

Process Optimization on the Basis of Full-time Equivalent Utilization by Deriving Various Key Performance Indicators

Onkar Vijay Mandawad

Second Year M. Tech Project Management,
Department of Manufacturing Engineering and Industrial Management
College of Engineering, Pune, Maharashtra, India
mandawadov20.mfg@coep.ac.in

Maneetkumar R. Dhanvijay, Sudhir Madhav Patil, B. B. Ahuja

Department of Manufacturing Engineering and Industrial Management
College of Engineering, Pune, Maharashtra, India
mrd.mfg@coep.ac.in, smp.prod@coep.ac.in, bba.prod@coep.ac.in

Ankita Mishra

Senior Project Manager - PMO
ZS Associates
ankita.mishra@zs.com

Abstract

Resource management is a prime factor among the various factors driving the industries. It is necessary to utilize the resources in best possible way. In service based industries human resources has the tremendous amount of importance, as they are the prime contributors in firm's growth. The stakeholders in these service industries are interested to track the utilization of human resources, for tracking the budget they have invested in the firm. The project managers are responsible for utilization reporting of FTEs. This paper represents the detailed analysis of resource management in the pharmaceutical industries, it has found that the current utilization process has been impacted due to the cumbersome method, inefficient tools and these factors were creating excessive utilization of human resources to administrate the process. To streamline the process with ease in the handling, increased accuracy and optimum resource utilization are the primary objective of this work. For streamlining the process this report has studied the various optimization techniques for resource utilization through the available literature resources, the DMAIC Methodology was implemented to optimize the current process, with the help of Root cause analysis and SIPOC analysis. This work has also derived the key performance indicators to trace the work done by the resources and implemented the Project management dashboard to track and visualize the utilization on granular level. With the improvement adapted, this work has achieved cost saving of 62% and 59% of time utilized per week.

Keywords

Resource Utilization, Process Optimization, Key Performance Indicators, Full time equivalent (FTE) and Project Management Dashboard.

1. Introduction

In the field of project management cost, time and scope are the primary constraints. These three pillars directly affect the quality of the project. Project management plays a crucial role in every project. Resource management is one of the key areas of project management. Planned resources have the largest dependency for the completion of project. Resources are of different type like human resources, financial resources, material resources, machinery resources and information resources. The application of the resources depends on the areas they are getting utilized. In the domain of production, material and machinery play a significant role whereas in the field of information technology, information and human resources have a major role and for the service based industries, human resources have the huge importance. Apart from this financial resources will be connected with each type of industries and projects. The department of project management in every industry has the responsibility to track the resources, utilize those

resources according to the budget and timelines of the project, ensuring no project is delayed and gets successfully completed within the given timeline and allocated budget.

To track the timelines, use of critical path is adopted. Similarly, for financial tracking, in the planning phase of the project the milestones are decided, which has the amount and work completion percent, and this acts as a benchmark while tracking the budget.

This work has been carried out on the basis of service based consulting firm in the area of pharmaceutical markets. The process which was setup for tracking of resource had some drawbacks and were not aligned with the overall budgets tracking. Therefore, it was necessary to optimize this process using the various optimization techniques available in project management. To optimize the process, it is necessary to understand the factors which have major contribution in the process and the differences between the expectations from the actual and proposed outputs of the process. To perceive the factors affecting the process, this work has implemented SIPOC analysis. It is also necessary to understand the problem statement and the flow of the process, this is a directory path for the further work that has been achieved by DMAIC methodology. DMAIC methodology have five phases namely defining, measuring, analyzing, improving and controlling. The detailed study of every phase and application of the possible tools, methods and analysis in every phase to get the expected outcomes has been completed by this work. Analysis of root causes is done with the help of fish bone diagram and multiple criteria decision making methods are used to decide the weightage and selecting the best alternative tool for the process.

