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WORK ALLOCATION STRATEGIES IN AN ORGANIZATION – AN ARTIFICIAL AGENT SOCIETIES APPROACH

Swapandeep Kaur[1], Harjot Kaur[2]

[1] *Student(M.Tech(CSE)), Department of Computer Science and Engineering, GNDU Regional Campus, Gurdaspur, Punjab, (India)*

[2] *Assistant Professor, Department of Computer Science and Engineering, GNDU Regional Campus, Gurdaspur, Punjab, (India)*

ABSTRACT

Nowadays, Simulation has been an imperative method for demonstrating and for anticipating and examining population ageing. Population Ageing has been represented as increasing ratio of older population over total population. The demographic transitions include fertility, mortality, migration and ageing transition are impacted on population ageing. The main cause of increase in population ageing is ageing dynamics. These dynamics differ by age and sex because population growth takes place age by age and differently from males to females. Modeling of population ageing caused by ageing dynamics are done either by using multi-agent based simulation or by micro-simulation. Both the strategies perform different multi-dimensional simulation probes ageing dynamics related procedures. These simulation strategies are being utilized increasingly in the sociologies. We will investigate these strategies and propose another strategy which illustrates the ageing dynamics in artificial agent societies. An artificial agent society is a synthetic representation of a society, which contains artificial humans called agents.

This research work will primarily investigate various types of ageing dynamics in an artificial agent society. Using ageing dynamics approach this paper offers systemic point of view on how population structure changed. Also, how ageing dynamics will affect the employees which are working in an organization illustrated in this approach.

Keywords: Artificial Agent Societies, Ageing Dynamics, Population Ageing, Influenced Factors, Micro-Simulation.

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I.INTRODUCTION

Artificial Agent Societies (AAS) manage changes in the age, size and sex arrangement of population through simulative environment, and the different concerned components concerning those progressions in ageing population. It manage the way in which population ageing is influenced by elements and by some demographic transitions, for example, fertility, mortality, migration, ageing, wellbeing, instruction, economy, marriage, fruitfulness, relocation, welfare and so forth. Demographic transitions impact the population ageing and caused some dynamics in ageing. Generally, *Ageing dynamics [9]* are the changes in biological and social factors of population. These changes occur also in the distribution of a population by age and sex when a society goes through demographic transition. The *ageing dynamics* are unavoidable and have great impact in growth and success of the organization and living standards of societies. Ageing dynamics differ by age and sex because population growth takes place age by age and somewhat differently from males than females. It matters not just how fast the population is growing, but which age and sex groups are growing and which one are growing faster or slower than others. Ageing dynamics affects both young and old population [3], [4].

In general, Biological changes of agents are depicted by Aging. *"Ageing is the way toward getting to be noticeably more seasoned, and it is process that is hereditarily decided and ecologically tweaked."* In people, ageing speaks to the gathering of changes in individuals after some time, enveloping physical, mental and social changes [2]. The movement of age structure in ageing of populace of social orders portrayed by population aging. *"It is the procedure of progress in the populace's age bunch structure in the feeling of an expansion in the elderly gathering's proportion to hindrance of the youthful gathering, as a noticeable and long haul incline" [11]*.

1.1 Ageing Dynamics in Artificial Agent Societies

The Population ageing can be best simulated by using artificial agent societies. (Or) We can say that the impact of ageing on organizations or on societies is one of the critical issues which can be analyzed by the use of artificial agent societies.

Artificial agent societies provide specific agent based computational model for computer simulation in social analysis. An artificial agent society (AAS) is a synthetic representation of a society. It simulates social phenomena. Artificial societies are used to understand how societies work by synthetically creating population in them [8]. The impact of ageing on organization or on societies is one of the critical issues that can be simply described by dynamics in age and sex structure of employees/agents. *Ageing dynamics [9] are simply the biological and physical changes in an agent which would grow as the age of an agent gets increase.* In an organization, dynamics are reflected by experience of employees in an organization increases with increase in their age. The experience of employee can be shared by multiple employees who are new within the agent society. The workload on employee should decrease as age increases. The proposed work studies the impact of aging population. This impact can be studied by the application of artificial agent societies. This work can be studied by researchers to enhance the utilization of artificial agent societies in future endeavors [4].

