaces can provide instant responses, freeing up human agents to focus on more complex tasks. In service companies, this improves the efficiency of customer support operations with drastic productivity gains when compared with the older call-center based customer care centers staffed by armies of employees spread across continents in some cases.

The examples cited above show that DX was achieved due to transformation of the digital pillars and then transformation of the processes they support. These examples were to highlight how productivity improved as a result of the DX of each pillar. But DX benefits can be seen in more areas, including cost savings, as well as intangible benefits such as increased customer satisfaction. Apple, for example, created a revolutionary transformation of mobile phones by introducing touchscreens and virtual keyboards that catapulted the company into a global leader in smartphones.

In order to understand the concept of process optimization, it is important to understand the role of processes in business operations, as outlined below.

OPERATIONS AND PROCESSES

A typical business is composed of many operations, such as human resources (HR), procurement, manufacturing, sales, after service, etc. Depending on the size of the business, the size of the operations also can be small or large. Managing a business involves effectively overseeing those various operations, and each operation consists of multiple processes.

As sales grow and become more complex, it is common to break down sales operations into smaller, more manageable units or suboperations. Breaking down those operations allows for better management, improved efficiency, and more focused attention on specific customer segments or geographic regions.

An operation can involve many processes. In the context of a business, an operation refers to a specific functional area or department responsible for carrying out certain activities to meet organizational objectives, for example, a sales operation, marketing operation, or production operation. The following swimlane diagram (Figure 1) from Kroenke and Boyle's popular text [9] explains a typical manufacturing company's major "operations" (listed in the top row), with the various processes listed below each operation.

Each operation typically encompasses several processes that support the overall function of that operation. For example:

Sales Operation: The sales operation may involve processes like lead generation, prospect qualification, sales presentations, negotiations, credit approval, and closing deals.

Marketing Operation: The marketing operation may involve processes like market research, campaign planning, content creation, digital advertising, and lead nurturing.

In essence, operations are the broader functional units that handle specific aspects of the business, while processes are the specific steps and activities that contribute to the overall functioning of an operation. Managing processes