Since the work is carried out for the pharmaceutical industries, the reporting of these resource is used to be on adhoc and frequent basis. This adhoc request used to take extra utilization of full time employees to provide the utilization reporting, as this utilization reporting used to be based on the utilization from different geographies, different drugs involved in the analysis work, type of request, brands of the drugs, FTE utilization and other factors related to the medicine science. While streamlining the process it was necessary to consider these frequent asks from stakeholders and create solutions for tracking these on regular basis. Considering all the parameters of the process this work has decided its objective as optimization of the resource utilization by reducing the time, minimizing cost required for the process, and enhance the accuracy and ease of the process. To achieve these primary objectives the selection of suitable data handling tool, and creation of project management dashboard using a suitable dashboard creating tool were considered as essential expected outcomes.

2. Literature Review

This section covered resource management and practical strategies for improving how human resources are used in various sectors. Nagaraju et al. (2015) reported that the management of resources has the vital role in completion of project in the allocated budget and timelines provided. This work has studied the resource allocation in construction business and the impact of resource allocation on the allocated budget. Zhang (2010) has described that the efficiency may be increased by using human resources in a logical and effective way. The assessment of the associated organizational components has been done and they put forth a two-way option model for the best distribution of human resources based on mobility.

Numerous authors have investigated improvisation and process mapping, a summary of their work is included in this section. Sujovaa and Marcinekova (2015) research speaks about the process improvement made in the wood processing industry of Slovakia based on the quantitative research through the questionnaires. According to this research optimization of process includes the analysis of the current implemented process and provided the best solution applicable for improvisation of the existing process. Zaman et al. (2014) reports about the mapping of process. Process mapping helps in understanding the flow of process. SIPOC (Supplier-Inputs-Process-Output-Customer's) analysis is used to map the process on more granular level. This analysis helps to understand the expected outcomes and the gap between current workflows.

The following section of the overview includes a summary of the literature for the process improvisation using the DMAIC approach. Smetkowska (2018) stated that DMAIC methodology is used to understand the problem and measuring the variables present in the problem. It also analyzed the problem, proposed a improvised solution and ways to control the established process. Mahto and Kumar (2008) determined that the root cause analysis approach helps identify the root causes affecting the process by analyzing the dependency of resources, collecting the data of the current process, evaluating tools used, methodology adopted and finding the major contributor impacting the process. Sadi-Nezhad (2017) reported about selection of project using Multi-criteria decision making methods, this

work stated that project selection is the indispensable part of the portfolio management. Selection of project is a procedure to study idea of each project and then selecting one project which creates the major impact to the firm. This work helps to know the method that are more efficient to choose regarding the selection criteria by order of preference. Leea and Chang (2018) elaborated the applications of multiple criteria decision making methods and the reasons for the MCDM methods to become popular in solving energy selection problems, Because these problems involve multiple and often conflicting criteria, and solving those conflict is the major application of these methods.

Mullinera et al. (2016) stated that each method has pros and cons as well as different application areas, none of the ways predominate over the others. The same multi-criteria decision problem can be solved by more than one method, leading to more reliable decision data. Taherdoost (2017) showed the precise method of managing the analytical hierarchy process. The most inclusive methodology for making decisions with many criteria is the analytical hierarchy process since it allows for the formulation of the issue as a hierarchical structure and accepts a combination of quantitative and qualitative factors. This work has also discussed how to formulate and analyze decisions using the analytical hierarchy method. Zhongyou (2012) developed applications for the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method, which constructs the best ideal solutions and worst idea solutions to problems of multiple attributes and uses the two benchmarks of being close to the best ideal solutions and being far from the worst ideal solutions as the criteria of evaluating the feasible projects.

