

MODELLING SEQUENCE UNEQUAL SIZE FACILITY LAYOUT PROBLEM USING SIMULATED ANNEALING

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ABSTRACT

It truly is suggested with this papers that will improved managed annealing (SA) methods be applied to deal with an ideal large continuous rough dimension service style problem. It really is offered with this papers how you can resolve the particular automated bumpy sizing support design design and style a significant in an attempt to produce the most effective structure whilst considering typically the quickest variety journeyed simply by models associated with circulation (people, materials, info, along with other assisting services), along with the least edge utilization (for the particular layout). The particular bumpy dimensions FLP (UFLP) has been understood to be a consistent Bumpy Service Style Problem (SUFLP) with this study, plus handled annealing (SA) had been utilized to fix the problem to get the perfect answer. To deal with the actual manufacturing atmosphere, this particular analysis offers up-to-date INTERPERSONAL WORRY methods with regard to heat environment techniques in addition heat decrease recommendations having a number of beginning temps in addition to preventing problems which are good outcomes of ruse. The specific assessments had been carried out to cope with the best concern regarding unequal sizing practical devices like devices, assistance gear, and even operate the process region, that was resolved within the books. Typically the method which has been produced increases the high quality involving SUFLP's options although dealing with large matter sizes. Based on the assessment outcomes along with recommended strategies, typically the iteration-based temp lowering guideline together with amalgamated plan functions the very best design design around the real software when it comes to answer top quality.

Keywords: Facility layout problem (FLP) and Simulated annealing (SA).

1. **INTRODUCTION**The good set up from the services within the ground strategy which has a considerable effect on production costs, manufacturing occasions, in addition efficiency degree is known as the Service Style Issue (FLP). Common, FLP rationalizes the particular stepping into creation and even support shipping amenities, that is advantageous in a function overall performance scenario. Consequently, a new practical service structures may reduce complete operating expenses up to 50 percent whilst concurrently growing general practical effectiveness (Drira ainsi que ing., 2007). The specific agreement plus positioning associated with useful gear have an effect around the common performance of the manufacturing grow. Services in many cases are organized based on normal procedures, which usually figure out the location regarding practical devices to be able to reduce generation expenses as well as journey ranges or increase proceeds (Djassemi, 2007). FLPs, nevertheless, are usually considered to be complex in addition to NP-hard issues (i. electronic., non-polynomial) (Balakrishnan ainsi que ing., 2003a). Various marketing processes for small issues and even heuristic methods with regard to larger issues happen to be offered inside try to much better fully understand this particular subject matter. Numerous methods, however, are certainly not flexible sufficient to support services involving different sizes (Balakrishnan ou 's., 2003a).

FLP may also be among the well-studied issues inside the issue related to combinatorial marketing, together with more than a 10 years connected with study dedicated to this specific (Meller ain ing., 2007). A variety of products

happen to be created with regard to FLP. Additional, it is displayed because quadratic task issue (QAP), quadratic arranged dealing with trouble (QSP), unbeirrbar integer development (LIP) problem, combined integer encoding (MIP) concern, or even graph-theoretic matter, and a lot more (Kusiak additionally Heragu, 1987; Alvarenga tout autant que 's., 2 carat together with Balakrishnan ou approach., 2003a).

FLP offers typically recently been modelled like a QAP, some sort of graph-oriented method, or perhaps a MIP problem, amongst some other techniques. Xie plus Sahinidis (2008) explain that this important drawback to QAP in addition to QSP will be these people experience a limitation, which can be typically the recognition associated with feasible web sites, and the unequal-sized FLP is usually insufficient. For instance, within the biggest feeling, QAP offers usually already been employed to replicate the particular equal-sized FLP (Mavridou and also Pardalos, 97; Drira au même tire que way., 2007), covering city planning, the control panel design, furthermore cable style, many other things (Meller and even Gau, 1996). Nevertheless, making use of typically the QAP design, it truly is unlikely that the support strategy using more than 20 sections is going to be suitably dealt with (Balakrishnan ain ing., 2003a). The actual unequal-sized FLP will be let in simply by areas inside a real-life environment, together with depending on earlier research, the particular QAP formula is a lot much less good for that unequal-sized FLP when compared with the specific equal-sized FLP (Logendran plus Kriausakul, 2006). Due to the requirements option used in identifying the most effective structure through several options, seeking the ideal design regarding unequal-sized FLP is definitely hard. Given that building the actual FLP being a QAP provides 1 considerable disadvantage in this 1 should determine all of the option areas for all those services, that is discretizing the problem, it is far from recommended with this scenario (Auriel in addition to Golany, 1996). Because of this, it really is far better establish typically the FLP without having determining the area, especially when it comes to unequal places.

