Workforce management decisions in IT services organizations: A hybrid model based approach

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Abstract

A services organization's profitable growth is dependent on its ability to have the right number of people with right competencies in the right location at the right time at optimal cost. Effective workforce management (WFM) decisions at strategic, tactical and operational level are critical to achieve this. Operational decisions include the matching and assignment of workforce to the project positions. Tactical planning refers to medium term decision making to determine the number, skill mix, location and experience bands of the workforce to be maintained in order to cater to the demand (project positions) in a planning horizon of a month, a quarter or a year. This includes decisions related to hiring, training and firing of workforce during a plan period. At the strategic level, human resource and business policies which guide operational & tactical planning decisions are generated, evaluated and decided.

Indian Information Technology (IT) services industry revenue was 146 billion US Dollars in the financial year 2015 with a growth of 13% year on year. With the automation challenges and protectionism in the major markets, the Indian IT services industry needs innovative WFM approaches to continue its growth story.

Given the complex decision scenarios for WFM, their short-term and long-term impact on the services organizations' ability to achieve profitable growth, good quantitative model based Decision Support Systems (DSS) are a necessity. These models range from mathematical to simulation models and each of them are best suited for addressing specific WFM decisions. There have been studies on hybrid model based

approaches for decision systems to use the benefits of different types of models. It has been shown by research that integration of model based DSSs improves the decision support performance. In the case of IT services industry, while the Key Performance Indicators (KPI) are common across the industry the methods to achieve them vary from one organization to another. Hence, off-the-shelf Workforce Management Decision Support System (WFMDSS) solutions are not easily usable. The number of publications on model based approaches for WFM of IT services industry is less compared to those for manufacturing, healthcare services, container terminals and such other industries. The discussions with workforce management professionals of some of the leading IT services companies in India also indicate that model based workforce management decision support systems are not very commonly used and those used address specific WFM decision scenarios. Thus there is a need for a model based approach which addresses the three levels of WFM decisions in IT services industry. This work is an attempt to fulfil this need.

In the first part of this work, a hybrid model based approach is identified to cater to this need. In the second part of this work, the feasibility of the identified hybrid model based approach is established and the benefits of using the same is demonstrated through improvements in KPIs.

The identification of the hybrid model based approach was done through a conceptual analysis of the various models and their usage followed by a systematic literature survey based analysis of the papers addressing WFM decisions through model based approaches. Papers were identified with an appropriate search criteria and classified based on the WFM decision(s) that each of them addressed and the model based approach that they used. Through appropriate statistical tests, for each of the WFM decisions and their combinations the model based approaches used to address them were ranked. This ranking was corroborated by conceptual analysis of the model

based approaches and the inputs gathered from practitioners in the IT services industry. Finally, it was concluded that a hybrid model based approach consisting of a simulation model and a mathematical programming model will address the three WFM decisions for IT services industry. Based on the decision scenarios that were considered for the three WFM decisions in this work, a Discrete Event Simulation (DES) model and a Binary Integer Linear Programming (BILP) model were chosen for the next step to establish the feasibility and demonstrate perceivable benefits.

After careful consideration of different hybrid model architectures, it was decided to use an architecture in which a simulation model is used to model the total system taking in values for a portion of the system or input parameters, from a mathematical model. Specifically a DES model is used to model the system and a BILP model is used to do optimal assignment on daily basis through the plan period.

Using established methodology a BILP model and a DES model were formulated for the IT services industry and integrated as per the chosen hybrid architecture. This was subsequently customized for a particular IT services organization. The customizations were necessitated due to the process steps and information tracked by the organization while retaining the commonly used KPIs of the IT services industry to assess the business impact. None of the customizations were due to feasibility issues.

The business impact was assessed using the KPIs used in IT services industry namely Revenue, Utilization, Average Cost to Company (ACC) and Labor Rate Multiplier (LRM). The KPIs of the actual data obtained from the organization for a financial year was computed. The developed hybrid model was used to generate plans for the same financial year with and without using the mathematical model for optimal assignment. Results from several such runs were compared through statistical tests. It was found that there were significant improvements in all four KPIs.

In order to demonstrate support for strategic policy evaluation decision scenario, a retraining policy was introduced in the model and through plans generated for the same financial year the impact of training on KPIs was studied. The training was introduced into the hybrid model and executed with and without using the mathematical model for optimal assignment. Significant improvement in all KPIs was observed. On comparing the KPIs from runs with retraining to those without retraining, it was observed that retraining introduced significant gains in Utilization without any significant impact on other three KPIs.

Thus, it was shown that the hybrid model based approach was feasible and resulted in significant positive business impact. It was also shown that retraining policy results in significant improvement in Utilization.

This hybrid model based approach is a unique attempt for the IT services industry. This can be used as a reference platform for further research to explore various combinations of models and evaluate policies for IT services industry. The work can serve as a reference for IT services organizations to create their own WFMDSS. WFM products can be enhanced with this approach and enable organizations to customize as per their requirements. This work can be extended to other industries and to include more sophisticated competency matching algorithms to enhance the performance of the WFMDSS further.

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List of Abbreviations

- **AAR:** All Account Rotation
- **ACC:** Average Cost to Company
- **AvTIA:** Average Tenure In Account
- **BILP:** Binary Integer Linear Programming
- **BR:** Bill Rate
- **CP:** Constraint Programming
- **CPI:** Cost Performance Index
- **DES:** Discrete Event Simulation
- **DP:** Dynamic Programming
- **DSS:** Decision Support System
- **GP:** Goal Programming
- **HM:** Hybrid Model
- **IP:** Integer Programming
- **IT:** Information Technology

- **KPI:** Key Performance Indicator
- **LP:** Linear Programming
- **LRM:** Labour Rate Multiplier
- **LSCM:** Logistics and Supply Chain Management
- **MC:** Monte Carlo
- **MIP:** Mixed Integer Programming
- **MM:** Mathematical Model
- **MP:** Markov Processes
- **NR:** No Rotation
- **OA:** Optimal Assignment
- **OADS:** Organization Account Data Set
- **OP:** Operational
- **PE:** Policy Evaluation
- **QM:** Queuing Model
- **QP:** Quadratic Programming
- **RL:** Rotation Limit
- **RQ:** Research Question
- **SAR:** Specific Account Rotation
- **SD:** System Dynamics

- **SM:** Simulation Model
- **SME:** Small and Medium Enterprises
- **SPI:** Schedule Performance Index
- **ST:** Strategic
- **TDS:** Test Data Set
- **TP:** Tactical Planning
- **TRE:** Total Relevant Experience
- **WFM:** Work Force Management
- **WFMDSS:** Workforce Management Decision Support System