A Comparison Analysis Study to Analysis Optimization Timetable to Support Work-Life Balance

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ABSTRACT
Scheduling academic staff timetable is important to avoid the classes clash or redundancy between teacher and student timetable. A good timetable allow the student and teacher time management with a good healthy and work-life balance. However, with the scheduling academic staff timetable may use many procedure to get efficiency result. Therefore, this paper is provides a gap of study for existing work on optimization timetable regarding their research purpose. This research report our findings from review and analysis of different studies. The strengths and shortcomings of the features and utility are also discussed in order to offer a better understanding of the research's gaps and weaknesses. This study concludes that these studies are still in their infancy and require additional improvement.

General Terms
Optimization Timetable

Keywords
Timetable, Optimization, Work-Life Balance

1. INTRODUCTION
Timetabling problems have received a lot of attention due to their wide range of applications, such as the flight timetable problem, employee timetabling problem, university or high school timetabling problem. However, it is more sophisticated than generic schedulingas it involves teachers, students, classrooms, and courses. Course scheduling has always been performed manually. Course scheduling can take a long time and need a lot of manpowerbecause to the wide range of constraints, resource limits, and intricate human aspects involved. Using computers to schedule courses, on the other hand, not only consolidates the preferences of the individuals involved, but also allows for great satisfaction despite the numerous limits. Obviously, this results in saving a lot of time and thus manpower. Therefore, automation scheduling timetable is necessity selection of algorithm.

Furthermore, scheduling timetable of academic staff is very important so that working time of academic staff can be optimize and balance. Therefore, balance of working time is a necessary and crucial. However, failure work-life balance for scheduling teacher timetable may resulted a quality of teaching and learning.

In this paper, a review on existing works and tool support to optimization timetable are presented. The following is where the paper is structured: Section 2 discusses the study's context. Section 3 consists of survey literature. Section 4 then depicted a discussion of overall finding, which includes a description of its comparison analysis. Finally, Section 5 concludes with a conclusion and future work.

2. RESEARCH BACKGROUND

2.1 Definition of Timetabling
Timetabling was defined by Wren [1]as “Timetabling is the allocation, subject to constraints, of given resources to objects being placed in space-time, in such a way as to satisfy as nearly as possible a set of desirable objectives”.

2.2 Definition of Swarm Intelligence
Swarm intelligence is a relatively recent problem-solving strategy that was identified through simplified social behaviour model simulations of insects and other animals[2]. It is inspired by the collective intelligence of swarms of biological populations. The algorithms of ants, bees, wasps, termites, fish in schools, and birds in flocks have all been studied computationally.The Ant Colony Optimization (ACO) algorithm is a meta-heuristic optimization technique inspired by biological systems that computes the shortest path between a source and a destination in order to find optimal solutions.

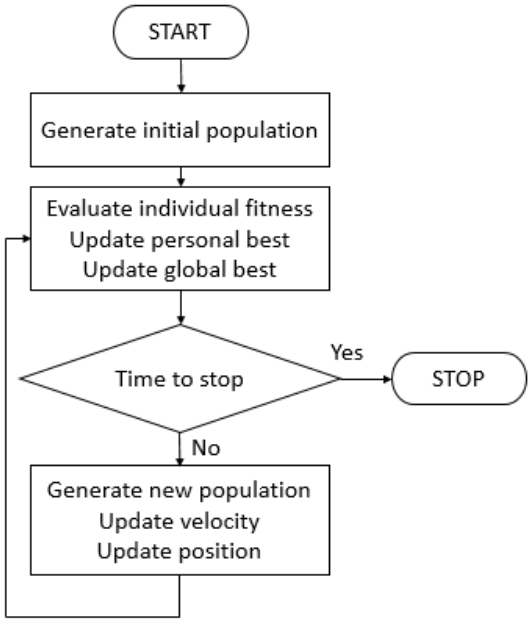

Fig 1: Flowchart of Particle Swarm Optimization algorithms[3]

The Particle Swarm Optimization(PSO) algorithm combines local and global search methods in an attempt to balance exploration and exploitation. The ABC algorithm is one of the most recently optimized algorithms. It is also a meta-heuristic algorithm based on swarms. Figure 1 provides Particle Swarm Optimization algorithms flowchart.