The section below provides a summary of the key Performance indicator's data from the literature that was examined. Kousay (2018) found that key performance indicators are the parameters to measure, whether the process has reached its goals or not by comparing the results with the benchmarks for the process. Ferreira et.al (2019) showcased reports about the usage of key performance indicators, according to this research key performance indicators are used to compare the difference between the two values of the same parameter, so that it becomes easy to track the gap between the expected and actual results. Keeping this KPI as base industry can work on the improvisation of the existing processes. Kanellou et.al (2021) explains that to identify the major key performance indicators in a process the experts are asked to suggest the most impactful areas. For selecting the important parameters among large number of options present, this work has used the open-ended questionnaire and collected the responses from the experts in the industry, based on the inputs received this work has derived the key performance indicators for their process. Windmark et.al (2018) has used the KPI's to compare the cost of tools with respect to their performance for the different alternatives. Based on these comparisons the decision for the suitable tool required for the process was made. Also, the research suggested that every process has its flow and to keep the outputs of the process in a particular range, boundaries are required with some limits. To decide these limits key performance indicators plays a crucial role.

In the upcoming overview, the data gathered for the creation and implementation of the dashboard is described. Simone et.al (2021) reported about the development of satellite dashboard which allowed to see the dual space activities easily. Prior to this work understanding the data significant technical training was required, which is the main aspect covered by the work. The methodology used was to propagate the data for future weeks and analyze it on every step. which has given a comparative analysis for the predicted and actual approaches. Gareth W. Young and Kitchin (2020) reported the process of city dashboard creation which helped the administrator and policymakers, to solve the issues with skills and literacy to handle, process, analyze, visualize data for the city as they got clarity on numbers and easiness in process with the help of data visualization dashboards.

3. Methods

This work is about the improvement of Full Time Employment (FTE) based resource utilization reporting process. And has followed the process optimization process steps to achieve the desired objectives as shown in Figure 1.



Figure 1. Process Flowchart.

Process Mapping

For mapping the existing process with the help of available literature and project management techniques this work has performed SIPOC analysis. Consequently, the analysis has helped to figure out the factors which has the major dependency on the process.

The existing process was consisting of three data sources

- a) The issues that are requested for analysis by the stakeholders to the industry
- b) Estimated time by the Full time employees on the requests
- c) Time Billed by the full Time employees on the request

Tools and the people working on this project were the main variables driving these processes, according to SIPOC study. As explained in Figure 2, Estimated work hours on a request and the billed hours for fulfilling the request serve as the process's inputs. The procedure involved calculating utilization based on requests from the stakeholders and recording the results in excel sheets. The results were presented to the associated stakeholders as utilization reports for the employees.

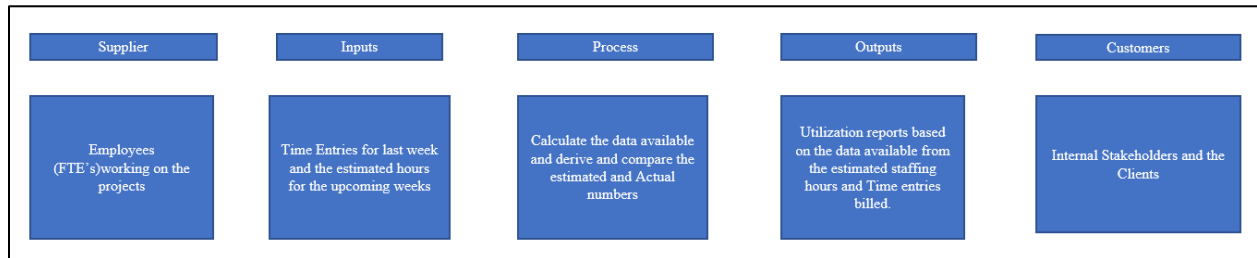


Figure 2. SIPOC Analysis

This work has researched the utilization reporting process in the literature and used DMAIC analysis to strengthen the process in order to address these shortcomings.

DMAIC

Define: The process's ineffective data handling tools and higher likelihood of manual errors have an impact on the amount of time and money needed to complete it. The process flow needed to be organized in order to increase efficiency and accuracy. The amount of time taken by the process was directly affecting the cost of the process.

