ADDRESSING STRATEGIC CHALLENGES ON MEGA CITIES THROUGH MS2G

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ABSTRACT

This paper proposes the combination of modeling and simulation and serious games in order to create an effective framework to address crowdsourcing. Indeed interoperable simulation, intelligent agents and serious games have great potential and a new architecture is proposed in this paper. Such architecture that is based on modern technologies and standards allow today to develop an effective cloud solution that could deliver simulation as a service (SaaS). This approach is defined as MS2G (Modeling, Simulation and Serious Games) and could be used to address also other areas such as capability development, training, etc.
In this paper MS2G is proposed to adopt it in order to face the strategic challenges related to future scenarios involving megacities; hence, the large metropolitan areas are expected to require simulation as support tool to address complex aspects such as energy, logistics, food, safety, security. Crowdsourcing in this framework provide a great chance for both policy makers and citizens to work together evaluating new solutions.

Key Words: Crowdsourcing, Megacities, Serious game, Modeling & Simulation, Collective Intelligence, E-government

1. INTRODUCTION

During last year the evolution of interoperability standards for modeling and simulation enabled development of new generation of models; for instance the case of intelligent agents devoted to reproduce complex behaviors have been effectively applied to several domains such as health care, country reconstruction, disaster relief, defense (Bruzzone, Tremori, Massei 2011, Diaz et al. 2013).; the idea is to get benefits from the engagement procedures of serious games and from simulation to guarantee interoperability.
The diffusion of new technological solutions supporting IoT (Internet of Things) are enabling cloud applications; these phenomena are contributing to enhance simulation potential being able to be distributed over a wide community of users (Weber 2010); to succeed in this task it is necessary to guarantee that these innovative generation models should adopt these new technological standards and solutions (Bruzzone et al.2013b).
Therefore it is also fundamental to guarantee that these models should be effective in being distributed to many users; so usability, engagement, friendliness, immersive and intuitive interface become crucial aspects to be included (Connolly et al. 2012).
From this point of view the methodologies used within Serious Games (SG) for guarantee user engagement as well as the relative immersive technologies have a great potential supporting these aspects.
Another crucial element is represented by the necessity to automate many objects in the models by attributing intelligent behaviors; indeed most of the complex systems that could benefit from the innovative simulators are characterized by being composed by many different entities dynamically interacting in a pretty sophisticated way (Bossomaier et al. 2009); in this sense the adoption of intelligent agents (IA) is a very smart idea and the availability of interoperable agents ready to be federated with simulators represents a strategic advantage (Bruzzone, Tremori, Massei 2011).
Due to these reasons, the authors propose to integrate Modeling and Simulation (M&S), Intelligent Agents and Serious Games (SG) within a combined approach defined as MS2G (Modeling, Simulation and Serious Games).

The idea is to get benefits from the engagement procedures of serious games and from simulation to guarantee interoperability.
The current paper address this problem in relation to create a crowdsourcing framework for Mega Cities of the future; by MS2G all stakeholders will be able to "wear the heat of the city major" and to play the game trying to solve complex real problems such as power supply systems, transportations & households.
The MS2G will allow considering sustainability (i.e. social, economic and environmental) under existing constraints (i.e. available space, technology capabilities, renewable energies etc.).

2. MS2G AS COMBINATION OF M&S AND SERIOUS GAMES

The authors proposes MS2G (Modeling, Simulation and Serious Games) as combined approach to address crowdsourcing and to further diffuse M&S.
It is evident that simulation offers many opportunities to be applied with demonstrable benefits as technology able to investigate new ideas, to test assumptions, to acquire knowledge, to predict future scenarios and to prepare solutions (Bruzzone, Kerckhoffs 1996). Indeed simulation in the last decades has been used in a wide range of field, such as: engineering, physics, medicine, logistic and military operation, astronomy, etc. with many different scopes (Massei 2006; Merkuriev et al. 2009).
Another interesting sector, characterized by different characteristics, it is represented by serious games, where the focus is usually shifting from entertainment to education and training keeping benefits of user engagement (Crookall 2010). For instance, serious games have educational values that are based on learning concepts advocated by constructivist psycho-cognitive theories; they guarantee intrinsic motivation, generate cognitive conflicts and provide situated learning (Mouaheb et al. 2012).
Mike Zyda provided an update and a logical approach to the term in his 2005 article and his definition begins with "game" and proceeds from there:

- Game: "a physical or mental contest, played according to specific rules, with the goal of amusing or rewarding the participant."
- Video Game: "a mental contest, played with a computer according to certain rules for amusement, recreation, or winning a stake."
- Serious Game: "a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives."