2.3 Definition of GA
Genetic algorithms, which are a type of gradual

developmental algorithm, are influenced by the process of natural selection. Natural selection begins with the selection of suitable individuals from a population [4]. GAs are a type of approach that may be used to address these problems quickly. They are founded on genetics and natural selection principles, with the primary notion being that the fittest individuals in a population are selected, and subsequently recombine or mutate into new forms to establish new groupings[5]. Figure 2 provides Genetic algorithms flowchart.

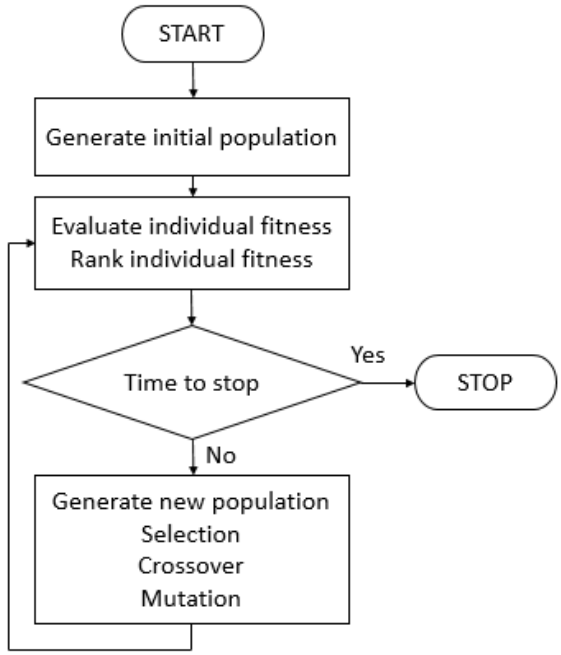

Fig 2: Flowchart of Genetic algorithms [3]

2.4 Definition of Work-Life-Balance

Duxbury [6] had defined work life balance as a mix of role overload, work-family interference, and family-work interference. Work-life balance is described by Hill, et al. [7]as a person's ability to manage the emotional, behavioural, and temporal demands of paid work, personal, and family duties at the same time.

In order to overcome the problems defined above, many approaches, methods, model, framework and tool have been developed to ease workers/employee including optimization timetable. However, according to existing study, there is a necessity for enhancements on the tools that help optimization that support WLB.

3. RELATED WORK

There are much of study of scheduling such as Fuzzy, Swarm Intelligence optimization method.
PSO is comparable to evolutionary computation approaches like SI inspired optimization algorithms like ACO, PSO, and ABC optimization algorithms.

Rashmi and Arbhishek[8] developed an approach using prediction algorithm with combining genetic algorithm and particle swarm algorithm. Automated timetable generation enhances the quality of the education institutes and tends to greatly reduce time and manual efforts. The Prediction Algorithm uses the advantages of the two Artificial Intelligence algorithms to generate more valid timetable output aiming to provide maximum allotment. However, this study is limited to consume work-time balance talent by the educators.

Liu et al.[9] proposed a timetable optimization problem for maximising regenerative energy utilisation in a subway system with headway and dwell time control. They created an artificial bee colony algorithm and ran numerical experiments on data from a Chinese subway line to compare it to the Genetic Algorithm. According to the results of the experiments, the artificial bee colony outperforms the genetic algorithm in solving timetable optimization problems. However, there is a scarcity of work for studies on work-life balance.

Wang et al. [10] developed a particle swarm optimization technique based on a genetic algorithm, in which the position vector and genetic evolution operators are reconstructed based on each train's departure and arrival timings at stations. Retiming, reordering, and altering stop pattern are examples of timetable rescheduling procedures. The real-world case study validates the proposed method's efficacy. Furthermore, the case study sheds light on the relationship between delay propagation and headway. They must, however, conduct more train operations and rescheduling strategies in data learning methods, as well as improve in future studies.

Knutsater and Sandh[11] proposed a standardised model using a Particle Swarm Optimization (PSO) algorithm based on data from Malmo University. The goal of this study is to see if uncertainty can be used as a primary variable during scheduling when considering events that need to be rescheduled. PSO can be used to provide a fitness score to assess the feasibility of a solution. According to the findings, there is a reduction significant of this study. However, this study only evaluates the PSO algorithm and does not evaluate the WBL.