Measure: This work has applied the open-end questioner method, for measuring the time required to run the process by the employees from different levels, and functional capability groups as reflected in Table 1. This questioner has also included questions for collecting the data that is required in regular utilization reporting process for the pharmaceutical clients. Responses were collected from the experts in the domain, for the qualitative data questions.

Table 1. Time analysis for the process.

Level of the employee	Data collection from Ontrack tool (Hours)	Staffing Tool	Time Entry tool
Associate	-	-	4 hours/week
Associate Consultant	-	2 hours/week	2hours/week
Consultant	-	1 hour/week	1hour/week
Project Management associate	2 Hours	2 hours/week	2.5 hours/week

Analyze: This work has carried out a root cause analysis, to examine the causes impacting the process. The root cause analysis was useful in identifying the problems, as shown in the Figure 3 it showed that the tools used in the current reporting process are ineffective for processing data, also the employees were making mistakes while providing input. The difficult procedure of providing inputs and tracking data with ineffective tools has often produced incorrect results.

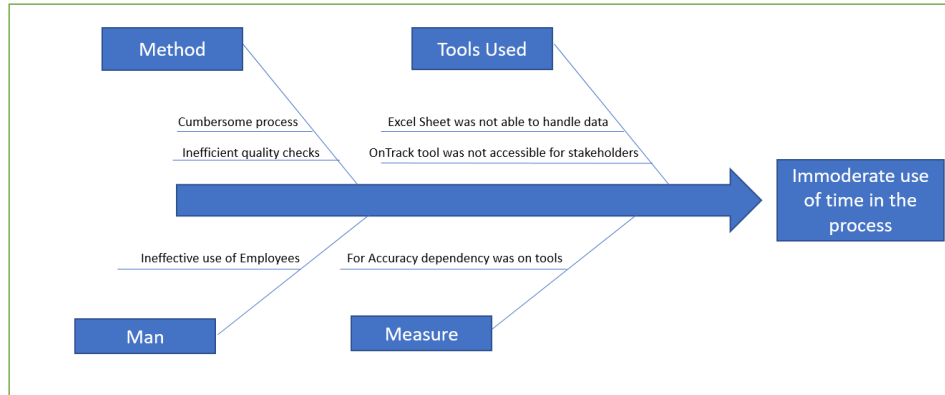


Figure 3. Root cause analysis.

This work has also analyzed the need to change the data handling platform. For enhancing the procedure and track the utilization work on granularity, implementation of Key Performance Indicators based on the various areas of the pharmaceutical domain. This analysis was done with the help of available literature review. The construction of a project management dashboard is another improvement suggested from this work in order to make these key Performance Indicators accessible and intelligible for the stakeholder

Improve: As the literature survey and analysis performed has suggested that there is need to adaption of efficient tools to administrate the process. This work has selected the Multiple criteria decision making methods to measure the weightage of the attributes of the criteria and select the best alternative tool among the options available. These criteria weightages are calculated with the help Analytical Hierarchy Process and alternatives selected with the help of TOPSIS method.

Selection of tool using TOPSIS and AHP method

Step1: Create the hierarchy for process.

This technique is utilized to determine the hierarchy of the process and establish the rankings through comparative analysis, as previously discussed in the literature review. Declare the process's goal and attribute. Make a hierarchy tree by placing the goal at the top, followed by the process qualities and alternatives as shown in Figure 4. The four attributes are Time (T), Cost (C), Ease of learning (E) and Data handling quality(Q)

