Process mining for Total Quality Management

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Introduction

Quality is one of the most used (or abused) words in any business transaction. There seldom is a sales pitch, a business case or a brand communication that does not talk about quality. While quality is often a very tangible parameter, businesses tend to use it as an intangible, which cancels out everything negative about the product or service. This is why professional organisations, in their pursuit to stand out from the crowd, opt for a stamp of approval of their business processes from an organisation that spearheads the pursuit of quality excellence. TQM, or **Total Quality Management**, is one of the pioneering frameworks in this pursuit of excellence. However, the world has changed and rather than depending on experiments or individual knowledge, we have learnt to depend more and more on data for decision-making. In recent times, process mining has brought about a new dimension in the way we look at processes, analyse them and drive quality. Hence, it only makes sense to use the power of process mining in driving TQM. This thought leadership article endeavours to highlight how TQM and process mining can take your organisation the extra mile in an ever-competitive world.

A brief recap of TQM principles

TQM is a century old concept now. Union of Japanese Scientists and Engineers (JUSE) committee, which awards organisations the Deming Prize for exemplary work around implementing and promoting TQM, in its article on 'Introduction of the Deming Prize 2014 for overseas' says,

"TQM is a set of systematic activities carried out by the entire organization to effectively and efficiently achieve the organization's objectives so as to provide products and services with a level of quality that satisfies customers, at the appropriate time and price."

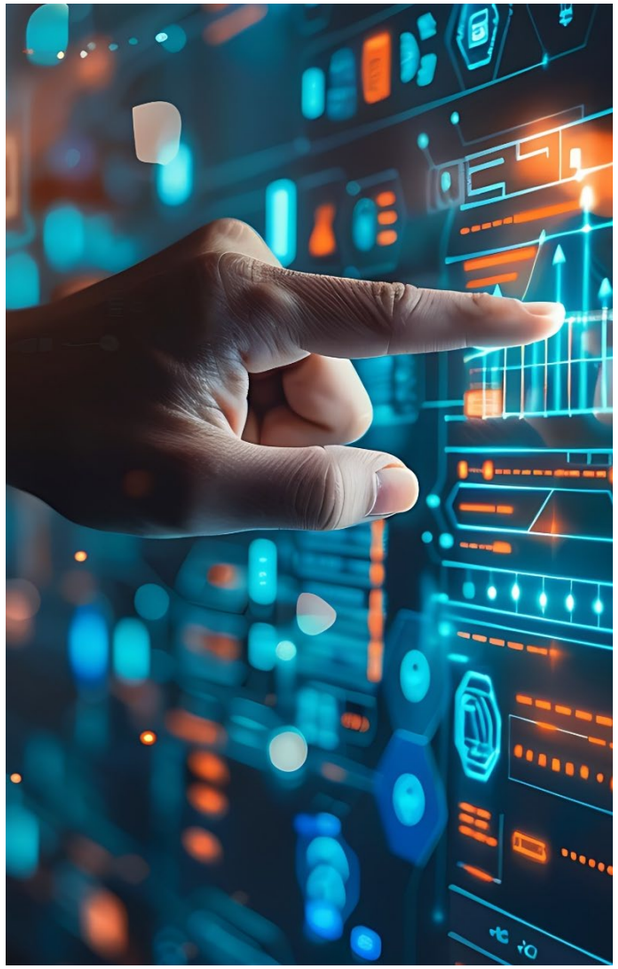
As we can infer from the above description, TQM aims to satisfy customers with quality products and services but at the appropriate time and price. Hence, organisational objectives must be focused on proactive customer-oriented strategies and considering these are always dynamic, a TQM-practicing organisation must be in touch with customers to realise their changing preferences and adapt accordingly. This can be achieved only if the leadership is cognisant of the long-term vision and mission and accordingly steers the organisation in that direction. This has to be achieved through a unified effort by the entire workforce and through efficient processes.