Nowadays, with the increase in the number of older people, there is a need to expect their numbers in order to develop strategies and future plans for them. In age structure of population, there is increase in the number of elderly people and decreased trend of their morality rates, which is considered as a natural result of reducing the diseases spread among the elderly and the efforts of health care for them. The older-population having heavy economic burden on society need a special care [8].

The presented work deals with study of effect that aging dynamics have on organizations or societies. Henceforth, best possible ways can be suggested through the proposed work [2], [9]. The age of an agent within the organization or in society results in experience that can be broadcasted to new agent under distinct situations that will analyze and measure the age of agent.

1.2 Problem Definition

In this paper, agent dynamics approach existing in artificial agent societies is used. By using ageing dynamics approach, we are illustrating what are various kinds of work allocation strategies possible in an organization. The organization is implemented by creating an artificial agent society. In this society, the operators or employees of an organization are agents, which are following various work strategies by lieu of ageing dynamics existing in the same. We are considering two mainstream approaches for modeling of this approach are measurable, micro-simulation or Agent based models (ABM). Measurable methodologies are excessively broad and don't assist, making it impossible with solving issues like investigating or expectation. The other two are exceptionally valuable for getting and understanding miniaturized scale large scale connections and results [12]. We should talk about micro-simulation and Agent based displaying approaches. The reason for this paper is to present micro-simulation and specialist based simulation in least difficult of terms and clear comprehension of contrasts in these two. It likewise breaks down the disadvantages of these methods in setting of statistic simulations and population elements simulations and how we can overcome these, while simulating the population ageing model [13 - 17].

1.3 Paper Organization

The section I gives introduction about the ageing dynamics approach including definition of ageing and description of the ageing dynamics in artificial agent societies (AAS). Illustration of problem definition is also done in this section. Then, the section II discusses the case-study which is considered using the ageing dynamics approach. The section III presents the proposed work regarding the work-allocation strategies in an organization -An artificial agent societies approach and its working algorithm. The conclusions extracted from this work are presented in section IV.

II. CASE STUDY

In this paper, the case study of Steel Company as an organization with ageing population is considered for modeling the proposed work [10]. Here, we are considering that this particular organization has three different

departments [4]. These departments involve different sections of employees working in it. For example, section one includes marketing department, section two includes production department, and section three includes finance department. Here, finance department indulges in salaries of the employees. Finance department also handles the revenue of the company. Production department handles the production of the company's goods and services. Marketing department comes, which puts their eye on the promotion of the company goods or services. Employees who are working in three different departments are belongs to different ages. The age structure of employees who are working in organization is to be examined. In a single department, various groups of employees are made according to their ages. Based upon the current age of an employee, work is allocated to him/her to perform. Aged persons are allotted tasks based on their experience. Less experienced persons (young) are working under the guidance of experienced persons (older). When the employees are getting old, they will retire at specific ages. The jobs which are performed by retires are shifted to less experienced employees (under guidance). The shifting of work from older to young employees reduces the work load on older workers. The older employees, getting retired are moving out from the societies. Side by side, Organization is also recruiting freshers (new employees) as well. The new employee is placed on a relevant position in the company, which is best for him/her. We have arrived at the conclusion that the workers near the retirement have much better mental and physical wellbeing status [18]. In order to improve the status of existing as well as new employees, organization can conduct workshops and training programs. This case study is evaluated by modeling "The Population Ageing Model". Figure1 shows the working model of the case study using ageing dynamics approach.