To be able to determine ideal remedies for people problems within a suitable quantity of processing time period, experts are actually looking into a number of estimation techniques, which includes several close by research and even meta-heuristics methods (Balakrishnan tout autant que 's., 2003a in addition Ramkumar de plus 's., 2008a). A number of innovative lookup techniques, including Controlled Annealing (SA), Tabu Research (TS), Hereditary Formula (GA), together with Ish Home Marketing (ACO), happen to be produced plus analyzed. The particular study of unequal-sized FLP (UFLP) provides obtained fewer desire for previously analysis, that has added towards inspiration just for this study. Therefore, considering that we've been contemplating the development structure, we would like to find the perfect keeping of unequal-sized efficient equipment inside the design while keeping the particular powerful set up. Subsequently, the main focus will be upon providing an answer which allows for any a lot more practical UFLP intended for difficulties linked to large degree.

2. PROBLEM DESCRIPTION

The particular production plant's support design is dependent upon the specific task associated with And prevents, that is the primary focus from the design. Every prevent will be composed of unequal-sized practical equipment regarding different designs, such as the device, an assistance gadget, along with a work-in-process area, amongst others. When making the actual design, all of us set aside the particular practical gear inside a continuous method, and focus our own attempts on the Constant Bumpy Service Style Issue (SUFLP). In addition, typically the service style technique should offer programs which are useful whilst nevertheless meeting the constraints that have been founded. The block's powerful set up ought to consider the different sorts plus dimensions related to unique useful products, that ought to be regarded as from the formula. Think about the following requirements for that manufacturing program although developing the body:

§ The goal would be to slow up the complete measured amount of the whole range journeyed in one prevent to a different, along with the edge utilization inside the strategy, towards the smallest feasible worth.

§ It is achievable to look for the variety among obstructs rectilinearly simply by using gathering in addition to drop-off aspects (P/D).

§ Materials are often relocated inside an arranged way in one prevent to another appropriate prevent till all the creation methods are usually completed throughout the generation process.

§ According for the ground design and style, every obstruct (or efficient tool) should be situated within the obtainable area, as well as room region are not able to terme conseillé using the room part of some other prevents.

§ The agreement views the needs with regard to limited areas, like the amount of place in between operating devices.

§ The upkeep of the area inside each and every obstruct for that installing of brand new useful resources later on.

Consider just one ground while deciding (single row).

Included in the last answer, every single prevent is usually designated for an appropriate area to get the cheapest achievable goal worthwhile without having busting a restrictions. In addition, listed here are essential presumptions designed for the particular UFLP as well as the practical system (machine, assistance unit, and even work-in-process area) layout within the type:

§ The rectangle-shaped perspectives of the prevent, division, equipment, help product, work-in-process region, and even cellular is utilized to describe the type.

§ A set square boundary involving dimension (floor length) by (floor width) will certainly encompass all of the useful tools together with hindrances with out overlapping.

§ The style tools' positions in addition orientations are usually decided randomly.

§ Machines might be place in the prevent in a purchase: all through, remaining to fix, or stuck in a job rectangle-shaped main grid. There are many unique types of device orientations inside a prevent, including homogeneous design within just whether straight as well as horizontally alignment, or maybe nonhomogeneous structure in up and down plus horizontally positioning.

§ A prevent is composed of various kinds of efficient equipment, just like a device, an assistance machine, and also a work-in-process area, and others.

§ A division is consisting of several person categories of obstructions essentially with each other.

3. THE MODEL

3.1 Assumptions

Listed here are the particular presumptions that have been produced in the having an appropriate numerical style.

one Every gadget might be set up to work within whether horizontally or even straight placement.

second. The particular sizes from the ground, the specific sizes in the prevents, typically the measurements related to practical equipment (machines, assistance resources, work-in-process), as well as the heads connected with useful equipment, most of these should be integer steps.

Within our example, will not get gathering plus drop-off (P/D) areas, and so the range between prevents was assessed using their described locations.

4. You will find spaces between a number of efficient devices.

five. Typically the practical resources that needs to be put together come with an unequal kind, having a number of arranged rectangle-shaped designs inside every prevent.

