Towards application of simulation in a social scenario

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***Abstract*- There are number of research practices, methodologies and tools existing and evolving to help the social science researchers in conducting there research studies such as doing surveys, analyzing quantitative and qualitative data etc.Social simulation models have a significant role play in the area of social sciences. The role of social simulation models have increased to such an extent that they are attempting to incorporate actual human social behaviour.This paper deals with the nature and implications of the growing importance of research in the area of social simulating models. The agent based social simulating models are supposed to serve as a prototype of the real social scenario. We discuss the purpose, design and direction of systems for the simulation of social phenomena from the perspective of a social expert and analyze their in real the world picture. The analytical study carried on social simulations is discussed on various parameters that have remained subtly trivial and insignificant in this research area. The parameters are classified as the type of application being simulated, the categories of result obtained from simulating models. We do this by arguing and speculating about what an ideal system of this type might look like and how practically useful and applicable it is to the current social scenario. It is certainly true that the use of Agent based modelling opens up new scientific perspectives but we must keep in mind the fundamental limitations and pitfalls of computer based modeling.**

***Keywords*-Social Simulation Models,Agent Based Social Simulation,Social Behaviour**

I. INTRODUCTION

Let us begin with a definition of simulation. "Simulation means driving a model of a system with suitable inputs and observing the corresponding outputs."

While this definition is useful, it does not suggest the diverse purposes to which simulation can be put. These purposes include: prediction, performance, training, entertainment, education, proof and discovery. An important type of simulation in the social sciences is "agent-based modeling." This type of simulation is characterized by the existence of many agents who interact with each other with little or no central direction.Social simulation has an analytical relationship to Artificial Intelligence, in general, and Multi-agent Systems, in particular. It is both an area for the application of methods, techniques and technologies of AI and MAS, as well as a source of inspiration for new theories, models and methods for AI and MAS, as it draws upon the theories, models and methods of the social sciences (anthropology, sociology, political science, economy, government, management, etc.). In social simulation, computers support human reasoning activities by executing these mechanisms. This field explores the simulation of societies as complex non linear systems, which are difficult to study with classical mathematical equation-based models.

Agent based computing is the design of the model and agents, while the computer simulation is the part of the simulation of the agents in the model and the outcomes. The social science is a mixture of sciences and social part of the model. It is where the social phenomena is developed and theorized. The main purpose of Agent Based Social Simulation is to provide models and tools for agent based simulation of social phenomena.

II. SOCIAL SCIENCE AND SOCIAL SIMULATION MODEL

The objective of social simulation is, trivially, to help us understand social phenomena. What is difficult to achieve is knowing what sort of understanding it can give us and how this may occur. Agent-Based Social Simulation (ABSS) is that it constitutes the intersection of three scientific fields, namely, agent-based computing, the social sciences, and computer simulation. According to the view adopted by Davidson, ABSS can be said to investigate the use of agent technology for simulating social phenomena on a computer. Based on the characterization above we may conclude that the main role of ABSS is to provide models and tools for agent-based simulation of social phenomena [2], and to apply these in different areas. Whereas social science includes any discipline or branch of science that deals with the socio cultural aspects of human behaviour. The social sciences generally include cultural anthropology, economics, political science, sociology, criminology, and social psychology. Comparative law and comparative religion (the comparative study of the legal systems and

religions of different nations and cultures) are also sometimes regarded as social sciences.

Research on social simulation is progressing very rapidly; social scientists have begun to convert social theories to computer programs. This is how simulation of social processes and experiments can be carried out that would otherwise be impossible. Simulation is useful when the phenomenon to be studied is not directly accessible or is difficult to observe directly. Also, computer simulation has been used as a method to clarify sociological theories [3]. As Gilbert has pointed out, one advantage of simulation is that it is hard to do. To create a simulation model from a sociological theory stated in a natural language, all assumptions etc must be described explicitly and formally. Also, in order to run a simulation, every parameter in the simulation model must be given a value. You simply cannot be vague about what is being assumed.

We argue that research in developing the social simulation model has not yet progressed enough to replicate a social system and there are still barriers in obtaining the real data and improve representations of social behaviour. Nor developed social simulation models are efficiently and realistically useful to stakeholders or policy-makers. There is this general sense of failure that simulation models of social phenomena can provide practical advantages or somehow become useful tools to the target users. A few drawbacks with the simulating models enlisted are as:

(i)How to assess that a social model fully replicates social behaviour.
(ii)All types of social behaviour and scenarios are grouped into the same category of "social behaviour" no categorization is there for designing the simulation models.
(iii) What development cycle should be followed for developing models in simulating social phenomena?
(iv)There are no examples of simulating complex social systems that involve too much of human intervention.
(v) Numerous models are there that either represent small social phenomena or limited social behavior.
(vi)There is still so much of disagreement within different social simulation models and within social simulation researchers' points of view

As stated by Edmonds and Steve [4] modelling social systems is difficult. It is difficult for (at least) two reasons. *Firstly*, the complex interactions that are involved in social systems mean that the outcomes are difficult to analyze using traditional formal approaches. One of the reasons is the "computational 'distance' from the system's initial set-up to the outcomes is so great that is completely impractical (and probably unhelpful) to attempt to derive general properties of the outcome from the set-up in an analytic fashion. *Secondly*, the characteristics of social phenomena are frequently best approached using semantically rich representations (purpose, emotions, social pressure etc.)and these are difficult to translate into formal model that they termed as semantic complexity.