The TQM definition highlights the need for organisational objectives aligned with customer satisfaction, and an enterprise-wide focus on achieving those objectives. However, how does the organisational leadership know that TQM is being implemented effectively and efficiently? For this, they must ensure that human resources and organisational capabilities are built to perform the required activities. Additionally, there must be data-backed analysis and decision-making to ensure that what they achieve is due to initiatives taken and not by chance. If they fail to achieve some objective, they must check if their initiatives have been properly planned and implemented. If not implemented, the reasons must be known and worked upon. If implemented, then they must do a proper root-cause analysis to identify why it failed and design a new set of initiatives if required.

Thus, the basic requirements of TQM will include the following:

1. A customer-oriented leadership, driving organisational alignment to business objectives
2. Systematic and lean processes driven by a capable workforce as per business objectives
3. A data-backed governance mechanism to constantly align process outputs with business objectives

There is a long history of building strong leadership and human resource capabilities in the business world. With huge improvements in technology and computational capabilities, it is data analytics that is often the key differentiator between a good and a great organisation. This is more so in the service sector, as things do not operate as smoothly or consistently as a production line. Further, there are innumerable variations in the way that a service can be executed and the ultimate output that is generated. This is true even if the underlying product is a manufactured good.



TQM in the digital era in a service world

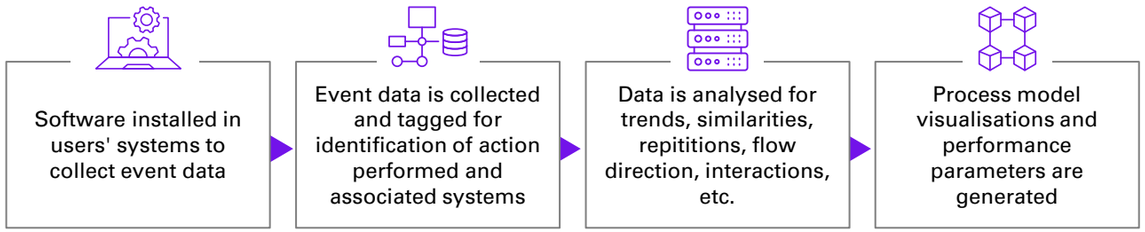
With the business world changing constantly, TQM has also evolved over time. The myth that TQM applies only to the manufacturing sector, does not hold true. From being a methodology focused on statistical quality control and zero defects in a manufacturing environment, today its philosophy covers all the needs of the modern world, including financial management goals, knowledge management, cross-functional management, and new socially and environmentally sustainable products.

In its simpler form in the olden days, all that was required, was to train people to be self-sufficient in ensuring quality and sample production data to do the statistical analysis. However, in today's world, especially in the service sector, data is being generated in unimaginable quantities. Popular spreadsheet based applications had to stretch their spreadsheet dimensions far and wide and then migrate to the cloud to accommodate the ever-growing number of columns and rows as well as interlinkages across files. While logic dictates that a lot of data is better than little or no data, even if computers can manage vast amounts of data and smart coders can collect and assimilate lots of data in required formats with a lot of coding effort, our management is still human. Most business leaders may have some understanding of modern data management—AI/ML, cloud computing and similar technologies—but they are neither experts in these, nor do they need to see data. They need information in a crisp and concise fashion. With 50 rows and 3 columns of data, it is easier to clean data, identify patterns, generate simple insights and prepare a chart. However, with 10 million rows and 20,000 columns of data in all kinds of formats—procured from different sources and processes—it gets difficult to identify errors, clean the data, understand the correlation and causation, and conduct a coherent statistical analysis. There is also the risk of using too many or too little number of factors, to generate concise insights for management to work on, with a high level of confidence.