A Serious Game is not simply a simulation; it has the look and feel of a game, a chance to win, but correspond to non-game events or processes from the real world, including for example military operations (even though many popular entertainment games depicted business and military operations). Serious Games with special emphasis on Homeland Security have been developed in many application, for instance as GNU-licensed Open Source engine (Darken et al. 2007) as well as web based multiplayer game (Bruzzone et al. 2014).
Hence, games are focusing on creating an engaging, self-reinforcing context in which to motivate, educate and train the players. This could be applied to very different sectors, for instance an application of monitoring obese people through a cloud-based Serious Game was developed in order to motivate them for physical exercising in a playful manner; the monitoring process focuses on obtaining various health and exercise-related parameters of obese during game-play in order to contribute to their weight loss (Alamri et al. 2014); in similar way serious games was used for measuring sense of presence affecting training effectiveness by online virtual simulation (De Leo et al. 2014).
Hence, there are games designed for supporting crowdsourcing using more realistic knowledge and tools (Eickhoff et al. 2012); so there is a strong potential in combining realistic simulation with computer games.
The innovative concept proposed by the authors is to develop a new generation of solutions devoted to support crowdsourcing that combines interoperable simulation and serious games; the main focus of serious game component is on the user engagement, while the interoperable simulation guarantees to be able to create scalable, reliable and modular scenarios where experts could develop experience and construct trustiness on the models.
In addition, the idea to deploy the simulator over a cloud and to be accessible over a server function allows getting benefits of SaaS (Simulation as a Service) paradigm. Indeed, the proposed architecture is scalable and could be easily distributed in a network, while users could access these services from the web without specific re-configuration needs; in this way the community of users and the knowledge repository generated by these new MS2G solutions is further empowered.
In the proposed example all the info exchanged with the user are presented within a plug in for standard web browsers.
From this point of view it is crucial to introduce also Intelligent Agents (IA) able to support agent driven simulation; this allows reproducing complex mission environments where multi entities should adopt "intelligent behaviors" reacting dynamically to the scenario evolution as well as to the different actor actions.
From these points of view the authors are integrating the IA-CGF (Intelligent Agent Computer Generated Forces), an innovative set of HLA interoperable IAs developed by Simulation Team and tested in multiple applications (Bruzzone, Tremori, Massei 2011).

Due to these reasons it emerges evident the opportunity to combine M&S and SG into MS2G as framework to create new engaging web games able to operate over a wide spectrum of platforms including mobile devices; MS2G approach guarantees interoperability with multiple models and simulators reinforcing aspects such as modularity, composability, reusability and capability to interact with real equipment and systems.
The authors propose to adopt the interoperable simulation standards to keep this solution open to be federated also with other models by using HLA, High Level Architecture (Kuhl et al. 1999, Longo et al., 2013-a); so this new approach, defined as MS2G, strongly relies on these capabilities. In addition MS2G could be adapted to address also other additional service respect crowdsourcing (e.g. training, dissemination, education) reinforcing the potential of this approach; indeed the users could finalize and test hypotheses, parameter changes, solutions and decisions within the simulator environment; the simulator results able to evaluate the impact of these changes and of the different assumptions on the final results.
The authors develop an architecture based on the integration of distributed interoperable M&S with a web serious games; the solution enable to create a web service by deploying simulation over a cloud and guaranteeing access from distributed users.
The paper focus on the development of an application addressing crowdsourcing in relation to future megacity challenges. Indeed MS2G allows to create virtual worlds where stakeholders could test different assumptions and consequence interacting dynamically with the simulator; by this approach crowd sourcing and data mining, become available to a large user community. The users will be able to take decisions and to evaluate different solutions related to food, logistics, energy, environment respect future urban scenarios. Indeed in these areas, simulation based approaches have already proved to be able to provide effective solutions and support the decision making process (specific examples can be found in Longo et al. 2013-b, Longo 2012). The interoperable stochastic simulator (part of the proposed architecture) could evaluate also the risk related to factors affected by uncertainty such as fluctuations in prices, potential natural disasters, population demand forecasts (Bruzzone et al.2008a).