3.2 Nomenclatures

The following nomenclatures were used in the development of the mathematical model:

x_i is the distance between the centroid of the block $i \in N$ and Vertical Reference Line (VRL)

y_i is the distance between the centroid of the block $i \in N$ and Horizontal Reference Line (HRL)

N is the number of the blocks, $N \geq 0$

Q_r is the orientation of the functional tool $r \in P$

L_x is the length of the horizontal side of the total floor

L_y is the length of the vertical side of the total floor

τ_r is the width of the functional tool $r \in P$

ν_r is the length of the functional tool $r \in P, \tau_r \leq \nu_r$

H is a considerable value, $H \gg L_x L_y$

m_r is the distance between the centroid of functional tool $r \in P$ and VRL (y-axis)

n_r is the distance between the centroid of functional tool $r \in P$ and HRL (x-axis)

e_r is the length of the horizontal side of functional tool $r \in P$

g_r is the length of the vertical side of functional tool $r \in P$

px_i is the distance between the pick-up point of block $i \in N$ and VRL

dx_i is the distance between the drop-off point of block $i \in N$ and VRL

py_i is the distance between the pick-up point of block $i \in N$ and HRL

dy_i is the distance between the drop-off point of block $i \in N$ and HRL

P is the number of total tools

$$Q_r = \begin{cases} 1, & \text{vertical orientation for tool } r \\ 0, & \text{horizontal orientation for tool } r \end{cases}$$

$$\lambda_{rs}^{\text{left(right)}} = \begin{cases} 1, & \text{then tool } r \text{ is left (right) of tool } s \\ 0, & \text{then tool } r \text{ is not left (right) of tool } s \end{cases}$$

$$\lambda_{rs}^{\text{below(above)}} = \begin{cases} 1, & \text{then tool } r \text{ is below (above) of tool } s \\ 0, & \text{then tool } r \text{ is not below (above) of tool } s \end{cases}$$

3.3 Mathematical Model

The mathematical model for UFLP formulated as a Sequential Unequal Facility Assignment Approach (SUFAA) is given as follows:

$$\text{Minimize } Z = \sum_{i=1}^N (|dx_i - px_{i+1}| + |dy_i - py_{i+1}|) \quad (1)$$

subject to

$$m_r + \frac{Q_r \tau_r}{2} + \frac{(1-Q_r) \nu_r}{2} \leq m_s - \frac{Q_s \tau_s}{2} - \frac{(1-Q_s) \nu_s}{2} + H\lambda_{rs}^{right} + H\lambda_{rs}^{below} + H\lambda_{rs}^{above} \tag{2}$$

$$m_s + \frac{Q_s \tau_s}{2} + \frac{(1-Q_s) \nu_s}{2} \leq m_r - \frac{Q_r \tau_r}{2} - \frac{(1-Q_r) \nu_r}{2} + H\lambda_{rs}^{left} + H\lambda_{rs}^{below} + H\lambda_{rs}^{above} \tag{3}$$

$$n_r + \frac{(1-Q_r) \tau_r}{2} + \frac{Q_r \nu_r}{2} \leq n_s - \frac{(1-Q_s) \tau_s}{2} - \frac{Q_s \nu_s}{2} + H\lambda_{rs}^{right} + H\lambda_{rs}^{left} + H\lambda_{rs}^{above} \tag{4}$$

$$n_s + \frac{(1-Q_s) \tau_s}{2} + \frac{Q_s \nu_s}{2} \leq n_r - \frac{(1-Q_r) \tau_r}{2} - \frac{Q_r \nu_r}{2} + H\lambda_{rs}^{right} + H\lambda_{rs}^{left} + H\lambda_{rs}^{below} \tag{5}$$

$$|m_r - m_s| \leq L_x - 0.5(e_r + e_s) \tag{8}$$

$$|n_r - n_s| \leq L_y - 0.5(g_r + g_s) \tag{9}$$

$$\lambda_{rs}^{left} + \lambda_{rs}^{right} + \lambda_{rs}^{below} + \lambda_{rs}^{above} = 1 \tag{10}$$

$$O_r, \lambda_{rs}^{left}, \lambda_{rs}^{right}, \lambda_{rs}^{below}, \lambda_{rs}^{above} \in \{0, 1\} \tag{11}$$

$$dx_i, px_i, dy_i, py_i \geq 0 \quad \forall i \quad m_r, n_r, e_r, g_r, \tau_r, \nu_r \geq 0 \quad \forall r, s \tag{13}$$