FIGURE 1

SWIMLANE FLOWCHART OF THE ORDER-FILLING PROCESS SHOWING HANDOFFS BETWEEN DEPARTMENTS.
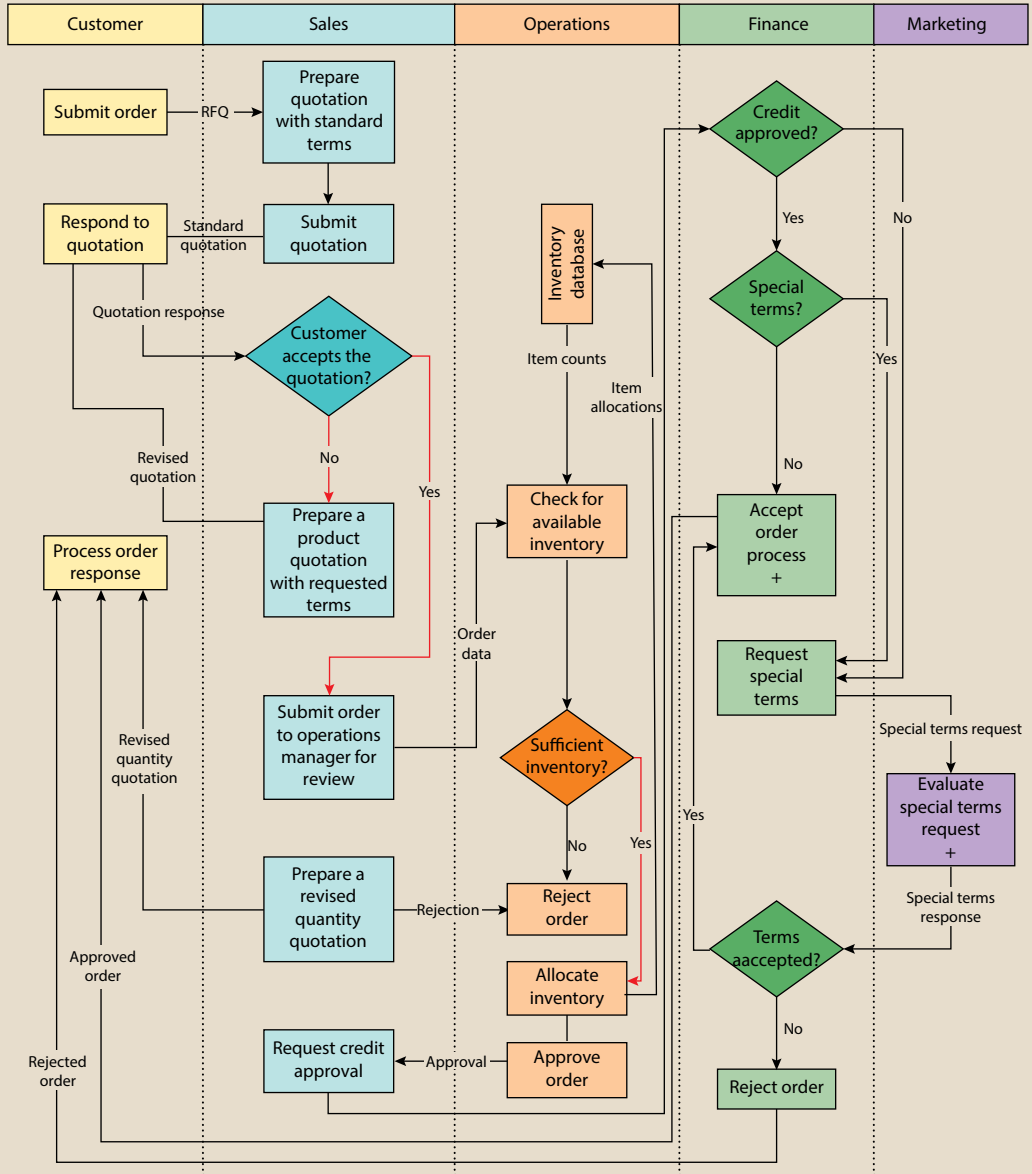
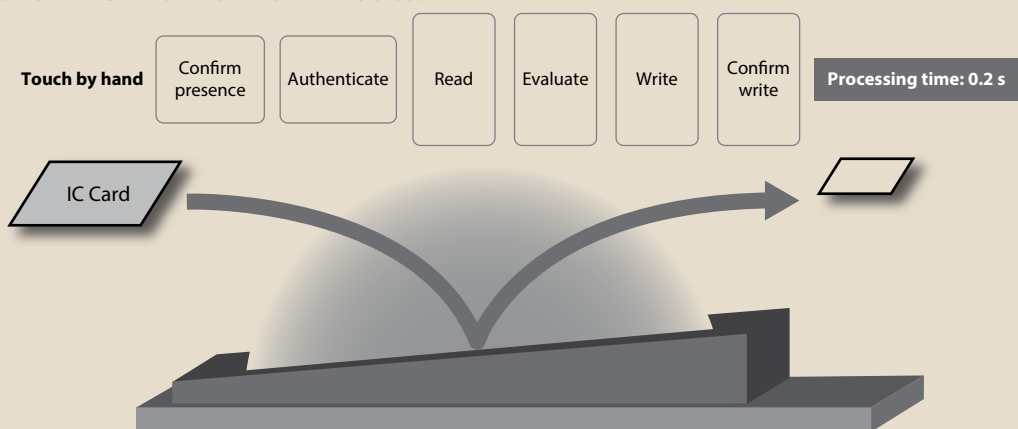**Source:** Reproduced with permission from Kroenke and Boyle [9].

within operations is essential to ensure efficiency, quality, and alignment with the organization's goals and customer expectations.