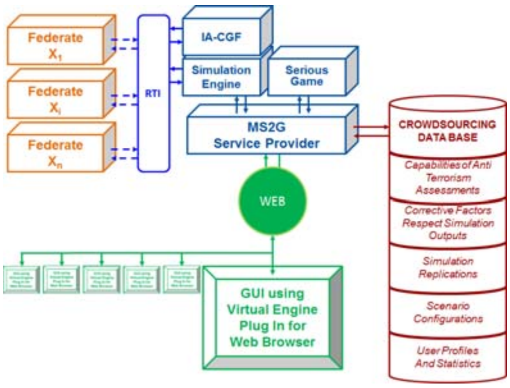

Figure 1: MS2G Architecture

The proposed architecture is represented in figure 1.
The main concept is based on the combination of Discrete Event Simulation, Web Based Simulation, Virtual Simulation and Intelligent Agents with the aim of introducing Decision Makers, Subject Matter Experts and other Stakeholders in an intuitive and interactive experience.

3. CROWDSOURCING AND MS2G

MS2G is a powerful instrument to analyze complex system such as a megacity, in particular for reproducing the evolution and interaction of several entities (Bossomaier et al.2009; Bruzzone et al. 2004, 2009, 2013a). Complex systems require to model different sub-components and entities as well as their interactions; this could be effectively done by modeling the different elements and to let them to interoperate (Kuhl et al. 1999).
The complex systems are pretty challenging to be studied due to the high influence of entities interactions and stochastic elements generating not linear components; these aspects lead to the generation of emergent behaviors that are not intuitive and often not predictable; due to these reasons simulation appears as the main investigation tool; therefore in order to identify solutions to control or direct the evolution of complex systems it is evident the necessity to develop some analysis and experimental approach; from this point of view the use of crowdsourcing results pretty promising.
Indeed “collective” intelligence is a business model that is already used by several companies by means of virtual communities; this approach is considered such as an open enterprise producing ideas, solutions and analysis from the whole community.
It was defined the collective intelligence phenomenon as "the capacity of human communities to evolve towards higher order complexity and harmony, through such innovation mechanisms as differentiation and integration, competition and collaboration” (George Pór, 1995).
Collective intelligence was already available potentially also in the groups, families and communities, but in order to produce effective results it is necessary to access a large, effective, efficient, quick and capillary network; indeed this potential is guaranteed today by new communications based on internet, social networks, IoT (e.g. connected device such as smartphone and computer). Today it is also possible to create and access large data quantities that could be used in order to characterize a particular process or a group of processes.
Indeed, crowdsourcing, or the outsourcing of tasks to the general internet public, has been made possible by technological innovations related to "Web 2.0" (Kleemann et al. 2008),
Therefore Crowd-sourcing is a new work methodology that unifies the experience, the knowledge as well as the different points of view of

many experts towards a collective intelligence for addressing a specific problem (Bruzzone et al. 2012).
The basic principle behind crowdsourcing is that more heads are better than one; it is evident that this could be strongly supported by innovative internet services and resources available on the web 24/7 for a large community through dedicated web platforms (Bruzzone et al. 2012). In this way users access to many information and are entitled to:

- increase transparency of available information
- get access to the available data
- share trusted information
- guarantee the storage of the information

The idea is to maximize the collective intelligence in order to find solutions or reach consensus about political decisions, such a new power plant, or a new transport infrastructure among the citizens (Bruzzone et al. 2013c).
The innovative concept related to use MS2G into crowdsourcing is the possibility to create an interactive virtual world to each stakeholder; in this way he could conduct his own experiments and test his hypotheses and ideas; in addition the MS2G world becomes available for sharing the experimental results in a large community