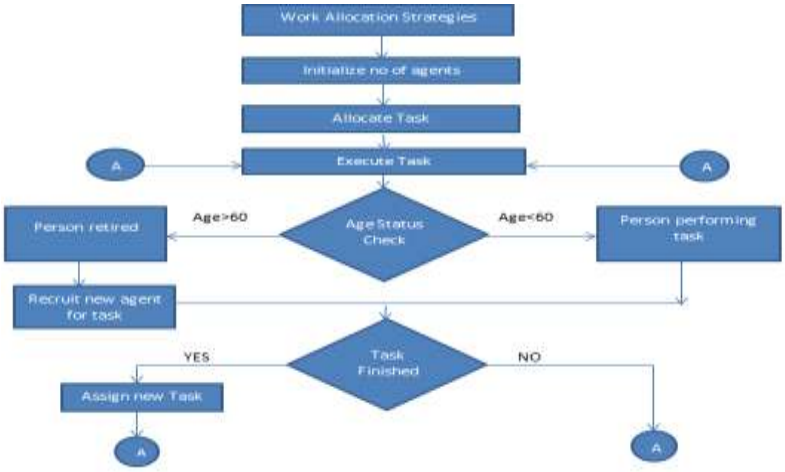

Figure1: Working Model of Case Study

OUTCOME

By applying the above strategies great improvement in the working is observed. The young person starts to learn greatly from the older persons. Workload from older persons eventually decreases and shifted to younger

persons. The process continues and improvement in overall result is experienced. The above situation is described in terms of the proposed model of Population Ageing.

III. PROPOSED WORK AND WORKING ALGORITHM

3.1. Proposed Model

The proposed model is modeled with respect to above case study. In this model, artificial agent societies are considered which provides great way out to analyze complex environment. Ageing in artificial agent societies is one of such inevitable situations, which must be analyzed to determine agent behavior [7]. The artificial agent societies provide a way to accomplish analysis process of ageing on behavior of the agent within the organization. The profitability of organization is greatly influenced by ageing dynamics. The ageing affect is listed through *the Population Ageing model* shown in figure 2.

This model describes ageing dynamics used to describe the behavioral changes as a result of ageing transition and its effect on society [11]. The agent societies can be considered to describe this mechanism and approach. The societies are formed by considering distinct behavior that agents possess. The agents having same attributes are grouped together within the same group. The effects of *Population ageing* on various societies are considered [10]. These effects of population ageing are described by the model of population ageing. The impact of population ageing is the increase in number of older people, caused by a decline in mortality as described in diagram. These changes are partly the result of *individual ageing*- people change biologically with age and societies react differently to older than to younger people, producing the social changes that accompany population ageing. These individual changes describe the interface ageing affect including effect on new, young and old persons. These individual changes occur in the context of each birth cohort[1], because improvements in health are changing by technological and environmental changes in life over which we have very little personal control [1], [2].

Population ageing and *Individual ageing* combine to produce ageing transition in society. It will change the sex and age structure of the older population. An age and sex structure represents the number of a given age and sex in society and is built from the input of births at zero and from death caused by diseases or other factors. There exist parameters which are affected by the ageing. Primarily, aging parameters considered Gender (male/female), Types of Age, Age phases, Dependencies and Influenced factors. The age effect on males is different than on females. The parameters for studying ageing affect are described as under:

1) *Gender:* It describes type of agent in terms of male or female. Generally, more male babies than females are born, but more males than females die at older ages. In most societies, females outnumber males at older ages.

[1] *Birth Cohort:* People who share something in common; in demography, this is most often the year of birth.

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2) *Age:* There are some different perspective on how to classify someone's Age:-

a) *Chronological age:* Chronological age tells the number of years a person has lived.

b) *Biological age:* A description of an individual's development based on bio markers comes under biological age. Biological ageing refers to a decline in physical abilities in older people accompanied by increased risk of illness.

c) *Psychological age:* Age of an individual determined by degree of emotional, mental, and physiological maturation comes under psychology. Now we are trying to say how old a person is without bio marker.

d) *Functional age:* It is a combination of physical, biological and chronological age. Functional age would give you the clearest understanding of a person.