TQM cannot be successful without data, managerial insights and quality measurement systems. So herein lies the big challenge—with so much data flowing in from everywhere, data volume generated is so overwhelming that our focus shifts from the process and we fail to understand what actually is going on. To simplify, let us consider a data entry operation. Data is being sourced in thousands of files from dozens of sources and hundreds of different formats of reports are being created to be circulated to tens of thousands of customers. This creates a confusion as to where the quality team should focus on. In most cases they are focused on checking for data errors and the time to market because that is all the bandwidth they have. It is a luxury to have more than one quality check (QC) analyst per 20 data entry executives, yet they are expected to ensure everything is being done accurately and on time. They can barely focus on the output, which makes it impossible for them to monitor the entire process. This is where we fall back on the concept of 'quality at source'. If we had a clear understanding of the process's purpose, adherence to it, the sources of variation, defects, and waste, we could alleviate concerns about the output. Additionally, we wouldn't need to struggle with deciphering vast amounts of output data to identify expected metric behaviour, dependencies, anomalies, and areas of focus. This would make driving Total Quality Management (TQM) less challenging. We would know what to train the workforce on, what the management needs to focus on, if we are in alignment with customer needs and accordingly drive quality improvement projects. This is where process discovery and mining come in. Unlike a typical BPM tool, it does not simply help build the should-be process map for a process team to follow. In its latest versions, it can study enormous amounts of data and determine all the focus areas from a process point of view and identify variations, defects, waste and areas for automation and more. In the next section, we will understand why, in today's world, it makes ample sense to invest in process mining to drive TQM or any other business excellence model.

Process mining and TQM

What is process mining exactly? While many must already be familiar with the term or may have heard of data mining, it means that we dig through systems and data pertaining to a process to identify how it is actually performed. This is akin to a Gemba walk or a shadowing session to observe human activity without the human effort required for doing that. In its most basic form, a process mining activity performs the following steps.



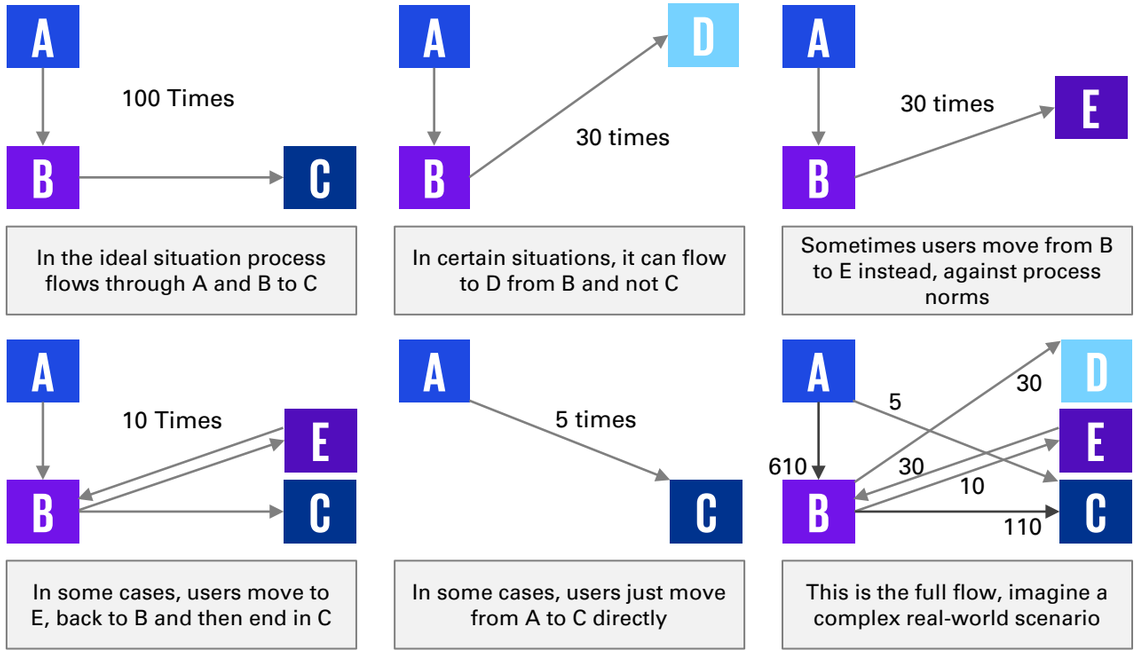
The final data can be used for multiple purposes as listed below:

1. **Process discovery:** When the underlying process is not clearly known or understood, or a process study/refresh hasn't happened in a very long time, we might be interested in learning how the process actually operates on the ground.
2. **Process conformance:** When there is a set SOP in place but we need to be sure that work is being actually done on the ground as it is supposed to be, we use process mining data to check conformance against the SOP.
3. **Process improvement:** When we know that there are process deviations or inefficiencies, we might be interested in identifying the reason for deviations or inefficiencies. Is it due to inefficient operators? Is it due to inefficient applications? Is it due to inefficient interaction between operator and application? Or is it due to some other unknown root cause?

The typical outputs of modern-day process mining software include the following:

1. There are process maps at different levels of detail. In an ideal world, each instance of a process is supposed to follow the same set of steps, unless there are several decision points. However, in reality, there can be a lot of back and forth, complete step deviations, an addition of new steps and so on. Typically, process-mining software allows the user to see the full set of variations or eliminate the minor variations and focus on the more commonly taken paths.

It is not uncommon to find out that the ideal process is followed less than 30 per cent of the times. Below is an illustration of the same.



2. As already shown above, process maps also depict the frequency of each path taken, sometimes numerically or sometimes through the thickness of the lines. It typically also highlights average time taken in each path.
3. Process-mining software also often shares some interesting statistics, such as the fastest path, the slowest path, the average cycle time, user-to-user variation, the highest number of repetitions (opportunity for automation), human effort required, etc.

However, the real power of process mining is not just in creating flowcharts or gathering summary process statistics. The real power of process mining is unleashed when it is overlaid with intelligent process information. Process mining collects system logs from standard ERP, CRM, workflow softwares, etc. There is also a technology called task mining which deploys sensors to capture user activities on screen to identify various applications used and actions taken. This is invaluable where application logs are not readily available. Alternatively, application logs can also be directly imported into some process-mining software for analysis. In this article, we will use the common term of process mining irrespective of whether the data was generated through system logs or through screen capture. For better understanding, a simple data log of activities is presented below:

Timestamp	Application	User ID	Machine ID	Action
7/25/2024 18:10:32	Spreadsheet	Alpha Romeo	MX212	Open application
7/25/2024 18:10:37	Spreadsheet	Alpha Romeo	MX212	Switch application
7/25/2024 18:10:51	Document	Alpha Romeo	MX212	Select field
7/25/2024 18:11:00	Document	Alpha Romeo	MX212	Copy data
7/25/2024 18:11:05	Document	Alpha Romeo	MX212	Switch application
7/25/2024 18:11:20	Spreadsheet	Alpha Romeo	MX212	Select field
7/25/2024 18:11:38	Spreadsheet	Alpha Romeo	MX212	Paste data
7/25/2024 18:11:54	Spreadsheet	Alpha Romeo	MX212	Select field
7/25/2024 18:12:02	Spreadsheet	Alpha Romeo	MX212	Type data
7/25/2024 18:12:12	Spreadsheet	Alpha Romeo	MX212	Move to next row
7/25/2024 18:12:27	Spreadsheet	Alpha Romeo	MX212	Type data
7/25/2024 18:12:29	Spreadsheet	Alpha Romeo	MX212	Move to next row
7/25/2024 18:12:39	Spreadsheet	Alpha Romeo	MX212	Calculate column sum

There might be additional information captured, depending on the software and the technology it is using. For example, task-mining softwares capture keystrokes, mouse clicks, key combinations, mouse coordinates, the active screen, the type of interface that is being clicked on (like a button, a check box, taskbar, etc.), the name of the file or URL and even the text at that location for better identification.

If an enterprise application is used for process mining, actions might be status of a ticket or task stage, like submission, evaluation, change, approval, resolution, etc. instead of the on-screen activity. In either case, the log is ineffective without the underlying meaning of these activities. Hence, to deliver an intelligent process output, the software has to be trained on the foundation of the combination of the application and the activity being performed from the business point of view.