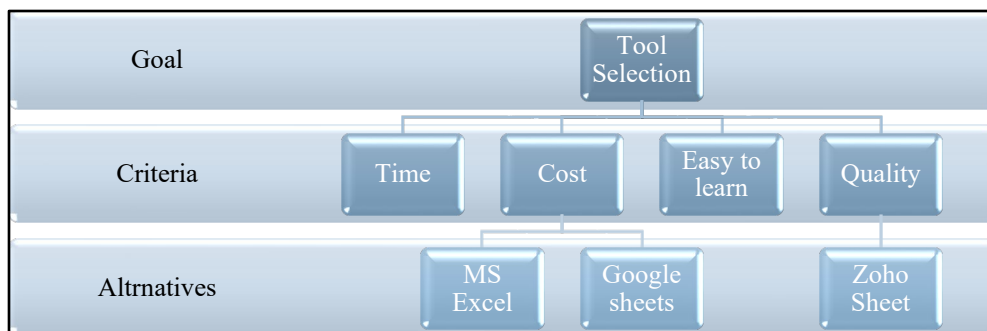


Figure 4. Process hierarchy.

Step2- Establish TOPSIS model

Step 2.1 Prepare the decision matrix containing Alternatives available and the attributes required as shown in the Table 2.

Table 2. Decision Matrix

Attributes/Alternatives	Time	Cost	Ease	Quality
Google Data sheet	4	4	2	5
MS Excel	3	4	4	2
Zoho	5	3	3	4

Step 2.2 As illustrated in Table 3, the next step is to prepare a normalized decision matrix.

$$R_{ij} = m_{ij} / \left[\sum_{j=1}^M m_{ij}^2 \right]^{1/2}$$

Table 3. Normalized decision matrix

Attributes/Alternatives	Time	Cost	Ease	Quality
Google Data sheet	0.56568285	0.624697412	0.371388249	0.745356429
MS Excel	0.424262137	0.624697412	0.742776499	0.298142572
Zoho	0.707103562	0.468523059	0.557082374	0.596285144

Step 3: Determination of weights by AHP Method

For obtaining the weightages of the attributes required, the implementation of AHP method is followed as next steps.

Step 3.1 The construction of the pairwise comparison matrix is depicted in Table 4 and the priority weight is determined in Table 5. These were the fundamental stages for obtaining the criteria weights of the attribute.

Table 4. Pair wise comparison matrix

Attributes	Time	Cost	Ease	Quality
Time	1	4	3	1/3
Cost	1/4	1	1/2	1/4
Ease	1/3	1/2	1	1/2
Quality	3	4	2	1

Table 5. Weights of attributes

Attributes	Weights
Time	0.3151
Cost	0.08918
Ease	0.1298
Quality	0.4658

3.3 Consistency Check

The consistency of the weights is confirmed by the consistency ratio, This ratio is calculated with the help of consistency of the studied matrix and random matrix by using the Consistency value (C.I), random index values are taken from the standard random index table.

$$C.I. = \left(\frac{(\lambda_{max} - u)}{u - 1} \right)$$

Correspondingly, the consistency ratio is employed to measure the consistency degree expressed as follows:

$$CR = \frac{CI}{RI}$$

where R. I. is the random consistency index which is dependent on the dimension of the matrix C, listed in Table 6.

Table 6. Random index

Matrix size	1	2	3	4	5	6	7	8	9	10
Random index value	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.49

C.R = 0.00723 < 0.1 thus the weights obtained by the analytical hierarchy method are consistent.

Step5: Determination of weighted normalized matrix

Weighted Normalized decision matrix:

Multiplying the weights obtained from the AHP method [Table 5] to the normalized matrix [Table 3] we obtain the weighted normalized matrix as shown in Table 7.