4. THE MEGACITIES CONTEXT

The global urban population is growing by 65 million annually and the number of people that lives in town and city is already more than 50% of the total world population generating 80% of total GDP (United Nation, 2014; PWC 2010). The cities represent only 2% of earth's surface, but they use 75% of global resources. (Bugliarello 1999).
Today the situation of Cities, Metropolitan and Urban Areas overpassing 10 million inhabitants are distributed especially over emerging countries (see figure 2); it is interesting to note that many new locations in Far East, Latin America and Africa are approaching such threshold.
Urbanization will be one of the major drivers for the next century and represents a major challenge. McKinsey Global Institute, in its forecasting, is reporting that in 2025 2.0 billion of people (25% of the total world population) will live in only 600 urban centers ("city 600") that will generate 60% of global GDP.
Continuing population growth and urbanization are projected to add 2.5 billion people to the world's urban population by 2050, with nearly 90 per cent of the increase concentrated in Asia and Africa (United Nation, 2014); in that period the size of household is declining, the biggest 600 cities are likely to account for 250 million new households.
In this context, the big challenge for the future is to preserve a harmonized growth of mega urban centers, preserving a good balance between urbanization, development, and quality of life for the inhabitants (Fujita et al.1999).

Sustainability should be considered as a major element by a comprehensive approach, where obviously simulation could provide significant benefits (Dupont, 2013; Fiala 2008; Cabezas et al. 2002)
A megacity is usually defined as "a metropolitan area with a total population in excess of ten million people".(How Big Can Cities Get?" New Scientist Magazine, 2006). Therefore a megacity could be represented by a single metropolitan area or two or more metropolitan aggregated areas.

Figure 2: Current Mega Cities around the World

In order to understand and analyze this problem more effectively it is necessary to consider several layers:

- the social layer (cultural diversity and variety, education, art, living conditions, transport, security, health care, innovation, etc.)
- the economical layer (work & mass unemployment, improvement of infrastructure, new technologies, decentralization, repartition of wealth, capital equipment, etc.)
- the ecological layer (energy sources, sustainable development, air and water pollution, noise pollution, traffic jam, water supply, urban sprawl, urban environment protection, public transportation, waste management, etc)

In GlobeScan research (2007) three city archetypes are defined in relation to different parameters:

- Emerging cities: Emerging megacities are characterized by high grow rates driven both by migration and natural growth with a rate of 3-6% per year. Emerging cities have a younger population profile
- Transitional cities: Tansitional megacities have a lower natural population growth but an high migration ; they usually grow by 2-3% per year. Several of these cities are seeing the first signs of an ageing population.
- Mature Cities: Mature megacities have much slower growth rates than both Emerging and Transitional megacities, at around 1% on average. Mature megacities also have older population profiles.

It is important to outline that megacities attract the most talented people and attract more investments, stimulating local and global economic growth with the city network In this context the competition among the megacities is extremely high; every city tries to keep the most talented people and to capture as much investments as possible from worldwide (Shannon et al. 2012).

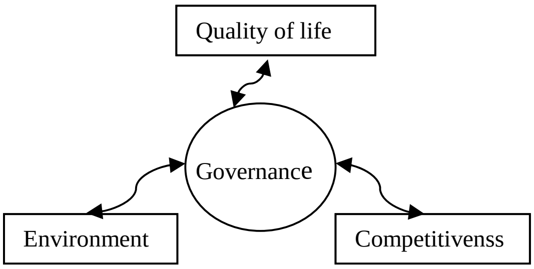

Figure 3: Governance Basic Model

As much as a city is competitive, as much results attractive enabling to enroll a higher number of new citizen. Therefore the Authorities and City Governance need to find a balance among competitiveness, quality of life and Environment as proposed in figure 3 (Fu-Liu et al. 2006).

This results in a quite hard task for the city majors who have to take decision within this really complex problems; indeed a megacity is a really complex system with a huge number of interactions within people, different systems & layers including environmental issues. These systems are continuously changing and growing, expanding in time and space and asking for more space and more energy while it is evident that they are affected by constraints such as limited economic, environmental and space resources.

