

A Review of Applications of Genetic Algorithms in Operation Management

Mohd. Imran Khan¹, Anuj Gangwar², Mr. Manish Gupta³

^{1,2}Dept of Mechanical Engineering

³Asst. Prof, Dept of Mechanical Engineering

^{1,2,3}Rajshree Institute of Engg. & Technology, Bareilly, India

Abstract- Numerous choice in operations management (OM) have a place to the course of Non-deterministic Polynomial difficult issues and in this way heuristic look strategies have been connected to progress OM choices. Whereas genetic algorithms (GAs) are promising apparatuses for looking quick and great arrangements in different OM ranges, future inquire about will advantage from a survey of the OM issues solved by GAs. The reason of this paper is to analyze the survey on OM with GA-based way and to propose possible difference from the point of view of analysts and professionals. A total of 119 peer surveyed journal papers published from 2007 to 2017 are looked into and analyzed methodologically. The function of GAs in OM are divided into process and product design, operations planning and control, and operations improvement. Perception from the existing literature are displayed and future inquire directions are proposed. In spite of the fact GAs have been one of the foremost well-known heuristic approaches for optimization, there are OM problems that are yet to be investigated. The discoveries of this review clear the way for future inquire about to apply GAs to solve OM issues.

Keywords- Operations management, Genetic algorithms Review

I. INTRODUCTION

Operations management (OM) is the action of overseeing the assets that make and provide administration and items (Slack et al., 2013). All organizations need operations to produce some mix of services and products. In any organization, three core functions are the promoting work, product/service improvement work and operations work. The advancing work is capable for communicating the administration and items to its markets to produce customer demand; the product/service advance work is responsible for coming up with modern or adjusted services and items to produce future customers' demands; the operations work is capable for making and transport services and products based on customer demand. In practice, however, there is not a clear division among these three functions while there exist other support functions enabling the core functions. From a wide

point of view, OM must connected with all other capacities of an organization and hence comprises all activities necessary for the day-to-day satisfaction of customer demand. Numerous choices in OM can be characterized as complex optimization issues that require a heuristic search strategy.

OM is a dynamic inquire about zone profited from the utilize of artificial intelligence (AI) techniques such as genetic algorithms (GAs) within the search for quick and great solutions to numerous practical issues. whereas GAs appear to be promising device for solving OM related issues, an efficient survey of applications of GAs in OM can offer assistance analyst to recognize potential inquire about zones future directions.

The aim of the paper is to examine OM utilizing GAs as valuable device, either as a standalone strategy or facilitate with other appropriate methods. Be that as it may, for ease of piece, a few improvement of Gas within the survey are not included. To begin with, though GAs are included within the development computation (DC) field, other DC strategies or Darwinian approaches are not included in this paper. This can be since these approaches merit a partitioned review. For a detailed literature survey of bio-inspired computing calculation, pursuers are referred to a later survey by Kar (2016). Second, in line with the center of this paper, the hypothetical advancement of the calculation are not investigated. There are numerous variations of GAs such as variable-length GAs and fuzzy GAs. Details of the alteration of the calculation are not talked about here. Instead, this paper centers on the applications.

Given the developing number of GA functions, a number of papers studying its functions have been distributed regularly. Coello (2000) given a survey of GA-based multi-objective optimization procedure. The discussion was at the specialized side, and hence the functions of OM were not secured. Aguilar- Rivera et al. (2015) checked the GA functions in back. In expansion to GAs, moreover surveyed other strategies based on Darwinian advancement such as genetic programming, learning classifier framework, multi-objective developmental calculations, evolutionary

optimization plans and competent developmental calculation. In see of the reality that there are different centered regions in OM, a few analyst checked on functions of information mining and AI in specific zones, such as job-shop planning (Cheng et al., 1996), provider assessment and determination (Ho et al., 2010), and quality change (Köksal et al., 2011). Ho et al. (2010) concluded that GA functions in provider assessment and determination were restricted whereas Köksal et al. (2011) distinguished that GAs were regularly utilized for parameter optimization for quality advancement. There are a number of surveys in OM zones and distinctive analyst divided them in several ways. Rao and Lingaraj (1988) divided OM functions into strategically and deliberately arranged functions. They distinguished eleven regions: total planning, forecasting, location choices, planning, capacity arrangement, format, process and product design, quality control, job design, inventory control, and maintenance and reliability.