This example is a simple case of a user copying certain data from a document into a spreadsheet, typing two rows of additional data and calculating a sum. The logs of a month of activity by a group of 10 users working eight hours a day will run into millions of rows of data. Without the underlying meaning of the activities, each row of data will be treated as a unique process step and, ultimately, the output will be unusable. The true essence of process mining is realised when, through machine learning algorithms, these otherwise meaningless data points are converted into something simple, such as the following:

User ID	Machine ID	Activity	Time taken
Alpha Romeo	MX212	Copy data from document into spreadsheet	66 seconds
Alpha Romeo	MX212	Type data into spreadsheet	49 seconds
Alpha Romeo	MX212	Calculate sum of the data	12 seconds

Now, we can use this data and maybe draw the inference that this person is particularly slow in this activity or not following the standard process. If this is happening across users, it might be that the machines they are using are particularly slow or standard processes are not clear to the team. Accordingly, process improvement initiatives may be carried out.

To establish the linkage between process mining and TQM, a quick revision of TQM principles is now in order. As mentioned earlier, 'a data-backed governance mechanism to constantly align process outputs with business objectives' is what sets organisations apart today. More often than not, the voice of the leadership is to focus on improving the output. Typical asks include:

1. Our delivery time is too slow. We must reduce delivery time by 20 per cent in a month's time.
2. We are receiving too many client complaints; we need 50 per cent reduction in complaints by the end of this quarter.
3. Sales are too low. We need 15 per cent y-o-y sales growth.
4. Our costs are too high. Let's cut down manpower by 25 per cent by this year's end.

These asks are reactive in nature and not the TQM way of working. It is fine to set a stretch target to work towards but how do we know if it should be an improvement of 20 per cent or 80 per cent without even knowing the underlying root causes?

How do we know the underlying root causes without even knowing the underlying process gaps? This is exactly where process mining fits in.

Let's take the first example of slow delivery time. Typically, a target is set based on either what the customer wants, what the competitor is doing, what we have been able to achieve historically or what we think is the most we can deliver. This, however, may not be the best approach. With detailed process mining, we might figure out that given the resources (both human and technological), probably we cannot improve more than 5 per cent, which may not even be justified by the amount of effort it may require. On the other hand, we might find out that there are wasteful process steps that are no longer required, adding no value or are being performed too slowly. By eliminating, modifying or automating them, we can even improve by 50 per cent and delight the customer.

We can further overlay additional information, such as defects, products, customers, etc., to identify if certain users, systems or process paths contribute to more defects and rejections. These issues can be directly linked to potential root causes.

Drawbacks of the current process mining applications

As of today, most process-mining software are not equipped to produce different kinds of analysis that we are looking for. Some are good at capturing the screen activity metadata, some at analysing huge volumes of application logs, some at creating cool visualisations, some at generating statistical reports and some at integrating process mining output with their automation solutions. Thus, no one software might be good at everything, from data collection to storing, analysis, visualisations and reporting. Many of them have limited customisation potential as well. They are not easily understandable to the layman and need a dedicated team of data scientists or analytics experts to use the output data and create their own customised output based on it.

The situation is, however, changing, with increasing demand for process mining over the last five years as many traditional BPM-offering companies have come up with their process mining solutions and are constantly improving on the same. The process mining applications need to keep working on the following aspects:

- A flexible application that allows the users to choose the type of data requirement
- Flexibility of the final output format and visualizations
- Differentiated approach based on whether the requirement is process discovery, conformance or improvement
- Ability to accept business context as input while suggesting automation opportunities
- Accept business metrics to generate usable analytics
- Continuously learn the actual process based on user inputs and not just logs

Any investment decision by an organisation should be made only after such assessments have been conducted on the process mining applications they are considering, to avoid future disappointments. Conversely, with a team of analytically strong people with programming skills, it is also possible to do basic process mining, using common programming applications or spreadsheets, depending on the volume of data we want to process.

Real-life use cases

Here are some real-life scenarios that you may be able to associate with and the process mining output that highlighted the primary root causes, along with what potentially can be better:

An HR team of a company was failing to fill vacancies in time 50 per cent of the time.