To evaluate these aspects it could be useful to adopt effective metrics; from this point of view an interesting study covering 112 Chinese cities respect sustainability proposed 18 individual indicators grouped into five key categories: basic needs, resource efficiency, environmental impact, the built environment, and commitment to future sustainability (Jonathan et al 2012). Indeed, in the megacity context there are many challenges that policy maker need to face, such as:

- ***Transport***: Congestion costs are often extremely huge both for economy and environment; improving public and private mobility is absolutely needed (Rodrigue et. al 2006)
- ***Food Logistic***: Food distribution in a megacity is a big challenge, and an efficient urban logistic could reduce traffic and pollution, increasing competitiveness. In addition traceability reduces and mitigates events like contaminations that are extremely since they can affect the health status of a large number of people.
- ***Reverse Logistic & Waste Management***
- It is important to consider both the flows of the supply chain, because in a megacity tons of waste are produced every day and need to be managed. An efficient reverse logistic can resize packaging reducing waste production (Pfohl et al. 2010)
- S***afety and Security:*** these are big challenges; usually in these contexts the organized crime is the biggest security challenge for megacities as well as terrorism. Furthermore protection against natural disaster such as earthquakes, flooding, pandemic events, could be required considering the high density of population.
- ***Power supply***: Energy and power supply is fundamental, and the use of renewable energy can reduce the environmental impact
- ***Environment***: Air, ground and water pollution should be considered; indeed water quality is one of the major issues in particular for Emerging cities
- ***Quality of Life and Healthcare***: Healthcare infrastructure and quality of life are key parameters for making a city more attractive for future developments.

Considering these aspects improving governance is usually the first step towards better and more competitive cities, by the way holistic solutions are desired, but obviously difficult to achieve; indeed, the main obstacle to strategic management and policy makers is often the poor coordination between the different levels of municipal government.

Indeed many megacities have many overlapping in the administrative bodies with limited responsibilities, which limit the efficiency in strategic planning.

Another important aspect is to involve not only the decision makers in the decision process, but also the citizens generating consensus.

This result could be achieved thanks to the internet revolution due to the large number of population that have an internet access: for instance today researches have been carried out on using new internet-connected devices for introducing new forms of active citizenship and e-government (Zhu Yi et al, 2011; Shuchu Xiong &Yihui Luo, 2010; Aljebly, R. & Aboalsamh, H. 2011; Jooho Lee &Soonhee Kim, 2014)

These considerations make evident the potential provided by MS2G into developing new solutions by creating an effective problem solving engine getting benefits from crowdsourcing concept and simulation capabilities.

5. MEGACITY GAME ASPECT

In this paper we propose a serious game developed for simulating decision in a megacity; by this approach the stakeholders are able to play role of city managers and operate over the web by trying to solve problems in the megacity, taking high level decisions and evaluating through the MS2G their impact.

The mega city is proposed through a dynamic evolving virtual 3D representation as presented in the following figure 4; therefore in the town there are Hot-Spots, these elements (see figure 5) represent the opportunity to change the parameters and to select the different alternatives, for instance the power generation configuration balancing different sources among nuclear, fossil, wind and solar facilities.
In the simulated scenario is possible to consider the population growth as well as the need for new resources such as new households, additional electric power and food. Population increase is an opportunity for developing the megacity, but is also a challenge in terms of resource demand, available space, jobs, energy etc.