Aytug et al. (2003) divided OM regions into six classifications: production control (e.g. stacking and planning), facility format plan, line adjusting, production planning, supply chain administration and plan, and other. Based on Chaudhry and Luo (2005) and Wong and Lai (2011) divided OM into eighteen regions for investigating the functions of fuzzy set hypothesis in generation and OM. Kobbacy and Vadera (2011) checked on AI in OM categorized into four ranges: design, planning, process planning and control, and quality, maintenance and blame determination. Subramanian and Ramanathan (2012) categorized OM into five broad themes: operations strategy, process and product design, planning and scheduling resources, project management, and managing the supply chain. The classification of OM areas by researchers is summarized in Table 1.

Table 1: Classification of OM areas.

Authors	Classification of OM areas
Jayaraman and Srivastava (1996)	Process choice, process design, product design, quality planning, facility location, facility layout, project management, long-term capacity planning, job design, aggregate planning, long-term forecasting, short-term capacity planning, distribution, scheduling
Proudlove et al. (1998)	Operations strategy, product design, quality management and control, process design, capacity planning and scheduling, inventory management, work-force management
Aytug et al. (2003)	Production control, facility layout design, line balancing, production planning, supply chain management and design, other
Chaudhry and Luo (2005)	Environment, process choice, process design, product design, quality planning, facility location, facility layout, project management, long-term capacity planning, job design, aggregate planning, long-term forecasting, short-term capacity planning,
Kobbacy and Vadera (2011)	Design, scheduling, process planning and control, quality, maintenance and fault diagnosis
Wong and Lai (2011)	long-term capacity planning, aggregate planning, short-term capacity planning, distribution, scheduling, quality control, inventory control, maintenance, short-term forecasting, purchasing
Subramanian and Ramanathan (2012)	Operations strategy, process and product design, planning and scheduling Resources

The rest of the paper is organized as follows. Section 2 describes the framework of the classification of GA applications in this paper. Section 3 presents a detailed review of GA applications in OM. Section 4 discusses the observations from the review and provides suggestions for future work. Section 5 concludes the paper.

II. A FRAMEWORK FOR CLASSIFICATION

Based on Table 1, the applications of GAs in OM in this paper are divided into 3 broad subjects, these are-

- (i) Process and item design
- (ii) Operations arranging and control, and
- (iii) Operations improvement

Process and item design- It could be a subject comprising plan exercises for fulfilling customers' prerequisites through forming or arranging items, administrations and forms. Exercises in this subject decide the assets required for the creation of administrations and items. At the foremost key level, prepare and item plan implies forming the systems of operations that supply items and administrations. At a more

operational level, it implies the course of action of the forms and assets that constitute operations forms.

Operations arranging and control- It could be a topic managing with the conveyance of items and administrations. The key to an operation’s skill to provide is the way it plans its exercises and controls them so that client request is fulfilled. This subject covers exercises related to arranging and controlling assets which are able of fulfilling client request on a day-to-day premise and guaranteeing the accessibility of assets.

Operations enhancement - It is seen as making the operations perform superior and ceasing them from disappointment. Exercises in this subject play a basic part in keeping up competitiveness since the operations’ competitors will too be improving.

The above topics can be encourage separated into more detailed operations decision areas as recorded in Table 2.

Table 2 Key decision areas in OM themes.

OM theme	Decision areas
Process and product design	Facility layout design Supply network design Job design and work Forecasting
Operations planning and control	Capacity planning Inventory control Scheduling
Operations improvement	Maintenance Risk management

III. APPLICATIONS OF GA IN OM

Process and item design

Key choices decisions tended to by the researchers within the areas of process and item design include facility format plan, supply network plan, job plan and work, and forecasting.

- a. Facility format design
- b. Supply network plan
- c. Job plan and work
- d. Forecasting

Operations arranging and control

Key choices zones tended to by the researchers within the areas of operations arranging and control include capacity planning, stock control, and scheduling.