Many applications of DX involve going deeper into an operation and exploring the most effective processes that can be improved using digital technologies, which basically leads to transforming processes rooted in digital pillars. A good example of this was explained in my DXPO video for the APO P-Talk [8], which involved transforming the ticket gates of JR East Railways. JR East, according to the company website, operates 12,000 trains and transports 16 million passengers each day. The smooth operation of such a massive transport system is a primary objective of the company. For passengers, buying tickets easily and quickly, boarding trains, traveling safely to the intended destination, and quickly disembarking without delays are primary concerns. Any delays in this process can cause "pain points" for customers. Among the key pain point concerns are the ticket gates, which have transformed over the years from completely manual systems to the current automated ones.

It a straightforward application of well-known Little's Law that to improve the customer gate pass rate, also known as gate throughput, the time a passenger spends to clear the gate must be shortened. In the case of JR East, new technology developed by Sony, which allows payment for travel via the

FIGURE 2

DX OF THE JR EAST TICKET GATE PROCESS.

Touch by hand | Confirm presence | Authenticate | Read | Evaluate | Write | Confirm write | Processing time: 0.2 s

IC Card

Source: JR East website [10].

contactless Suica Card, was adopted. However, the entire process had to be digitized, from creating the Suica Card that can be loaded with cash and then automating the validation of the card at the gate, as illustrated in Figure 2.

The DX of this ticket gate process involved:

- Transformation of the data networks involved in payment systems (hardware pillar)

- Transformation of software involved in communication and transaction processing (software pillar)

- Transforming the data-gathering and-sharing process (data pillar)

In addition to those DX processes, the information and knowledge pillars have also been transformed, as new data analytical tools can extract intelligence to devise strategies for customer growth and planning. JR East seems to have gained many strategic advantages as the acceptance of the Suica Card has expanded beyond the JR East train system [10] to include:

- Supermarkets, shopping centers

- Fast-food chains, cafes

- Electronics retailers, drugstores

- Taxis, rental cars

- Hotels

- Entertainment venues

The speeding up of the financial transaction times or gate clearance times have had direct impacts on increasing the productivity of operations. The increased efficiency can be interpreted as contributing to the productivity of users and resources such as ticket gates. It should be noted that "ease of use" was a critical factor in the wide acceptance of the Suica Card, which in 2022 reached 90 million plastic cards and 16 million mobile cards [11].

DESIGN THINKING

In the JR East example of transforming ticket gates to accept Suica Cards, there were two primary objectives: increasing the efficiency of operations; and increasing customer convenience. Such strategic thinking is paramount when applying DX to achieve objectives. This process focused attention on "design thinking." Steve Jobs, founder of Apple and considered a visionary, famously said, "Design… is really how it works." Since then, design thinking has been widely used in business to address customers' or users' needs when creating solutions to problems.

Design thinking can be applied to improve processes in both the manufacturing and service sectors. By adopting this approach, manufacturers or service providers can better understand the needs of customers and stakeholders, such as internal employees who may be involved in the functioning of the processes concerned and external end-customers who purchase products or services. They can also identify pain points and develop innovative solutions to enhance efficiency, productivity, and overall performance. The five key steps in design thinking are illustrated in Figure 3 [12]. Design thinking became mainstream, along with this five-step model, when business schools, from Harvard to Stanford, started teaching it, often citing Steve Jobs' creations as examples.

FIGURE 3

FIVE KEY STEPS IN DESIGN THINKING.