- In a majority of these cases, it was found that the hiring manager decided to change the required candidate criteria mid-way through the recruitment process.
- Better clarity of candidate requirements and regular feedback from recruitment team to the hiring manager regarding the talent market situation can address this situation.

Some members of a team collecting bank-rate-related data over calls were taking too long to get the information.

- It was found that during at least 50 per cent of the duration of the calls (generated from a computer application), the slower users were performing other activities. On a deeper dive, it was identified that the contacts that these users had typically kept them on long holds when compared to the contacts of the other users.
- Better liaison with the banks, identifying different contacts or finding alternate means of securing the data can improve this situation.

A team had to copy industry market research data from some structured reports and standard tables, which turned out to be a very time-consuming process.

- It was found that the process was repetitive, and tables were identified based on some keywords and the searching, copying and pasting of datapoints one by one, which made the process time consuming.
- Data can be directly extracted without human intervention through data extraction tools.

A team had to provide near real-time data to customers and were failing to meet the expected timelines and also introducing errors.

- It was identified that more workload was being dumped on faster users, leading to slower users sitting idle and faster users getting fatigued.
- Upskilling of the slower users and more even job distribution can improve the timeliness as well as the accuracy.

Despite technological investments into new applications, the cycle time of a process was not found to be improving.

- It was seen that on an average, people were sitting idle on the job for around 15 minutes per instance. This was identified to be due to an increasing concern regarding potential job loss if the technological transformation was proven as successful.
- Better change management and human resource management plans centered around user benefits can address such challenges.

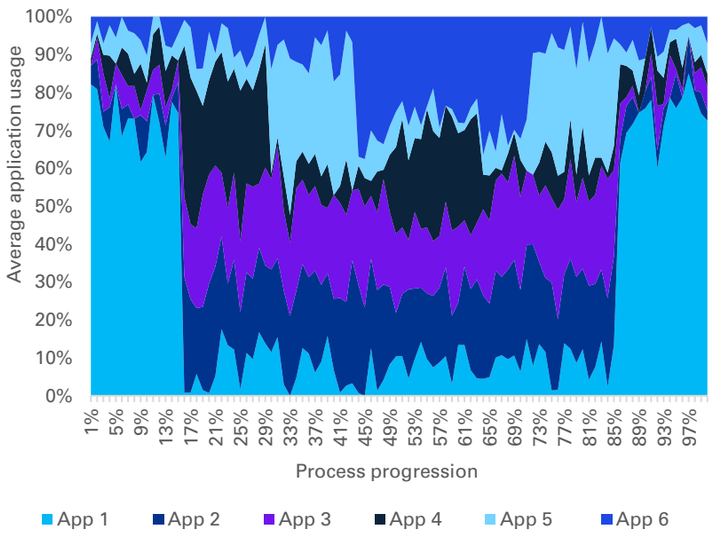
A customer service team was found to be taking too long to solve customer queries, leading to a customer churn.

- It was found that team members were multitasking on multiple queries at once, often due to escalations and reprioritisations. They had to put an ongoing task on hold, switch to a second one and, often even more, come back to the first one at a later time, reopen all relevant documents, recall where it had been left off—all of which caused huge delays.
- A better queuing mechanism and different channels for addressing queries of different priorities can reduce frequent switching of tasks and eliminate related delays.

A cloud kitchen was facing apparently random stock-outs of coffee, making it difficult for them to maintain optimal inventory.