- a. Capacity planning
- b. Inventory control
- c. Scheduling

Operations improvement

- a. Maintenance
- b. Risk management

IV. DISCUSSION

Observations

Fig. 1 appears the dissemination of GA thinks about within the nine OM areas. Planning is the foremost well-known range where Gas have been energetically connected, taken after by stock control. The most well-known region is supply arrange plan. The three slightest well known zones are estimating, support, and chance administration. Fig.2 shows the dispersion of checked on GA ponders within the three OM subjects. It can be seen that the majority of the checked on work centered on operations arranging and control. Typically not astounding since the choice ranges secured in this topic, where are capacity arranging, stock control, and planning, are the beat four regions as appeared in Fig.1. On the other hand, operations change is the slightest popular OM subject where GAs have been conducted. This can be since there are only two choice zones within the subject and GA considers on chance administration are or may be restricted. Fig.3-5 appear the dispersion of the considers completely different choice zones in each topics. In prepare and item plan, the choice zone where GAs have been connected the foremost is supply organize plan. It has been watched that the most GA considers on supply organize plan endeavored to illuminate diverse sorts of plan issues. All supply chain plan issues surveyed increments when the system includes multi-purpose, multi – periods, and CLSNs. In the most of the surveyed work, be that as it may, the request was displayed as being deterministic. Work plan and work design and work issues may be to decide the grouping of employments at the working environment. In this paper such optimization issues are classified as planning issues. Other than, work plan and work may include subjective data such as ergonomics issues may not be NP- hard issues to be illuminated by GAs. The third most well-known region is the office format plan. The conveyance of SFLP and DFLP are comparable. Whereas most of the models were single -

objectives was to play down the costs. The slightest well-known region is determining. It has been found that most of the applications in this region coordinates GAs with other procedures such as SVR, NN, chaotic mapping, fluffy hypothesis, and highlight selection. The typical objective was to play down the estimate blunder.

In operations arranging and regulations, marginally more than half of the GA functions are on planning. It has been watched that IPPS JSP were the common planning issues to be tended to by GAs. Analyst too expanded JSP into diverse issues such as FJSP and DFJSP. Since of the expansive assortment of planning issues which are NP- hard issues, GA-based approaches have as of now been connected in tackling diverse planning issues. There might not be much commitment or commonsense bits of knowledge in the event that GAs are utilized as a standalone procedure for planning. Instep, within the later distributed writing, when tackling planning issues, GAs have continuously been hybridized with other procedures such as TS, and fluffy hypothesis. The best leading distance is commonplace authority. The prevailing models utilizing GAs to fathom stock control issues decided strategic and operational level choices such as arrange amount, stock level, reorder point and so-on. However, a number of models considered deterministic requests. Other than, a few analysts centered on the computer- based GAs in arrange to compare to real generation circumstances.

In this, overview, there are as it were two choice ranges in operations enhancement For most operations, upkeep can be for the most part classified into remedial upkeep and preventive upkeep. Whereas remedial upkeep is performed after disappointment, preventive support incorporates a well-defined set of tasks. In this study, nearly all of the upkeep procedure decided by GAs were preventive and coordinates with generation planning. On the other hand, with respect to GA ponded on hazard administration, the existing work was restricted to trending to fire dangers, venture dangers and budgetary risks.

Future scope

In this, future investigate directions in each choice zone in OM are suggested.

- The larger part of GA inquire about to tending to planning issues incorporate measure on generation effectiveness within the objective capacities. It ought to be famous that, in any case a few businesses might have other concerns, for case, natural issues. Subsequently, more down to earth consideration should be included within the objective capacities within and limitation

within the future research. For occurrence, the minimization of vitality utilization and no hold up imperative might be taken into consideration. Other than, there might not be much commitment or down to earth experiences on the off chance that GAs are utilized as a standalone method for solving planning issues. Future studies in this zone seem center on how to parameterize a GA usage and dodge the plausibility of untimely merging within the hereditary look handle for scheduling.

- A inquire gap in inventory control exists in implementing GAs for joint support and stock optimization framework below inconsistency. In reality, companies keep stock of save parts is to perform upkeep in arrange to reestablish the framework as rapidly as conceivable. As a result of the complicatedness and the hypothetical character of such a joint optimization issue, GA-based approaches may well be a fitting strategy for finding the about ideal arrangement. To bargain with the vulnerabilities and imprecision, other suitable procedures such as fluffy set hypothesis can be consolidated with GAs.
- Within the area of maintenance, the majority of the papers depict preventive support. In any case, no papers appears to exist on the disappointment constraint, repair constraint and repair number checking arrangement. Other than, it is found that coordination maintenance procedure with generation planning took an incredible interest within the scholarly community since the final decade. Coupling GAs with diverse disappointment probability dispersions can be a curiously field for encourage investigate. Whereas finding ideal maintenance techniques is important for progressing the reliability of a framework, the measures of framework strength and stabilities in the GA objective work require more examinations.
- Risk administration and support are closely related. Support is how companies attempt to maintain a strategic distance from disappointment by taking care of their physical offices. Risk administration is approximately things going off-base and what operations can do to stop things going off-base. Whereas there exist diverse GA think about on maintenance, a investigate gap exists in applying GAs for hazard administration. It is recommended that risk administration can be coordinate with other OM ranges when solved by GAs. Usually since choices such as bringing down inventories, and changing office layouts, can all serve as implies to form the operational disappointment more prominent? In this sense, the GA destination can take under consideration the related chance levels during optimization. Future GA studies

can too center on optimizing the assets allotments plans such that assets would be accessible when required.