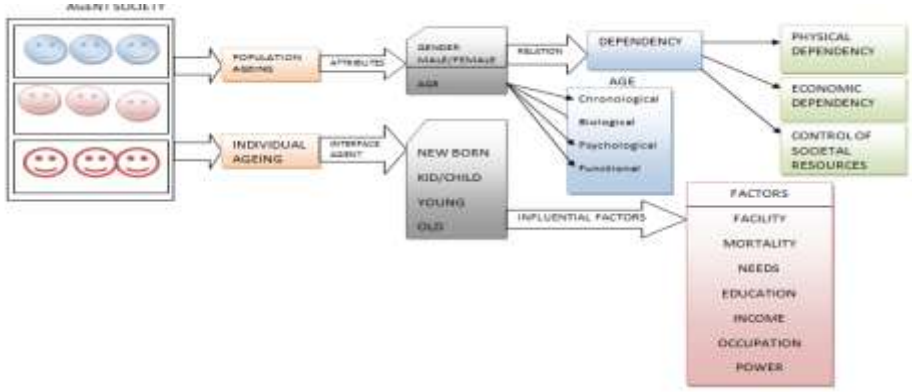

Figure2**.** Population Ageing Model

3) *Dependency:* Age wise dependency exists. As the age increases dependency on others increases. Various dependencies of older population exist in the proposed model which leads to burden on younger population. Some of these dependencies are described as following:

a) *Physical Dependencies:* Due to age factor older people become less physically capable to survive and less conscious. Their stamina gets reduced up to a great extent. This is how they have to depend upon youth. This dependency can be reduced by keeping personal healthcare agents or assistants.

b) *Economic Dependencies:* Economic burden reflect on the active proportion of the population of working age. Economic dependency exists when non-active population is dependent on active population. In other words, older population dependent on younger population financially.

c) *Control of Societal Resources:* Control of societal resources comes under older population because of their properties and welfare which depends upon their life expectancy rate that is higher than younger population. Other societal issues like controls, responsibilities are also under the older population. The age can adversely affect the performance of an organization. The factors which are influenced through ageing are described as under:

- *Fertility:* Lesser the fertility rate, lesser the number of young ones and higher the older population. This mechanism cause burden on the society where lesser the number of working ages.

- *Mortality:* Mortality is inversely proportional to age. Mortality decreases with age. At older ages, mortality of males is more than the mortality of females.
- *Need:* Needs increases with age. Hence need is directly proportional to age.
- *Education:* Better education is a very important factor that raises the opportunity for children and encourages women to limit fertility. The literature survey over the last few hundred years has meant that each generation of older people tends to be better educated than previous generation. This will generate a better society for every age group.
- *Income and Wealth:* Income increases as age increases since agent may be promoted to next higher post. As the time passes, agent may get retired and hence income can decrease.
- *Power:* Power decreases as age increases. Therefore, this affect is inversely proportional to age.

3.2. Working Algorithm

The above mentioned case study is evaluated using the proposed model, which will be working according to an algorithm (Work_Allocation_Age). This algorithm will check the age structure of employees who are working in an organization. The employees in an organization are assigned multiple works, which will be performed by various work-allocation strategies according to their ages.

Algorithm(Work_Allocation_Age)

1. Initialize Societies
2. *Society* = Group of Agents
3. Initialize Population.
4. *Population* = No_of_Agents.
5. *Age* is age of an agent in a society
6. *Work* is work allocated to an agent in a society
7. Check the *Age status* of each Society.
8. Make *Societies (groups)* including Agents with similar type of work in one society.
9. Perform *execution of the Allotted_work* to the different agents in a society.
10. If Finished($Work_i$)
    Assign *New_Work* to *Agents*
    End if
11. Increase Age_i with each tick(unit of time)
12. If Age_i>60 then
    Retire $Agent_i$ and move it out of the society
    Make Young $Agent_j$ to join the compatible society

End if

13. If all the *Allocated_Work* is done
    goto step 9
    Else
    goto step 3
    End if
14. Return average work load on individual agent and number of agents with work assigned and agents which are free.

IV. CONCLUSIONS

In this paper, we have presented, various effects of ageing dynamics existing in artificial agent societies. All the dynamic aspects which are discussed by us for population ageing in artificial agent societies are inspired by the dynamics aspects of human ageing, as both of them have quite a number of similarities. We have elaborated on types of ageing and effects of population ageing on older population as well as younger population in an organization. Also, we have formulated in this paper, a model of *population ageing*. This model throws a light on the population ageing as well as individual ageing and their influenced factors. The proposed work analyses the steps which are taken by distinct organization in order to cope with ageing of employees. The organizations utilize the ageing experience of the older employees to broadcast the experience to other employees and decrease the load on an older employee gradually. In future, we plan to implement this work using NetLogo multi-agent programming and simulation environment.

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