

An Indian-Australian research partnership

Project Title: Automated Planning in Workforce Management

Project Number IMURA0375



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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?

(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1. **Advanced computational engineering, simulation and manufacture**
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research

The research problem

The importance of an efficient and robust workforce schedule is paramount and well established in service industry. Workforce expense is one of the largest controllable expenses, hence it is essential to plan and manage workforce meticulously to meet organizational objective e.g. to meet the customer demands at desired service levels.

Workforce management, at operational decision making level, is about assigning right employees with of right skills to right job/work at right time, so as to

- Optimize labor hours, thereby improve payroll cost and labor productivity
- Improve customer service, thereby improve sales and margins
- Improve employee satisfaction thereby reduce staff turnover rate.

The workforce management (scheduling) process comprises of steps as forecasting the staffing requirements, scheduling the employees, and controlling the schedule. The process involves forecasting staffing requirements (i.e. number of people required for each skill/job) at the desired level of granularity, and then assigning individual associates to shifts as well as jobs such that requirement is met maximally with minimal wasted resources, while considering various rules related to associates (like shift rules, break rules, minor rules, pay rules) and organizational policies (minimum staffing requirements and closing shifts rules). It answers questions like, how many people are required to satisfy forecasted business volume, which employee should be allocated for doing what work (job) at what time (day & start time) for how long (length of period)?

Workforce scheduling of several varieties is well studied topic in both academic as well as trade literature. Abundant literature is available on application of various techniques to **generate workforce schedule from scratch** and is been applied to various industries. The solution methodologies typically use statistical techniques of forecasting (time-series, regression etc.) to generate business forecast and exact (LP/MILP) as well as meta/heuristics (SA, GA etc.) based optimization techniques to schedule employees.

What would be interesting to study are:

- Once these automated schedules are generated, the users (generally managers) modify them to suit their outlook. How can one use machine learning to capture and then include the users' desires in the automated process itself to create adaptive schedulers?
- The technique suggests that schedules/plans are always synthesized every week by balancing the predicted demand and supply for that week. Assuming that for most weeks, except for special occasions, the expectations are of small changes to the actuals observed in the preceding week, how can one period's schedule be modified to address only the small demand/supply deviations of the next period, avoiding all the CPU power needed in the standard approach above?
- The techniques described in literature and above will minimize the imbalance of demand and supply, but there is nothing to prevent the imbalances to be localized in the temporal dimension (e.g. at a particular hour of a day or a day of the week). In situations where the organization needs several people of several skills and the people are multi-skilled, the imbalance may also get localized in a skill or two or in a handful of the individuals. How can we improve the model and solution technique to prevent such concentration of the bad things?
- Three methods have been suggested to convert the business forecasts into workload forecasts. Given the inherent error in all forecasts at the granularities at which they are computed, what alternate methods can be devised that do not need expensively/laboriously measuring productivity, or service standards yet the support the same level of business efficiency?

Project aims

The research work focus on investigating methodologies to 1) to develop workforce schedule from existing schedule (instead of generating it from scratch) either using schedule templates or using the schedule deployed in the past so that generated schedule will match current weeks demand and employee availability and preference, such that new schedule would include users' desires (learnt from past modifications).

Expected outcomes

The research work should aim to build methodology/models to develop schedule using existing schedule with minimal changes in least amount of time using fewer computational resources.

- Literature review
- Development of a formulation and approach to the workforce scheduling problems, where schedule is not being generated from scratch
- Methods and techniques to solve above mentioned problem
- Presentation of results.

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

It is expected that the project will involve advanced computational engineering and simulation, and techniques like machine learning and pattern recognition to generate new schedules from existing schedule in least amount of time using fewer computational resources.

Capabilities and Degrees Required

Engineering Graduate with background in industrial engineering and operations research or computer science.