III. SOCIAL SYSTEMS AND SIMULATION

In social simulation, computers support human reasoning activities by executing these mechanisms. This field explores the simulation of societies as complex non linear systems, which are difficult to study with classical mathematical equation-based models.

Agent based social simulation models are potentially used for predicting individual and flock behavior in social phenomena. For example ABM is very popular in ecommerce for predicting market trends and behavior[5].The models developed by Moss and Edmond has been developed to capture salient characteristics of observed regularities in specific social interactions. They represent a set of modeling techniques and an integrated methodology which capture the rigour and precision of the economist's approach to the social sciences also encompassing the richness of sociologist's approach. For example in markets for alcoholic beverages are "special", "traditional", "imported" (though usually produced domestically),"unique". The first models reported by Moss and Edmonds [6] were based on marketing practitioners' assessments of the different reasons why agents might buy such beverages. All of the models by Moss and Edmonds [5] [6] [7] described represented agents or their behaviour in ways which were validated independently of the models. It was found that the behaviour of consumers in the intelligent market modeling system conforms to the independent views of marketing practitioners.

Simplistic models often use unrealistic assumptions about the structure and processes of studied social behavior, a fact that further complicates cross-validating social simulation models at macro and micro levels [10]. Once a simulation model is built, the modellers proceed to test hypotheses with scenarios that replicate the real social phenomena. The simulation results are compared and analyzed with the involvement of policy makers and stakeholders. In case if the results consistently diverge from what has been observed in reality, it depicts that probably the datasets were incorrect or the representation was not compatible with the real world situation. Thus this results in model being modified till it is both comparable to available evidence and is acceptable by stakeholders and policy-makers. One of the significant

reasons for this incompatibility of simulation models with the real time scenarios is that the stake holders are no where or have little role to play in the design of these models. The factors affecting social phenomena are from different fields for example economics, environment, sociology etc and all these factors need to be involved when designing a prototype. The work done by Hassan etal.introduced different dimensions in the agent based social modeling. He emphasized that there are social problems that require the consideration of some aspects with uncertainity as human thinking does.So, they addressed these considerations using fuzzy set theory [1].They depicted that the use of fuzzy logic can improve agent models that get closer to reality. Pointing out to the fact that abstractions for the agent models can oversimplify the view of reality and complicate the social scientist to interpret the results in the same terms in which the survey data or other observations are expressed.

There is another significant contribution by Moss etal. in the area of social simulation that was developed as a key step in the demonstration of a new methodological approach This approach rests on stakeholder participation in the model design and validation stages together with a compositional validation procedure. They developed an agent based social simulation model of water demand policy and response [9]. This model integrates representations of both natural and social systems and is developed in collaboration with stakeholders. Another important contribution involving the stakeholders by Moss etal. is the development of an agent based simulation model of the effect of drought on domestic water consumption. They validated the model qualitatively at micro level while ensuring that numerical outputs from the model cohere with observed time series data. The cross-*validation* of agent based social simulation models was a significant advancement in the analysis of social process. These researches have definitely contributed to analyzing the social phenomena and the importance of the involvement of stakeholders is also given significant importance thereby causing a spurt in the research of similar issues. But still the fact remains that the modeling is simplistic in nature and many parameters are not taken into consideration due to limitations and barriers involved with a social phenomena. Therefore very complex systems involving too much of human intervention is difficult to model.

With the present state-of-the-art it is probably impossible to use simulation models of social behavior for plausible prediction. Real social systems are undoubtedly more complex and volatile than any simulation.

III. CASE STUDIES

There are several research projects that deal with modeling and agent based social simulation. For example:

- In the MAELIA Project some scientific integrative simulation tool is being build for supporting policy-making and decision-taking for the water management. This Project (started in 2009) consists in developing a multi-agent system for the assessment of the impacts of the environmental norms, with some strong focus on issues related to the basin-scale water resource management. Environmental norms mean all the norms that are susceptible of having some environmental dimension or target. [11]