Table 7. Weighted Normalized decision matrix

Weights	0.315193228	0.089182922	0.129801251	0.465822598
Attributes/Alternatives	Time	Cost	Ease	Quality
Google Data sheet	0.178299403	0.055712341	0.04820666	0.347203869
MS Excel	0.133724553	0.055712341	0.096413319	0.138881547
Zoho	0.222874254	0.041784256	0.072309989	0.277763095

After getting the weighted normalized matrix, the Ideal best and ideal worst was decided with the help of formula as shown in the Table 8.

$$V^+ = \left\{ \left(\sum_i \max_{j \in J} V_{ij} \right) / i = 1, 2, \dots, N \right\}, \quad V^- = \left\{ \left(\sum_i \min_{j \in J'} V_{ij} \right) / i = 1, 2, \dots, N \right\}$$

$$= \{V_1^+, V_2^+, V_3^+, \dots, V_M^+\} \quad = \{V_1^-, V_2^-, V_3^-, \dots, V_M^-\}$$

where $J = (j = 1, 2, \dots, M) / j$ refers to the beneficial attributes, and $J' = (j = 1, 2, \dots, M) /$ refers to the non-beneficial attributes.

Separation values are obtained after getting the ideal best and worst solution by Euclidian distance and the obtained values are as shown in Table 9.

$$S_i^+ = \left\{ \sum_{j=1}^M (V_{ij} - V_j^+)^2 \right\}^{0.5}, \quad i = 1, 2, \dots, N$$

$$S_i^- = \left\{ \sum_{j=1}^M (V_{ij} - V_j^-)^2 \right\}^{0.5}, \quad i = 1, 2, \dots, N$$

Table 8. Closeness value

Ideal value	Time	Cost	Ease	Quality
Vj+	0.222874	0.041784	0.096413	0.347204
Vj-	0.133725	0.055712	0.048207	0.138882

Table 9. Separation value

Alternatives	Si+	Si-
Google Data sheet	0.0671177	0.213037806
MS Excel	0.2270239	0.04820666
Zoho	0.073505	0.167364021

From the separation values the relative closeness of the particular alternatives is measured. And based on the relative closeness the rankings are given to the alternatives available

$$P_i = S_i^- / (S_i^+ + S_i^-)$$

Table 10. Ranking order of alternatives

Alternatives	Pi	Rank
Google Data sheet	0.7604269	1
MS Excel	0.1751501	3
Zoho	0.694834	2

By using TOPSIS method this work has concluded that Google sheet is the ideal best solution among all the tools present as shown in the Table 10.

Control: The replacement of data handling tool added the effectiveness to the process, to control the newly adopted tool and make the reporting process simpler this work has derived the Key Performance Indicators. These KPI's are based on the utilization of full time employees and their inputs recorded in the data handling tools. While studying the previous work on KPI's this work has analyzed some of the existing KPI's and their usages in the respective industries.

In the service based industry, primarily associated with pharmaceutical clients the reporting is also associated with the areas of medical terminologies. Thus, the work has gathered data from the industry expertise to decide the KPI's, this experiment is completed by circulating the open end questioner among the higher level management and stakeholders associated with the reporting process.

This work has derived the five KPI's to show the granular level utilization reporting process based on the pharmaceutical terms.

1. Full time employee utilization
2. Utilization based on location
3. Utilization by Therapy area
4. Utilization by type of work
5. Utilization by medicine brand

This work has implemented the best alternative tool available but as there is some involvement of employees, probability of error remains in the process. For tracing the inputs inserted by employees this work has added some quality checks to the process to control the errors in data inputs. This process has weekly cadence, so the quality checks are also performed on weekly basis.

Quality checks implemented into the process to check the billed estimates and logged hours are correctly tagged:

1. Historical estimates but no billed hours
2. Total estimates = 0
3. Future Estimates = 0
4. future estimates >=100
5. Sum of Total logged - Sum of future estimates >=+- 10

This study has worked on making the utilization reporting process more user friendly, for achieving the desired objective this work has implemented the Project Management Dashboard for utilization reporting of employees using the Google data studio dashboard.