Source: Reproduced with permission from Dum and Siang [12].
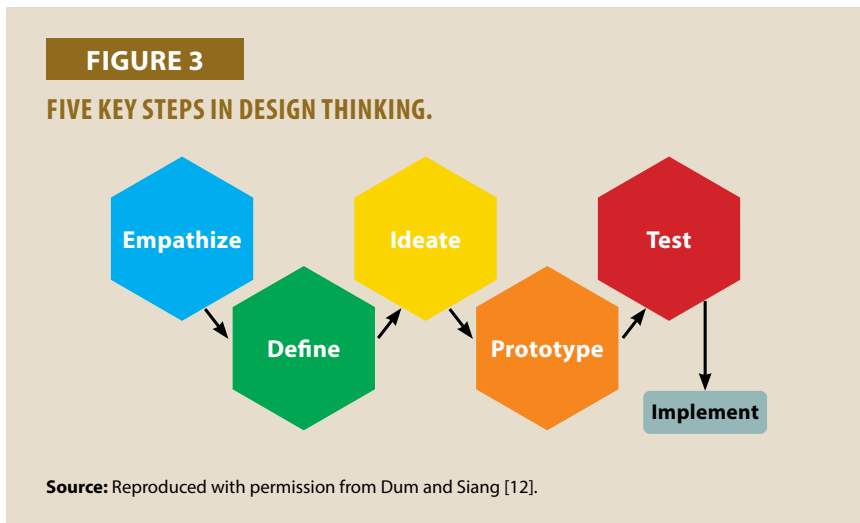
Empathize

The first stage of design thinking involves what we can call "the DX team," which is basically the team tasked with deploying DX of the concerned process or processes. This DX team must thoroughly observe the users impacted by the transformation of the concerned process; the users may be outside customers or internal employees who must undertake the process. In the case of JR East, the general public who travel on JR trains are customers. Internal employees are JR staff who manage the ticketing process. With the new Suica Card-based ticket system, gates become much more efficient and the productivity of employees is increased. The DX team must understand the customers' and employees' pain points. This "empathizing" gives valuable insights into improving processes.

Relieving pain points also encourages more users to adopt solutions due to ease of use. The wide acceptance of the iPhone, without having to read lengthy operating manuals, showed the power of design thinking in DX. Steve Jobs and Jony Ivy, Apple Chief Designer, transformed hardware as well as software with the introduction of touchscreens and a host of easy-to-use soft tools like push-button-free keyboards which can easily be used in any language.

Define

In the "define" stage, manufacturers or service providers use the insights gathered during the empathize phase to define specific problems or areas of improvement. This could involve conceptualizing the challenges in a user-oriented way to ensure that the DX solutions directly address the needs and pain points of those involved in the processes.

Ideate

During the "ideate" stage, the DX team brainstorms to generate a wide range of ideas and solutions to tackle the pain points identified. The focus is on improving processes to benefit the entity or company; for example, a solution that may be cost-effective, more efficient, or easier to use. The innovative ideas and strategic ideas can be considered by thinking outside of the box.

According to Apple Chief Designer Jony Ivy, Steve Jobs often asked him "Can we do this better?"when shown a new design [13]. The DX team may include

people who could see such potential to improve a process. If the company does not have such experts, especially with digital skills, it may want to tie up with a strategic partner, as in the case of JR East that partnered with Sony because of the technology it possessed.

Prototype

In the "prototype" stage, scaled-down versions of proposed solutions or process changes can be created. Prototyping allows the DX team to test and validate digital-based solutions, which can be hardware or software oriented, before implementing them in practice. The Japanese practice of kaizen, or continuous improvement, is also a form of prototyping. Iterative testing helps refine solutions, identify potential issues or errors early on, and come up with optimum solutions or even completely new innovations.

Test

In the "test" stage, prototypes are examined in real-life scenarios. Feedback is collected from stakeholders, and the performance of solutions is evaluated. This feedback loop helps identify further improvements and ensures that the proposed changes align with the actual needs of customers or internal employees, thus improving efficiency and productivity.

IMPLEMENTING DXPO: THE HUMAN ELEMENT

Once the solutions have been thoroughly tested and refined, they can be implemented on a broader scale. The implementation process may involve training employees, updating standard operating procedures, and integrating the changes into existing workflows. With DX-driven solutions, another key point is that data can be accumulated, unlike in nondigital processes. JR East accumulated Suica Card data from millions of passengers and analyzed them with big data analytic tools to understand user behavior [11].