$$L_x, L_y, H \geq 0$$

$$\{(i, j) \mid i = 1, \dots, N; j = i, \dots, N\}$$

$$\{(r, s) \mid r = 1, \dots, P - 1; s = r + 1, \dots, P; r \neq s\}$$

Especially, the particular objective functionality within Formula (1) is involved along with decreasing the entire measured quantity of ranges journeyed in one gathering precise location of the prevent to a different drop-off stage of the prevent, and also increasing the specific edge utilization inside the style. Practical gadget overlapping plus placement inside design sides are usually avoided from the limitations with this style, which usually furthermore limit practical device vulnerable parts towards the design inside along with determine the actual variables' domain names related to software. The particular constraints within the units (2) in order to (5) are often disjunctive restrictions, which means that these people prohibit any type of set of useful gear through overlapping together with some other within their features. In addition, an instrument might be situated possibly remaining or even correct, and also over or perhaps underneath, associated with an additional system. Whatever the situation may be, the right binary flexible will be expose to be able to impose the right limitations in addition to restriction (10) simply leaves another a few unnecessary. For instance, permit state device will be under the as well as typically the. Therefore, you will find most likelihood of gadget will be still left, proper or even previously mentioned connected with application where (Corry and even Kozan, 2004). At the same time, limitations (8) to be able to (9) ensure that the particular

efficient gear are usually find within the limitations from the ground strategy (Heragu, 1990). After that, difficulties (11) in order to (17) designate typically the limitation on every adjustable.

4. METHODOLOGY

For that factors like this particular papers, the particular UFLP marketing problem will be handled like a Continuous Rough Service Design Problem (SUFLP). Balakrishnan ainsique ing. (2003a) found that whenever implementing typically the main grid framework inside an SUFAA design, the particular sizes from the issue as well as the time period necessary to calculate these answer more than doubled. This is certainly especially correct with regard to designs along with unequal dimensions. SUFLP variations give prevents within obtainable area in a manner that the fabric journey range among each prevent plus the advantage use within the program will be held down quantity.

Rawal et. al (2021), Poongodi M et. al(2022), Poongodi M et. al (2021), Dhiman P et.al (2022), Sahoo S.K et.al (2022), K.A et. al(2022), Dhanraj R.K et. al (2020), Yan Zhang et.al (2020), Md Hossain et. al (2021), Md Nazirul Islam Sarker et. al (2021), Y. Shi et. al (2020), Guobin Chen et. al (2020) Since the circulation may be the exact same both in instances, design problem is going to be understood to be typically the stationary SUFLP with this research.

4.1. Simulated Annealing

Inside combinatorial marketing, Managed Annealing (SA) is generally a metaheuristics strategy which is often used to resolve issues. FLP is a frequent problem that will SOCIAL FEAR is utilized to fix. It is often exhibited of which, over time, INTERPERSONAL WORRY provides a far more ideal answer compared to some other iterative enhancement strategies (Turgut ainsique ing., 2003). Consequently, we will use SOCIAL FEAR techniques for dealing with large UFLP difficulties, that is indicated being an SUFLP design, to be able to determine the perfect options. Over the following component, we are going to have the details of the easy VOTRE formula with regard to resolving the particular SUFLP type within additional level. Among sometimes, we're going check out the specific SOCIAL FEAR method, in addition Determine five shows the flowchart from your VOTRE protocol which will coming from suggested with this particular UFLP, that will work as the building blocks throughout our own function. Additionally, these guidelines for that SOCIABLE CONCERN criteria, which can be typically the foundation in our job, are usually demonstrated:

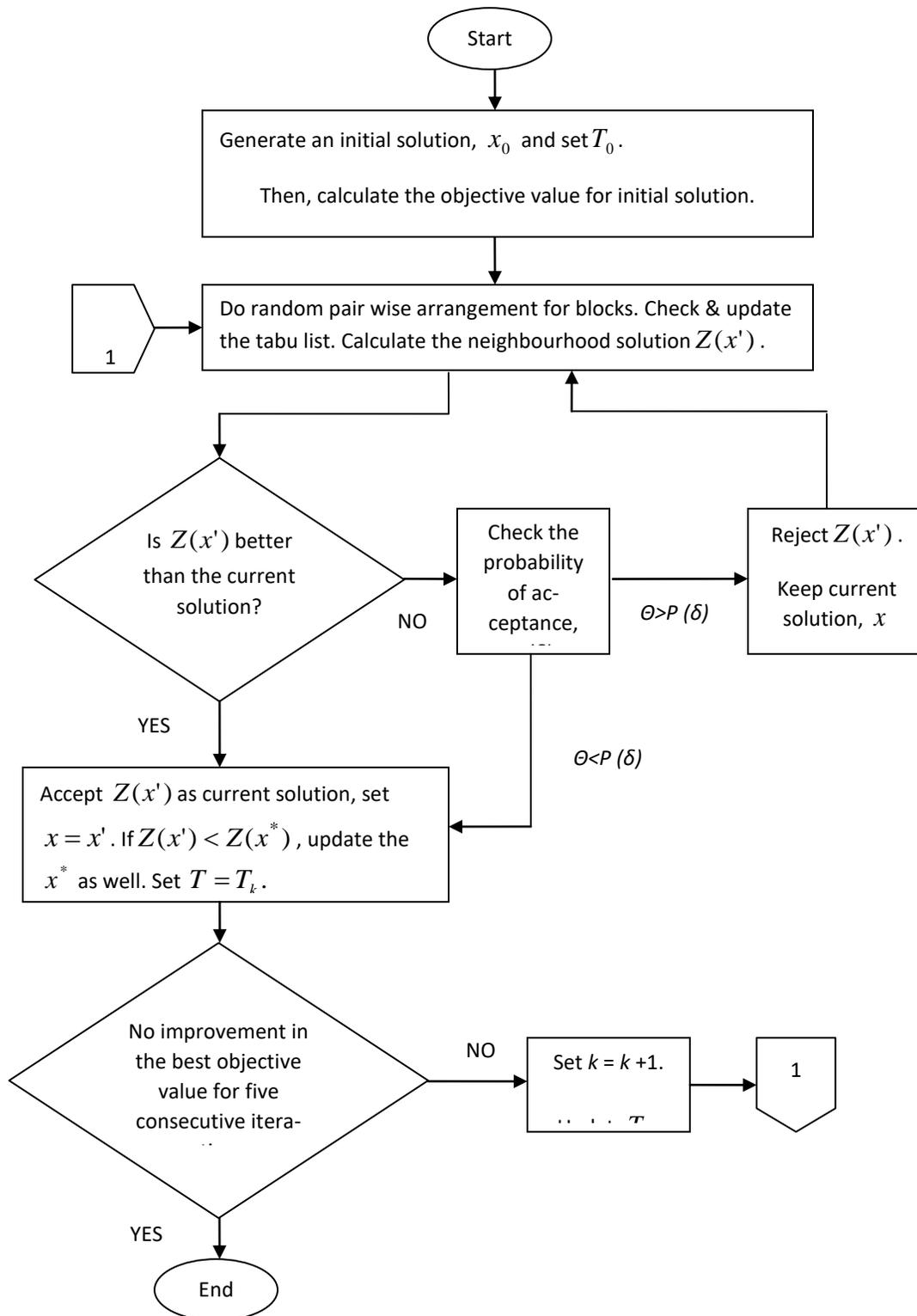
1. Initial permutation, $\pi = (1\ 2\ 3\ \dots\ n)$
2. Initial temperature, $T_0 = 1000$
3. Final temperature, $T_f = 0$
4. Temperature reduction rule, T_{k+1}
5. one Neighborhood option would be acquire making use of arbitrary pair-wise set up of two prevents. The idea of tabu listing dimensions are used whenever choosing the specific obstructs to become rearranged, where a listing of unacceptable arranges will be kept to prevent biking between exact same options. Therefore, the cost of tabu listing dimensions are started two, that is the amount of iterations that the recently approved neighborhood choice will be prohibited in order to change.
6. second . Select one neighborhood answer each time simply.
7. Quit if you find virtually no enhancement within the finest goal functionality really worth with regard to 5 successive iterations or even $T_k < T_f = 0$

4.2. Temperature Setting Schemes

A variety of types of heat environment techniques are usually recommended with this research. Almost all temp environment techniques is going to be put on almost all temperatures decrement recommendations with regard to numerous guidelines determining the start heat plus preventing needs, and everything heat range decrement guidelines is going to be put on almost all temps establishing techniques. 4 different environment decrementing guideline strategies happen to be looked into with this analysis, and they are generally the following:

4.2.1. Simple Scheme

In order to solve the model, we first employed the simple scheme (SS) for temperature setting as a starting point in this investigation. This approach involves the temperature decreasing from one iteration to the next. The temperature decrease trend of the basic method is seen in Figure 6.



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FIGURE 5 SA Algorithm.

4.2.2. Cycle Scheme

VIVE heat environment continues to be altered to produce the particular period plan (CyS) in this instance. Rather than permitting typically the temp to decrease in one version to a different, CyS enables the particular temperatures to stay continuous at some time through the version procedure. It really is prepared to keep exactly the same heat for a quantity of successive iterations, which technique is going to be carried on till the preventing necessity continues to be arrived at. Three-cycle technique because portrayed within Determine seven displays the design associated with temp the process.