- In forecasting, thinks about outlined the determining models for a specific operation or party in a supply chain, such as the common gas supply framework, a hotel, and a clinic. From a broader point of view, in any case the exactness of one party’s forecast is necessary for not only itself but too the other parties, since the qualities of its figure frequently influences the execution of the complete supply chain. In line with this see, future research in determining lies within the bearings of supply chain estimating. Concurring to Syntetos et al. (2016), supply chain forecasting goes past the operational assignment of extrapolating request necessities at one echelon. It include complex issues such as supply chain coordination and sharing of data between different partners. It has been watched that, there were potential picks up in forecast precision accomplished by hybridization of GAs with other intelligent strategy such as neural organize. Many examination on utilization of hybrid GAs in forecasting are in this way authorised.

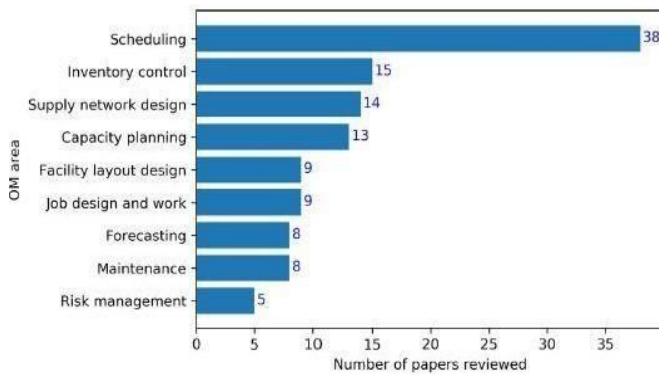


Fig. 1. Distribution of GA studies in the nine OM areas.

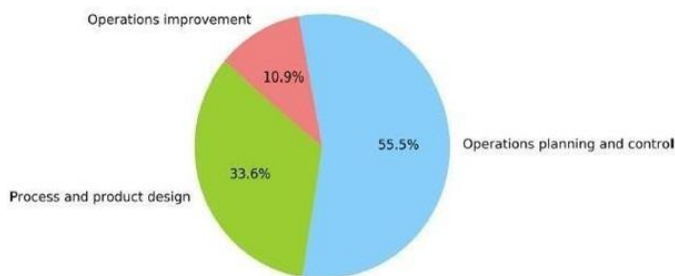


Fig. 2. Distribution of GA studies in OM.

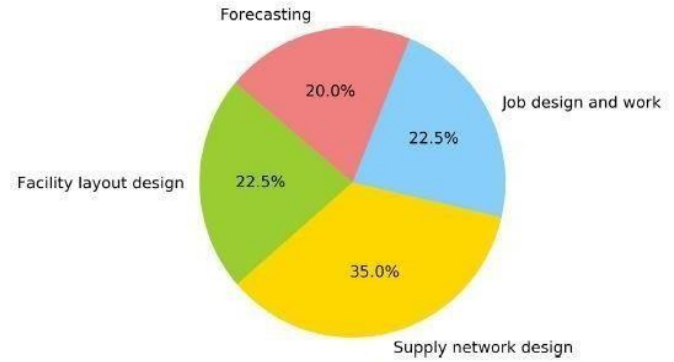


Fig. 3. Distribution of GA studies in process and product design.

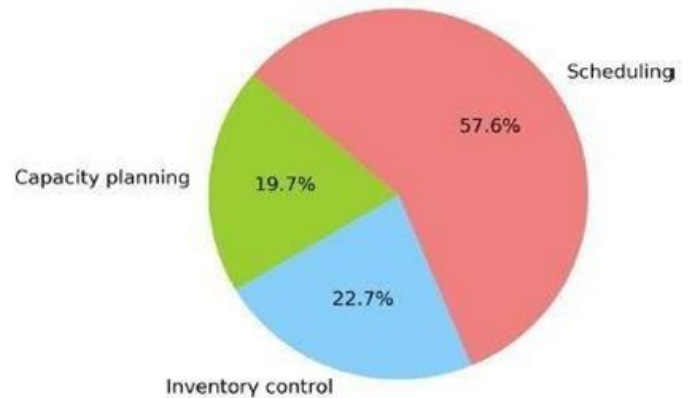


Fig. 4. Distribution of GA studies in operations planning and control.