As explained in my APO P-Talk on DXPO, DX can be made more effective and customer-centric with design thinking. While DX involves leveraging digital technologies to transform business processes and customer experiences, it needs a carefully chosen DX team to undertake the process.

To implement DXPO for improving productivity, a good understanding of both DX and productivity is needed. Even in a medium-sized company, overall operations can be complex, and processes involving services can be completely different from processes involving manufacturing. The DX solution that improves the productivity of one process may not be the best to improve the productivity of another. The best digital approach usually depends on the characteristics of the individual process. This is why a team with a strategic mindset and basic understanding of DX is needed. The key functions of the DX team, in both service and manufacturing, are listed in Table 2.

DX teams tasked with improving productivity must be familiar with multiple skills. It may be impossible to create "ideal" DX teams due to the expertise needed. This must be addressed in hiring practices. It is also worth noting the importance of design thinking involvement in team objectives, including innovating, testing, and prototyping of solutions in hardware, software, and data solutions.

TABLE 2

DX TEAM OBJECTIVES AND TASKS.

DX Team Objectives	Tasks
1. Strategic assessment of potential processes to improve productivity	Thoroughly analyze current processes

Identify pain points, bottlenecks, and areas with potential for improvement

Create a clear understanding of business objectives and outcomes to achieve through DX |
| 2. Identify hardware solutions | Research and select appropriate technologies, e.g., machine upgrades (like JR East ticket gates), robotics, sensors, IoT devices, etc.

Evaluate costs, benefits, and potential ROI of hardware solutions

Consider maintenance, training, and compatibility with existing systems |
| 3. Identify software solutions | Determine whether processes could benefit from software solutions, e.g., ERP, SCM, CRM

Research new algorithms in AI, machine learning, data visualization, dashboards, real-time data to identify quality trends

Research ease-of-use solutions, such as soft keyboards, with high ROI |
| 4. Find data-driven solutions | Identify processes where data-driven solutions can make a significant impact, e.g., predictive analytics, machine learning, AI algorithms, or data visualization tools

Analyze big data from various sources, both internal and external, to gain insights, optimize processes, and make informed decisions |

When implementing DX solutions, my APO P-Talk on DXPO identified three cases involving the availability of human resources: internally available, e.g., Shinsei Bank; some internal resources but cooperating with a strategic partner

as needed, e.g., JR East and Sony; and some internal resources but cooperating with a cloud partner, e.g., two cases of cloud partnering.

Recently, with the rise of big data, many large and medium-sized companies have been storing data in cloud data centers. Cloud consultants, such as Snowflakes, Datadog, and Databricks and IT service companies like TCS and Infosys are now global players offering DX services. With the wide availability of open software, even SMEs can create innovative DX solutions for increasing productivity or efficiency. However, finding the human resources with the right skills can still be challenging.

EXECUTING DXPO: OPTIMIZING PROCESS IMPACT

Combining DX and design thinking is a powerful approach to improve processes and make them more productive. It makes the transformed solutions more appealing to users as they are easier and/or more convenient. The following benefits are apparent.

Customer Value

In strategic assessment of potential processes to improve productivity, DX teams must review areas for improvement. Attention must be given to processes that add customer value. Two customers types are involved: internal employees involved in the processes concerned; and external end-customers who purchase the products or services. If a machine produces defective parts, it lowers the productivity of that machine; this is a pain point for internal employees. From a strategic perspective, this is a quality problem for the entire company. Thus the DX team's job is to determine whether the quality problem can be minimized or removed by using digital technologies.

In the case of JR East, the ticketing process directly impacted external customers due to the time needed. Moreover, it caused productivity problems for the entire company due to congestion caused, especially during rush hours. The DX team chose to transform the ticketing process because of the value to customers.