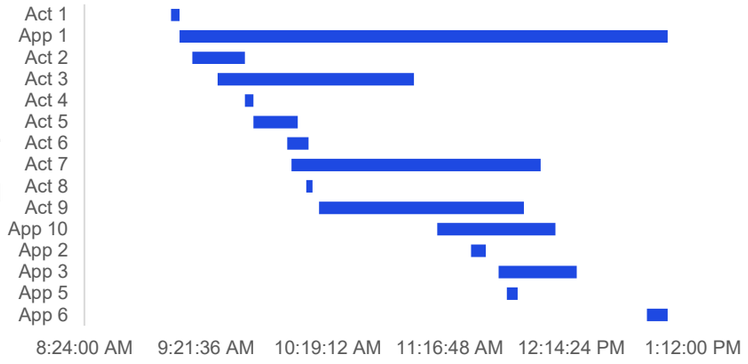
- It was found that on the majority of such stock-out days, the kitchen would face a spike in coffee delivery demand the previous night. On a deeper dive, it was identified that this was primarily driven by college students staying up at night before exams and assignments.
- There are different ways in which this challenge can be addressed: The kitchen can consider setting up a separate kiosk for the college students, gather more information regarding such dates in the future or implement an innovative incentive programme for this target group to win discounts for early ordering, etc.

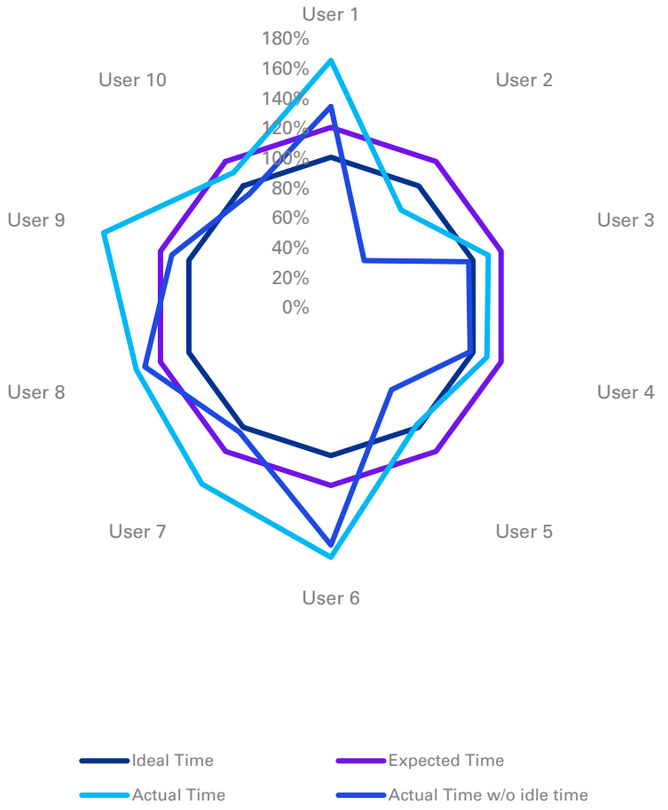
Below we can see some custom visualisations to demonstrate how we can look at process mining data from different perspectives. These may not be available in a standard process mining package.



The adjacent chart shows the average percentage usage (y-axis), of different applications, denoted by different colours, during the timeline of a task (x-axis) at an aggregate level. As is clearly visible, almost every application has been used at each stage of a task, in one instance or another (suggesting a possible process violation). We also see periods during the lifecycle of the task, where the usage level of particular applications is higher. These can be compared against the standard process.

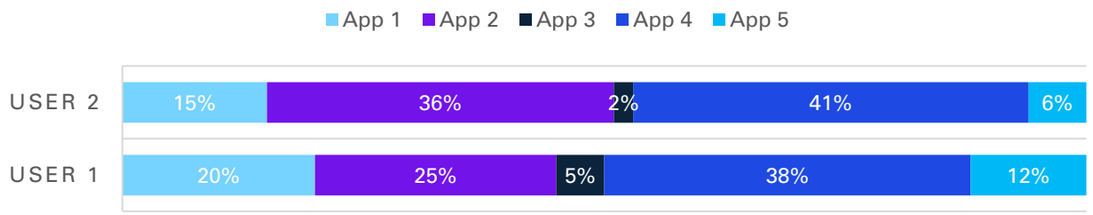
A different way to look at the data can also be to check the average start and end times in the lifecycle of a task, where an application is active. This shows a relative range and sequence of initiating and stopping different applications or activities. In the adjacent diagram, each line is a different application or activity.