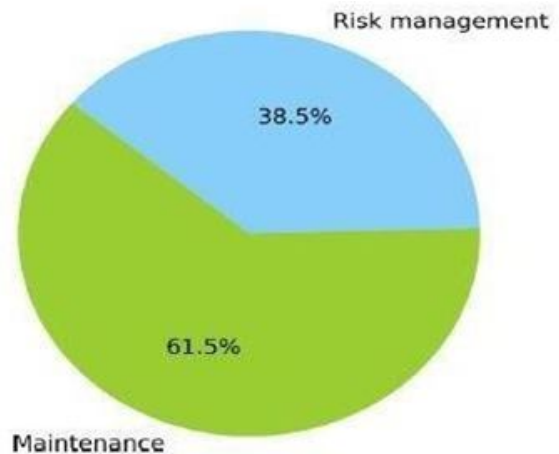


Fig. 5. Distribution of GA studies in operations improvement.

V. CONCLUSION

This paper made an attempt to survey the applications of GAs in OM within the final decade. The survey from 2007 to 2017 was divided into three subjects, specifically process and product design, operations arrangement and control, and operations advancement. The three topics contain 9 distinctive choice areas in total, which

are facility layout plan, supply organize plan, job plan and work, forecasting, capacity planning, inventory control, scheduling, maintenance, and risk management. A total of 119 papers were surveyed methodologically, each of which was categorized into a specific choice range for investigation. Based on the survey, valuable gaps in the function of GAs were advertised. A GA-related investigate and work plan for assist in work in OM was too given. In any case, this survey has several restriction. First, it is expected that a different definition of the problem domain might result in a different sample of papers and a different structure of the thematic analysis. Second, reviewed work is limited to English and peer reviewed publications. However, non-peer analysis chronicle, books and non-English chronicle might contain important GA utilization that fall within the scope of this study. Whereas it is trusted that this survey will instigate curiously advancement and utilize of GAs in OM areas and encourage more useful and practical solutions in diverse industries, reviewing works that were excluded from this review could lead to additional insights.

REFERENCES

- [1] Syntetos, A.A., Babai, Z., Boylan, J.E., Kolassa, S., Nikolopoulos, K, “Supply forecasting: Theory, practice, their gap and the future”. *European J. Oper.Res.*252 1-26. (2016).`
- [2] Kar, A.K. Bio inspired computing- “A Review of algorithm and scope of applications”. *Expert Syst. Appl.* 59, 20-32. (2016)
- [3] Aguila- Rivera, R, Valenzuela-Rendon, M, Rodrihuez-ORTIZ, J.J. “Genetic algorithm and Darwinian approaches in financial applications”. *Expert System application*, 42(21), 7684-7697. (2015).
- [4] Subramanian, N., Rmanathan, R. “A Review of applications of Analytic Hierarchy Process in operations managements”.*Int. J. Prod. Econ.* 138(2), 215-241. (2012).
- [5] Koksals, G, Batmaz, I, Testik, M, C. “A Review of data mining applications for quality improvement manufacturing industry.” *Expert System Applications*.38 (1,218-232). (2011).
- [6] Kobbacy, K.A.H, Vadera, S. “A survey of AI in operations managements from 2005-2009”. *Int. J. Manuf. Technol. Manage.* 22(6), 706-733, (2011).
- [7] Chaudhary, S.S., Luo, W. “Application of genetics algorithm in production operations managements: a review”*Int. J. Prod. Res.*43 (19), 4083-4101. (2005).
- [8] Aytug, H., Khouja, M., Vergara, F.E. “Use of genetic algorithms to solve production and operations management’s problems: a review”. *Int. J. Prod. Res.* 41(17), 3955-4009. (2003).
- [9] Coello, C. A. C “An updated survey of GA- based Multiobjective optimization techniques”. *ACM Computer Sury.* 32(2), 109-143.(2000).
- [10] Cheng, R., Gen, M, Tsujimura, and Y. “A tutorial survey of job-shop scheduling problems using genetics algorithms:”*I. Representation. Computer.Ind. Eng.* 30(4), 983-997. (1996).
- [11] Rao, H.R., Lingaraj, B.P. “Expert systems in production and operations management classification and prospects”. *Interfaces* 18(6), 80-91.