Omar et al. [12] proposed the Whale Optimization Algorithm (WOA) as the most recent metaheuristic algorithm to be used for solving NP-hard problems. For tuning the main parameter of WOA under different MapReduce applications, a different initialization strategy and cluster-based approaches will be used, which helps to control exploration and exploitation. Accelerate the convergence of meta-heuristic technique with quality solution based on findings. A proposed model for improving the current SI by improving WOA as an example, which has the potential to be replicated to other SI algorithms but requires more algorithm development and experimentation.

Mehmet [13] proposed a hybrid approach combining Genetic Algorithms (GA) and Ant Colony Optimization (ACO) for Integrated Process Planning and Scheduling (IPPS) problems. A GA is combined with a local search strategy based on the interior point method in the new hybrid optimization technique (hAG). By solving a constrained multi-objective mathematical test-case, the efficiency of hAG is demonstrated. The experimental results with AIS (Artificial Immune System), GA, and ACO show that the proposed model outperforms other non-hybrid algorithms in various scenarios. Furthermore, this study experimentally demonstrated that ant colony optimization outperforms the genetic algorithm in large-scale problems while the genetic algorithm outperforms ant colony optimization in small-scale problems.

Zandavietal [14]proposed a hybrid optimization technique that combines the Nelder-Mead Simplex algorithm with the Non-dominated Sorting Genetic Algorithm to optimise the scheduling problem for distant laboratories to coordinate

shared access (NSGA). The hybridization of the Nelder-Mead simplex and non-dominated sorting genetic algorithms results in significant time savings and accuracy when dealing with scheduling challenges. However, a work of WBL is lacking in this study.

Irene et al.[15]developed a hybrid PSO-local search (LS) and the second one is hybrid PSO-constraint-based reasoning (CBR) for Solving University Course Timetable Problem. According the finding, they found that hybrid PSO-CBR algorithm is capable in finding feasible and near-optimal solution compare to hybrid PSO-LS and standard PSO algorithm. However, the plan provide more experiment in different scheduling area using the hybrid PSO-CBR algorithm.

4. RESULT AND DISCUSSION

This research compare the eight existing works related to optimizing timetable for WBL. The comparison features based on methodology/approach/technique as shown in Table 1.To developed scheduling timetable, a proper requirements must be considered to encourage the positive effectiveness and success of development that able to support work-life balance. However, current works and tools do not provide a proper approach such as there is none tool developed to support WLB. Thus, it is necessary to have a tool for supporting WLB specifically in academic level. We have conducted a review on the four studies Swarm Intelligent and Genetic Algorithm. A two studies was found work on the framework that provide hybrid in PSO and GA.

Based on our review as shown on Table 1, this research found that there are various models used by optimize the timetable that supporting swarm intelligence. Based on the analysis, the analysis support genetic algorithm and analysis are required process to optimize the timetable. Further, most of tools is lack to support timetable. In this respect, this research believe that there is study related to the optimization for scheduling timetable but there is lack of method to work-life balance for academic timetable where automation scheduling of academic timetable

Table 1. Comparison technique of scheduling in WBL

		Technique						Method/ Framework/ Tool		Approach/			
Year	Name	PSO	Simplex Algorithm	Genetic algorithm	Whale Optimization Algorithm (WOA)	Ant Colony	Bee Colony	Model	Method	Approach	Framework	Tool	WLB
2019	Wang [10]	✓		✓				✓					
2021	Rashmi and Arbhishek[8]	✓		✓							✓		
2018	Liu[9]						✓	✓					
2019	Knutsater and Sandh[11]	✓						✓					
2020	Omar et al. [12]				✓			✓					
2018	Mehmet et al. [13]			✓		✓		✓					
2020	Zandavi[14]		✓	✓				✓					
2013	Irene, Deris and MohdHashim[15]	✓						✓					
	Total	4	1	4	1	1	1	7	0	0	1	0	0

5. CONCLUSION

It is critical to schedule academic staff timetables in order to avoid class clashes or redundancy between teacher and student timetables. Most academics do not have a proper timetable, which encourages them to put in less effort in school. As a result, this paper fills a research gap in existing work on optimizing timetable scheduling for research purposes. This research present the results and analysis of various studies on optimizing timetables that support WLB. The strengths and weaknesses help to understand the limitations of the current approach. This research can conclude that the current state is deficient and requires further improvement. In future work, this research intend to develop a framework and an automated tool to optimise timetable scheduling with a work load factor to support academic work-life balance. This tool will assist the academic monitoring academic timetable and performance.

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