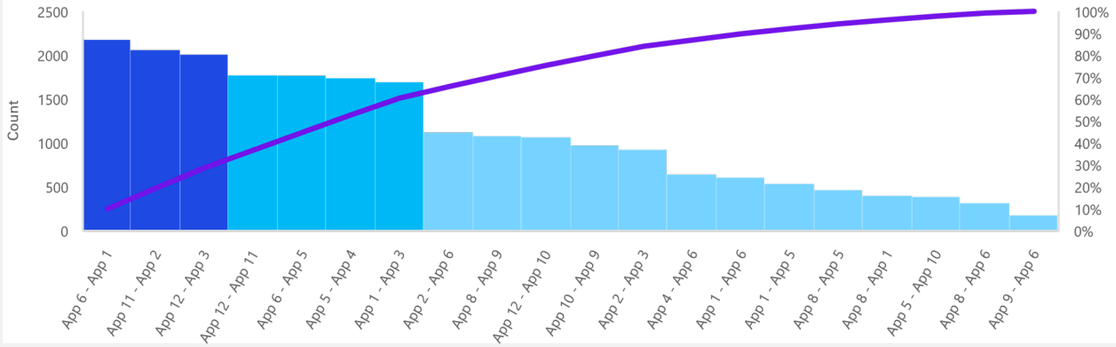


We can also utilize process mining to study individual level performance. In the radar chart on the left we can see actual performance of individuals in grey against an ideal time (best case scenario) of a process in blue as well as expected time (typically a standardised average handling time for the process) in orange. With task mining data we can even go a step beyond and identify actual time taken in the task after eliminating any idle time when user was inactive while on the job.

The stacked bar graph on the other hand is a one-on-one comparison of average time spent on different applications, between two individuals performing the same process and using the same applications. This can be seen in a relative scale in a stacked graph as shown, or at an actual level (without stacking). At a relative level it may seem here that the two users demonstrate different levels of speed while operating different applications. We may overlay this with actual time taken and defects in output to identify levels of proficiency with different applications. It must be noted here, that using such study for punitive purpose may be counter-productive, as we might not get unbiased data in future. Such studies should be used for training and development purposes for best results.



Automation is another common use case for process mining. Many process mining applications directly highlight automation potential based on frequency of back and forth in certain steps. The graph below shows frequency of back and forth between application pairs. Using business know-how of the reason behind such back and forth, we can estimate which activities can be safely automated and where other lean initiatives need to be adopted.



While several process-mining softwares exist, as long as we have the required data in the form of events and logs as required by the software, based on our business needs, processes, levels of online and offline activity, frequency of analysis, etc., it is not mandatory to use expensive advanced software. Once we get used to the methodology of analysing the data, we can use spreadsheets or programming applications to get the information that we are looking for. However, process mining is an imperative functionality in any modern organisation's arsenal as well as a must-have data analytics skill for today and the near future. TQM can benefit immensely from it if we use it in a regular and systematic process.

How can KPMG in India help?

KPMG in India has been at the forefront of business transformation over several years, across industries and locations. We understand the requirements of changing times, the processes and technologies driving them. We help our clients achieve their end-to-end business excellence goals that improve performance, enhance quality, grow their business and build eminence in the industry.

Our in-house TQM team will not only help you imbibe the TQM culture in your business practices and workforce, focused on gaining leadership in satisfying customer expectations, but are also equipped to generate best-in-class insights with BPM and process mining know-how to help you have the winning edge over your competition. Our offerings include (but are not limited to) the following:

- Understanding client processes and providing in-depth insights against industry standards
- Highlighting key areas of improvement and advising on the journey roadmap
- Utilising industry best practices to develop new capabilities for efficient ways of working
- Supporting our client's need for transformational change through complex and large-scale projects
- Supporting the client in becoming an industry leader

We have delivered tangible benefits to multiple clients across industries and geographies and we understand the power of combining TQM with process mining in ushering our clients into the next era of business growth.

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