- Other research project such as the application of a regulated open Multi-Agent System (MAS), mWater, uses intelligent agents to simulate a flexible water-right market. Though there are many sophisticated decision support systems for water management from a hydrological perspective, but none of them designed from a social perspective. The multi-agent system(MAS) facilitates in designing intelligent agents that mimic humans, thus implementing different factors such as (mis)conducts, trust criteria and users willingness to water-right trading., It supports in dynamically changing norms and regulation at no cost, and explore the impact on the evolution of the market, within a decision support tool. Mixing all these elements together, the implementation of mWater system is done as an electronic institution that demonstrates very appealing for decision taking and policy makers to test: i) how regulations and norms may modify the users' behaviors, and ii) how the quality indicators of the market are affected.[12]

There are several sophisticated basin simulation models, particularly decision support systems for water management. From a hydrological perspective, these works have successfully bridged the gap between the state of the art in water-resource systems analysis and the usage by practitioners at the real-world level. [12]However, the gap can still be considerably narrowed from a social perspective, which is an important limitation nowadays. The major objective here is not only to consider hydraulic factors, such as river basins, water demands, pumping ows, etc., but also different norms typology, human conducts, trust criteria and users willingness to agree on water-right trading, which may finally lead to a successful situation for more efficient use of water.

- The NewTies project is implementing a simulation in which societies of agents are expected to develop autonomously as a result of individual, population and social learning. These societies are expected to be able to solve environmental challenges by acting collectively.13]. The NewTies project aims to discover whether an artificial society can 'construct itself' with only the bare minimum of experimenter-provided rules or theory. The project outlines a design for a simulation which can be tuned in ways that are expected to promote the emergence of agent social behaviour to solve environmental challenges analogous to those that human societies have been able to overcome.

IV. SOCIAL SCIENCE AND SIMULATION ISSUES

The literarture is flooded with social simulation and modeling techniques. We have described a few case studies in the previous section that deals with handling complex social scenarios with simulation (MAS) and modeling. But, making too close a link between the simulation and human societies would many a times lead to inappropriate results. The reason is that the simulated agents do not possess all the human qualities, and we do not know to what extent the differences between humans and the agents are important for the generation of analogous social phenomena. For example, it was noted that the simulation does not treat 'warmth' as a distinct need for the agents, although in cold climates it is for humans [13].

The important issue here is how logically and empirically correct are the techniques and results obtained from modeling these scenarios.What type of validation needs to be done to measure its significance and relevance.

Growing research on social simulation [8] has shown that it has helped solve many social complexities that might not be practically possible to solve or predict or the deduction of results would have been affected. Simulation is able to take complicated inputs, process them by taking hypothesized mechanisms into account, and then generate their consequences as predictions. But, contrary to this there is a pressing need of social simulating models that actually help the stake holders or have practical applications beyond the theories.

Human societies are complex in that there are many, non-linear interactions between their units, that is between people. No categorization has been done in social phenomena. Some require excessive human intervention whereas some can be modeled without the involvement of stakeholders. For example, the adoption of one of a pair of alternative technologies within a society can be greatly influenced by minor contingencies about who chooses which technology at an early stage in their introduction. Modellers should have a good understanding of the case and they should be able to assess if a particular social phenomena can be represented using a model or not by involving the stakeholders and the policy makers. What approach should be followed to model very complex social systems that are affected by various parameters from different areas does not exist.

There are many barriers in conducting the real time assessment of the actual social scenario. Unlike laboratory scientists, who conduct their work under relatively controlled conditions, most social science researchers conduct their work out in the field. In their efforts to study the society within which they live, they must employ an array of social research methods. However, if they are not careful, their research data can be erroneous if it is corrupted or obtained in a wrong way, without proper channel or consent. Thus data can be easily corrupted in the absence of proper precautions. These limitations would sure affect the modelers in modeling the phenomena.

V. CONCLUSION

In this paper we have tried to assess the social simulation models from the prospect of its actual capacity to solve real time social problems. From the perspective of social phenomena, it is essential that modeling process should have its acceptance beyond socio theoretical frameworks. Although agent-based modeling employs simulation, it does not necessarily aim to provide an accurate representation of a particular empirical application. Instead, the goal of agent-based modeling is to enrich our understanding of fundamental processes that may appear in a variety of applications. The validation techniques need to be more standardized and accurate so that they may actually establish some realistic results that have actual significance in real social scenario. Progress requires the development of an interdisciplinary community of social scientists who do simulation. Progress also requires the development of an even broader community of researchers from all fields who are interested in the simulation of any kind of system with many agents. Explorations are required for the type of development methodology needed for developing such systems. Certainly, ecology and evolutionary biology have a great deal to offer for the study of decentralized adaptive systems. Likewise, computer science has recently started to pay a great deal of attention to how

large systems of more or less independent artificial agents can work with each other in vast networks. For the social processes to be modeled, investigated and understood by the social scientists or for agent based software engineering, it becomes essential that well validated concepts from social psychology and streams of cognitive science, along with the involvement of policy makers and stakeholders should be employed to build models capturing the features of social scenario observed in, reality so that the explorations contribute beyond the academic theories.

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