4. Data Collection

Data collection plays a significant role in the understanding of any process. It helps to distinguish the factors affecting the process, root causes associated with the problems present in the process. Also, only analysis of data can help to select the alternative options available to replace the existing process. This work is based on the utilization of human resources working in the pharmaceutical consulting firm. Human resource utilization is a key aspect in every projects management, and the time of the employee working is the main constrain of the process. This work has calculated the

time of employees in terms of full time employee (1 FTE = hours/week/person). Data collected here is issues created on JIRA platform, work that has received from stakeholders is transformed through JIRA platform. The staffing hours estimated on a request by an employee in the current and upcoming weeks and the time billed by the employees on a request that they have worked, this time entries are the main data base for this work.

5. Results and Discussion

5.1 Numerical Results

After the implementation of Google sheets as the tool for data handling, the process has been able to reduce the time from different levels of employee as shown in table below.

The process used to take 16.5 FTE hours and after the change in tool this number has reduced to 6.75 hours. This has reduced the total 9.75 FTE hours per week as shown in the Table 11.

Table 11. Time analysis after improving the process

Level	Data collection from JIRA tool (Hours)	Staffing Tool	Time Entry tool
Associate	-	-	1.5 hours/week
Associate Consultant	-	1 hour/week	1 hour/week
Consultant	-	0.5 hour/week	0.75 hour/week
Project Management associate	1 hour/week	0.5 hour/week	0.5 hour/week

Cost Associated with the process

Table 12. Cost analysis

Level	Billing Rate	Before	After
Associate	\$ 40.00	\$ 160.00	\$ 60.00
Associate Consultant	\$ 60.00	\$ 240.00	\$ 120.00
Consultant	\$ 70.00	\$ 210.00	\$ 87.50
PMO Associate	\$ 35.00	\$ 227.50	\$ 70.00
Sum		\$ 837.50	\$ 337.50

The cost and time are the dependent constraints of every project, this work has improved the required time to run the process, so the cost associated with the project has also reduced by \$500 per week as replicated in the Table 12.

This Work has derived the Key Performance Indicators based on the utilization of full time employees and reflected them on granular level terminologies of pharma industry.

- a) Utilization by location: The KPI has examined the work by location based on where the stakeholders that made the request are located, as indicated in Table 13.

Table 13. Utilization by location

2 weeks back	Sales
Bangalore	8%
Pune	92%
Last Week	Sales
Bangalore	7%
Pune	93%

- b) Utilization by top brands: The data shown in Table 14 represents the top medicine brands contributing in the utilization of full time employee.

Table 14. Utilization by top brands

Brands (No. of Requests)	Share
Cipla (n=5)	15%
Lupin (n=4)	13%
Sun pharma (n=4)	9%
Biocon (n=2)	6%
Marksans (n=1)	6%

- c) Weekly Utilization of employees: This KPI reflect the percentage utilization of the employees in each week, by comparing the time they have estimated for a work and the time billed for that work. For the future weeks billed time is considered as estimated time only
Estimated time = (No. of employee * 40) Hours – Hours estimated on holiday ticket (Table 15).

Table 15. Weekly Utilization of employees

Week reference	Time Billed (Hours)	Estimated Time (Hours)	Utilization %
Current -3 week	575	580	99.00%
Current -2 week	733	709	103.00%
Current -1 week	718	740	97.00%
Current week	611	676	90.00%
Current +1 week	622	715	87.00%
Current +2 week	578	715	81.00%
Current +3 week	476	715	67.00%

Utilization by type of work: The efforts spent by the employees are segregated according to the work type as shown in the Table 16.

Table 16. Utilization by type of work

Week Date	Diagnostic	Reporting	Promotional & Pricing	Research	Forecasting	Sales	Analog	Social Listening
20 th Jun	23%	25%	12%	10%	1%	3%	2%	18%
27 th Jun	21%	19%	15%	23%	0%	4%	1%	14%
4 th July	20%	19%	9%	24%	0%	1%	0%	15%
11 th July	24%	15%	2%	31%	0%	3%	0%	17%

- d) Utilization by Therapy area: The work performed by the staff is divided into various therapy areas in consideration of the main therapeutic specialties, this classification makes it easier to comprehend how much effort is put into each therapy field (Table 17).