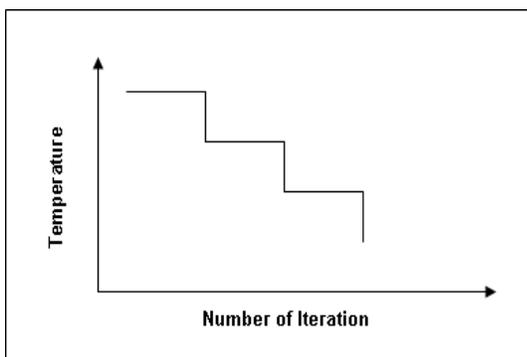


FIGURE 7 Cycle Scheme

4.2.3. Cyclic Exponential Scheme

The specific cyclic rapid plan is another variety of the conventional strategy (CES). When the heat will be lower, the particular SOCIAL FEAR formula gets self-destructive because it helps prevent an approval associated with much less appealing options through becoming regarded as. Consequently, SOBRE TELLES will be used to be able to prevent this particular limitation simply by enabling upwards motion by using heat resets. If you find virtually no improvement within the ideal goal worth carrying out a specific quantity of successive models within PARA TELLES, typically the heat will be totally reset towards the improved ideals which were utilized. The particular heat will reduce once more based on the temp lower rules. Once the preventing necessity will be arrived at, this tactic is going to be repetitive until it finally is usually satisfied. Typically the temperatures type of the particular cyclic rapid strategy is observed in Determine eight.

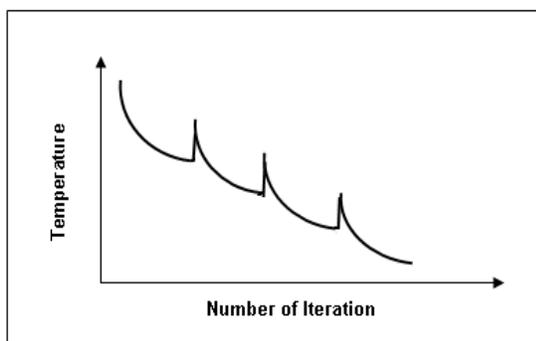


FIGURE 8 Cyclic Exponential Scheme

4.2.4. Composite Scheme

Using the notion of the refinement technique in composite heuristics, it was possible to enhance the present solution after it had been discovered to be the local optimal solution in the new temperature setting scheme. Because CyS and CES outperform SS in terms of performance, we incorporate both of them into our composite scheme. The union of CyS and CES has the potential to be advantageous. This implementation is referred to as CoS for the sake of simplicity. In the case of a composite scheme, we construct an initial solution by chance. We then continue the process of using the cycle temperature setting scheme followed by the cyclic exponential temperature setting scheme till we get the ultimate solution for the problem.

4.3. Temperature Reduction Rules

There are three temperature reduction rules have been used in SA for this research is as follows:

4.3.1. Geometric reduction rule (GRR)

The geometric cooling schedule is straightforward and most frequently used temperature reduction rule where α denotes the cooling factor (Triki et al., 2005). The formula for GRR is as follows:

$$T_{k+1} = \alpha T_k$$

4.3.2. Cooling Factor based on Van Laarhoven and Aarts (αVA)

This is the altered heat reduce guideline associated with Vehicle Laarhoven ainsi que ing. (1987). All of us used this particular annealing routine suggestions regarding to be ended within polynomial some it really is anticipation that the few modifications is going to be adequate to attain heat balance among every temp decrement. Therefore, all of us altered the particular Vehicle Laarhoven ou ing. (1987) simply by changing together with (cooling factor). The real reason for this specific customization will be to check out the heat decrease along with chilling element impact.

$$T_{k+1} = T_k \times \frac{1}{1 + \left(\frac{\ln(1 + U_k)}{\alpha} \times T_k \right)}$$

Where α is the cooling factor, k is the number of iteration ($k = 0, 1, 2, \dots, K$) ($0 < \alpha < 1$) and $U_k = | \text{Neighbourhood Solution} - \text{Current Solution} |$

4.3.3. Iteration based Van Laarhoven and Aarts (kVA)

It is a little customization on αVA chilling routine where will be transformed simply by where may be the quantity of iterations. The real reason for this particular customization will be to check out the plan with no a result of chilling element (α) and even parameter-less air conditioning element. The amount of iterations is utilized rather than cooling down aspect to see in case there is any kind of enhancement inside the answer high quality anytime nited kingdom raises.

$$T_{k+1} = T_k \times \frac{1}{1 + \left(\frac{\ln(1 + U_k)}{k} \times T_k \right)}$$

Where $U_k = | \text{Neighbourhood Solution} - \text{Current Solution} |$ and k is the number of iteration ($k = 0,1,2,\dots, K$).