Implementation Potential

When trying to implement a DX approach, companies must look at the human and other resources needed to execute plans. Three types of digital solutions can be explored: hardware solutions; software solutions; or data-driven solutions. Depending on the expertise a company has access to, solutions can be a combination of all three. Technically savvy DX experts can also develop their own innovative digital solutions. Many well-known digital startups, including Zoom and ChatGPT, were created like this.

Finding the right IT/digital skills is often an issue, because as companies started rushing to DX, a shortage of IT employees with the necessary skills became obvious. This shortage had a greater impact on smaller companies and those in non-IT areas. But companies have several options to choose from, from building their own internal IT divisions, to strategic partnerships to provide digital expertise, to using cloud partners. Depending on the situation, a company can assess its implementation potential to find the appropriate IT resources available.

DXPO Impact Evaluation Model

With a skilled DX team, a company can embark on its DX journey by identifying processes and the best solutions using design thinking. Human resources are the key to improvement. At the outset, the question is often: "Where should we start?" This can be answered strategically by evaluating customer value and implementation potential in tandem using my DXPO framework [8].

In order to link customer value with implementation potential, DXPO reviews identified processes requiring productivity or efficiency improvements and rates them using a 1–10 scale, based on its importance as a pain point, to the concerned part, which can be end customers or internal employees who want to improve their productivity.

FIGURE 4

DXPO IMPACT EVALUATION PROCESS [8].

Processes	Design Thinking	A: Customer Value (1–10 scale)	B: Implementation Potential (1–10 scale)*	Impact= A x B	Rank
P1	Design Thinking	8	10	80	1
P2	Design Thinking	5	5	25	?
P3	Design Thinking	10	5	50	?
PN	Design Thinking	A	B	AxB	C

Created by the author based on the "Impact" evaluation used in *Design Thinking*.

* Implementation Potential is to be evaluated by considering organization's access to IT Knowledge Team: Internal, cloud, etc.

The potential for implementing the identified DX solution too needs to be likewise rated using a 1–10 scale, as explained in my P-Talk. If a process is very important, requiring urgent solution, it is assigned a high value. However, if the company does not have the resources to use DX, then the assigned value of implementation potential is low. The "impact" of implementing the solution is the multiplication of the two values. Ranking the processes based on impact determines which processes are to be undertaken (Figure 4).

CONCLUSION

Not all the efficiency or productivity problems in processes can be addressed by DX. Identifying the right process to deploy DX is the role of the DX team. It is also possible that nondigital solutions exist, which can be more effective to streamline and increase efficiency. One such approach originated in "lean thinking" originated under the TPS. By analyzing a process, teams can locate redundancies, bottlenecks, and areas for improvement and thus increase productivity without relying on DX tools. For example, the TPS kanban system of inventory management uses cards to signal the need for replenishment. This approach helps prevent overproduction and reduces waste by ensuring that materials are supplied only when needed and thus contributes to improving productivity.

However, it is interesting to note that with the spread of digital technology, kanban has evolved and become digitized. This DX of the Toyota kanban system is interesting, not only for improving productivity but also for minimizing costs while enhancing production line operations, thus contributing to enhancing productivity as well [14]. Another key point to note is DXPO can be generalized to go beyond productivity to focused optimization. For example, if the objective is to focus on customer growth, DX can provide metrics enhancing aftersales service processes, on-time delivery, brand loyalty, etc.

Keeping DXPO initiatives current as technology develops is essential for staying competitive and maximizing the benefits of technological advances. Some key ideas include kaizen, continuous learning, and remaining updated with new, faster technologies. For example, ChatGPT AI models can increase the productivity of processes in new areas of business. Doctors, consultants, insurance companies, and even government organizations have found that ChatGPT-type tools drastically increase their productivity [15]. Staying engaged with technology providers also helps.

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