Table 17. Utilization by Therapy area

Therapy Area	Utilization%
Neurology	3%
Gastroenterology	4%
Respirology	2%
Orthopedics	6%
Hematology	5%
Ophthalmology	2%
Others	2%
Immunology	37%
Oncology	39%

To make the utilization reporting process, this work has studied about the project management dashboards used to track the project activities. Keeping the several parameters in consideration such as learning curve, cost and ability to connect the various data sources, Google data studio dashboards are selected. This dashboards helps to stakeholders to fetch the required data in no time because of the customization added in the dashboard (Figure 5).

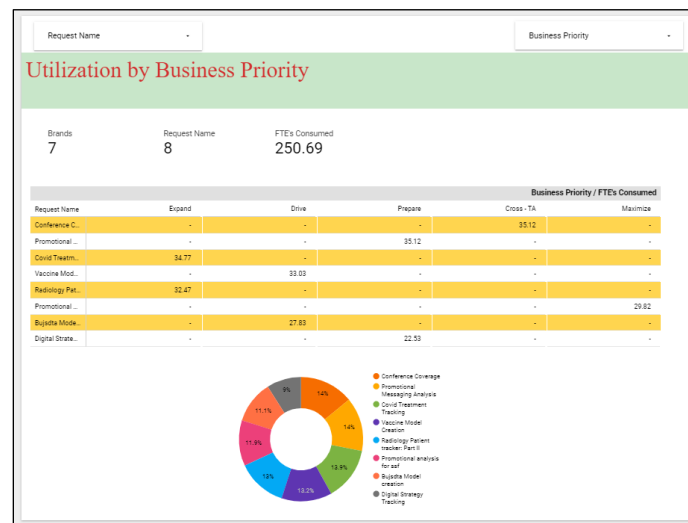


Figure 5. Project management dashboard

6. Conclusion

- This work has identified the flaws of the existing process by using the SIPOC analysis.
- The DMAIC methodology has improved the process by capturing the root causes for the inefficiency in the process. Also, it has used the MCDM methods to select Google sheets as the best alternative tool for administrating the process.
- Key Performance Indicators are implemented to keep the track of the process, and for keeping the track of these KPI metrics this work has implemented the project management dashboard using Google data studio platform.
- The implemented tool has helped to reduce the time by 9.75 hours/week, resulting in 59% total time saving to run the process.
- The reduced time for the process has resulted in the cost saving by \$500 per week, this has affected the cost reduction by 62%.

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Biographies

Onkar Vijay Mandawad is an engineering Graduate student completed his BTech in Production Engineering from Shri Guru Gobind Singhji institute of Engineering and Technology in 2019. Currently he is pursuing his master’s in Project Management specialization, Department of Manufacturing Engineering and Industrial Management from College of Engineering Pune.

Dr. M. R. Dhanvijay is presently working as Associate Professor in Department of Manufacturing Engineering and Industrial Management, College of Engineering, Pune, Maharashtra. He had completed his Ph.D. in Mechanical Engineering and master’s in Mech-Production Engineering, he has also completed his M.B.A in Material Management. He has a teaching experience of around 18 years. He had also published over 21 Research Papers in national and International Journals and Conferences in the area of advance manufacturing engineering.

Dr. B. B. Ahuja is a senior faculty at the Department of Manufacturing Engineering and Industrial Management, College of Engineering, Pune.

Dr. S. M. Patil is presently working as Assistant Professor in Department of Manufacturing Engineering and Industrial Management, College of Engineering, Pune, Maharashtra. He had completed his Ph.D. in Production Engineering and master’s in Production Engineering. He has a teaching experience of around 12 years. He had also published over 10 Research Papers in national and International Journals and Conferences.

Ankita Mishra is presently working as a senior project manager- PMO in ZS associates, she has total experience of 7 years of in project management. she had also published over 3 Research Papers in national and International Journals and Conferences.