5. FINDINGS AND RESULTS

With this study, amazing solving the particular SUFAA making use of typically the suggested formula will be if you take the very best construction, (configuration using the minimum range journeyed in addition edge utilization) out from the operates for that problem. With regard to ruse factors, the particular formula has been requested thirty works to resolve big concern scale a lot more than seven-hundred practical equipment inside the solitary line style. The particular overall performance from your formula is going to be assessed utilizing the typical answer as well as the portion modify. The typical option would be the whole amount of greatest objective ideals for all your functions separated from the levels of works. At the same time, the specific change is founded on immediately after among ideal remedy plus regular option discovered with the formula, indicated within portion.

In addition, typically the guidelines should be selected cautiously to get good alternative high quality inside a similarly period of time. Therefore, all of us improved the first heat () via one thousand in order to 5000 in addition to ten thousand. It is because that will huge related to can lead to likelihood associated with approval, permitting the majority of the neighborhood treatment for become approved. In addition, the particular preventing qualifying criterion is an important component which has an effect around the general top quality from the answer. Prolonged run occasions (Chae as well as Peters, 2006) usually cause a lot more good remedy because the formula is effective at getting away through nearby optima and even finishing a powerful research of the useful region. This particular studies have therefore invented the stopping qualifying criterion that needs simply no improvement within the finest aim worth right after seven together with 10 successive iterations, correspondingly. Table two consequently consists of all the suggested fremde mixtures which will be employed to evaluate each of the temp decrease guidelines employing a simple heat environment method (SS). Office a few shows an ideal unbekannte configurations for each in the temp reduce requirements which are used making use of DURE. Following of which, the perfect n?here environment to be used to check another three or more temperatures establishing methods for CyS, DE TELLES, additionally CoS, that are pictured inside Desk 4.

TABLE 3 Best Parameter Setting for Temperature Reduction Rules using SS

TRR	Best Parameter setting	T_0	SC
GRR	6	5000	10
α VA	3	1000	10
k VA	9	10000	10

TABLE 4 Simulation Results

TRR	TSS	Parameter setting	Z''	Z_{Ave}	T_{Ave} (secs)
GRR	SS	6	28039.85	28417.21	53.7
	CES		28039.85	28370.61	173.7
	CyS		28039.85	28402.01	49.7
	CoS		28039.85	28339.48	159.7
α VA	SS	3	28039.85	28406.39	55.8
	CES		28039.85	28372.28	178.4
	CyS		28039.85	28450.27	50.5

	CoS		28039.85	28352.95	187.3
kVA	SS	9	28039.85	28406.06	46.8
	CES		28039.85	28362.75	163
	CyS		28174.85	28442.44	45.7
	CoS		28039.85	28330.95	165.7

TABLE 5 Summary of Simulation Results

Case	Z^w	Z_{Ave}	Dev (%)	T_{Ave} (secs)
GRR_CoS_6	28039.85	28339.48	1.07	159.7
α VA_CoS_3	28039.85	28352.95	1.12	187.3
kVA_CoS_9	28039.85	28330.95	1.04	165.7

TABLE 6 Solution Quality (deviation in %) of all the Temperature Setting Schemes

Temperature Re-duction Rule	Temperature Setting Scheme			
	SS	CyS	CES	CoS
GRR	1.33	1.28	1.17	1.06
α VA	1.29	1.44	1.17	1.10
kVA	1.29	1.42	1.14	1.03

All the suggested heat reduce guidelines provide the finest goal associated with 28039. eighty-five from 30 operate within the Table five. Nevertheless, kVA_CoS_9 works the very best using the typical aim related to 28311. thirty-five in comparison to some other temp lower regulations. This means that which will CoS strategy work in locating the most effective placement with regard to practical gear inside the production style. Through Desk 5, all of us furthermore recognized that this temperatures reduce guidelines with no chilling element impact (kVA) functions much better answer high quality when compared to heat decrease regulations together with chilling aspect (GRR plus α VA) inside phrase associated with remedy top quality.

Based on our own tests that have been carried out with this study, the specific kVA_CoS_9 provides an improved enhancement towards the option good quality in addition to succeed to resolve our own big issue dimension connected with SUFLP. Therefore, kVA heat range lowering guideline of CoS method along with in addition preventing requirements linked to ten successive simply no enhancing answer generates the very best regular alternative. Determine nine demonstrates the particular user interface related to greatest keeping of practical equipment within the the design of SUFLP problem making use of kVA_CoS_9.

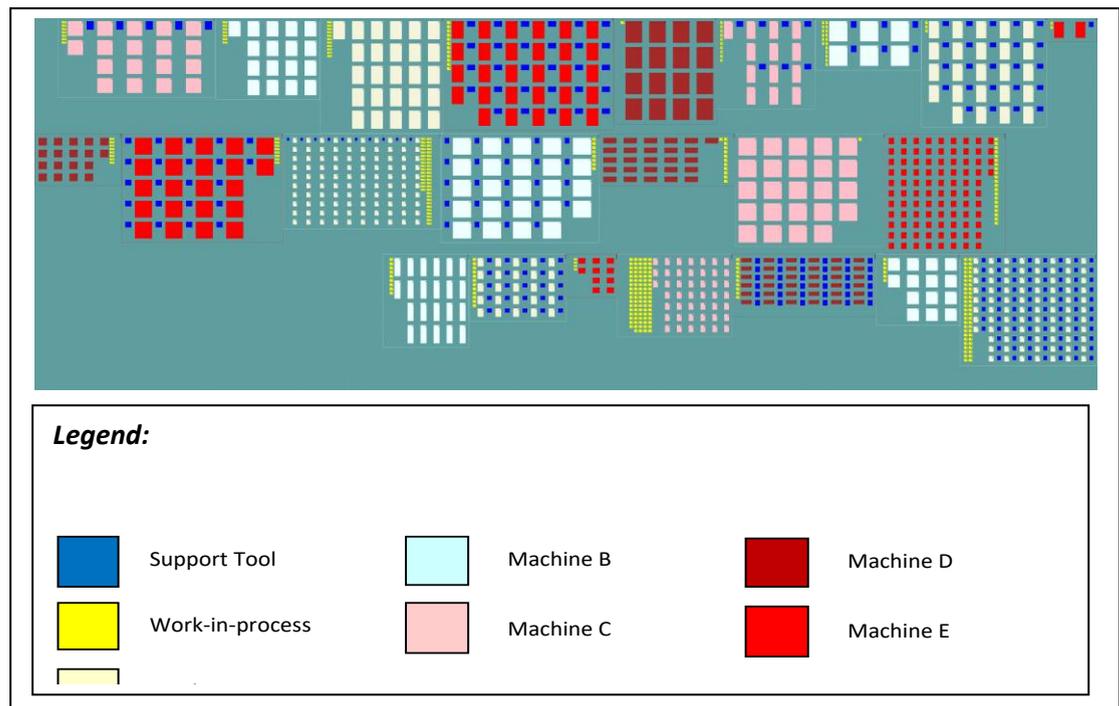


FIGURE 9 the Best Solution for kVA_CoS_9 ($Z^{\psi} = 28039.85$)

6. CONCLUSIONS

Making use of the particular SOCIAL FEAR technique, i had been capable to create the specific UFLP being an SUFLP design. By using typically the normalised weighting element, this particular VOTRE strategy continues to be suggested to be able to obtain the perfect gadget design that will minimises the sum of the complete product among ranges journeyed in between P/D (pick-up plus drop-off) aspects around the device along with the utilization associated with advantage utilizing the ideal system structure. It had been particularly designed to catch the actual impact regarding chilling activities in addition to heat decrement guidelines having a number of unbekannte ideals, that was integrated in to the model's formula.

To conclude, the particular FLP works with looking for the most efficient bodily set up involving services necessary to help the of goods or even solutions. With this study, the usage of INTERPERSONAL WORRY like a common strategy continues to be recommended to solve SUFLP with regard to big issue with a lot more practical restrictions and even objectives. SOCIAL FEAR along with numerous heat decrease recommendations together with temp environment techniques methods remains offered. In line with the emperical testing's, it is often found that kVA temp lowering guideline utilizing CoS together with initial temperatures associated with ten thousand plus preventing needs regarding ten successive no enhancing answer produces the very best choices. Apart from of which, this suggested heat range reduce regulations with no air conditioning element impact works more effectively typical objective worth when compared to temperatures decrease guidelines together with chilling aspect. Usually, typically the kVA_CoS_9 performance will be SOCIAL FEAR is situated to do much better in addition show effectively on the program with regard to big issue dimensions involving SUFLP.

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