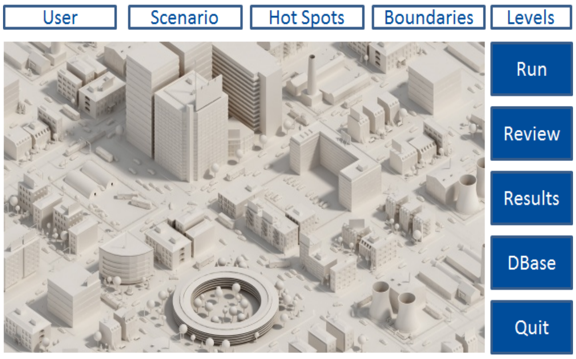

Figure 4: Example of Megacity Crowdsource MS2G

In this framework the decision making is a complex problem since there isn't only one correct solution and due to the multivariable parameters that could be used to compare alternatives; in addition the high number of elements dynamically interacting in the megacity further increase the system complexity.
For example, building a new coal power plant in order to satisfy the growing demand of electricity, increases the level of air pollution, but provides also new job opportunities; on the other side, a huge investment in wind farms results very space consuming, so available space for green areas or new households is strongly affected. Other solutions like offshore wind farms, that have a better energy density and less interference with the local systems, could result in unprofitable investments or can lead to an increase of the cost of energy for the final consumers.
MS2G makes use of the idea of gaming, simulation and crowdsourcing as powerful instrument to share information among the stakeholders by testing alternative solutions, saving and sharing previous results among the stakeholder community; in addition the experimental results provided by the simulator could be presented in the virtual world to the players in a very intuitive way.
Indeed players could try to solve problem by themselves, while they understand the effects of their decisions and assumptions; obviously each choice and solution is evaluated in terms of metrics (i.e. money, space, environmental impacts, etc.)
MS2G in this context should take in account a high number of variables obtained through simulation over the whole city by modeling different subsystems such as human subsystem, environmental layer.
The human system takes in account the variables related to the human presence such as the population, the size of the city area, the industrial area, the number of jobs, the annual income, the quality of life etc. The environmental system, takes in account the green area in the city, the emissions and the quality of air, water and land. The results of the simulation consist of both Global effects and local effects among different timescale, considering both short terms and long terms effects and consequences.
For this reason the two dimensions that are considered are to map the results are related to:

- Time (short and long term)
- Space (local and global effects)

In order to proper model megacity, the human behavior need to be simulated considering aspects such as political, cultural, economic, ethnic, religious elements as well as unemployment, taxes, etc.
From this point of view the MS2G approach in this case benefits of reusing models developed in IA-CGF to address these elements and to simulate urban tensions, interest groups and disorders (Bruzzone et al. 2008b).
In general MS2G could include different models addressing many diverse phenomena:

- Finance: profits, losses, cost of energy, etc.
- Political aspects: political acceptation or disfavor
- Pressure into ecosystem
- Water, materials, energy flows
- Ecosystem changes: evolutions of some parameters as disaster frequency, sea level, etc.

This confirms the advantage of adopting interoperable simulation able to federate different models into a common federation for reproducing mutual interactions among these phenomena.
Single results are available on the virtual world within the Hot-Stop in order to compare the different values (e.g. cost, GW, GWh, Area, CO2 emitted, water consumption, energy consumption, etc.).
Also Global Results are proposed in terms of:

- Water footprint as lake equivalent
- Carbon foot print as a black/grey cloud equivalent on the city
- Energy final cost
- Food cost
- Water cost
- Green residual area
- Building area
- Results in term of cost are stochastic according to scenarios.
- Other outputs can be the population status in term of Welfare
- General satisfaction (peak, blackout,…)
- Psychological status
- Urban Disorder Probability

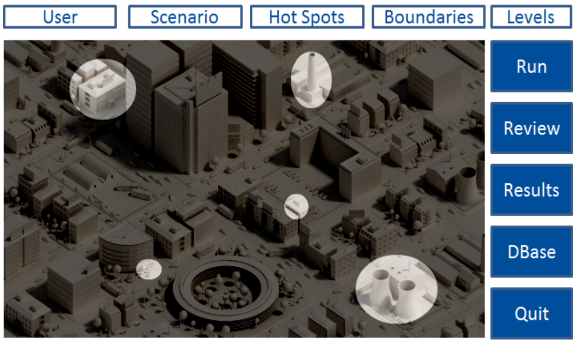

Figure 5: Hot Spots in the MS2G

Examples of Human Input Variables	Units of measure
Population	#
Pro capita house water consumption	liters/day
Pro capita food consumption	kcal/day
Total new productive area	m^2
Total new building area	m^2
Development rate (different for mature, transitional and emerging city)	%

Examples of Environmental Input Variables	Units of measure
Altitude	m
Area of the city	km^2
Wind data (important both for wind farm and for pollution),	m/s
Total surface of the green areas	km^2
Industrial areas and households areas	km^2
Wind data	m/s
Water availability	kg/inhab
Rain data	cl/m^2day

6. AN EXAMPLE OF APPLYING MS2G: PLANNING ELECTRIC POWER SUPPLY

One of the problems that the user may have to face is planning the electric power supply in the megacity; due to these reason, it is proposed a basic example related to this aspect. The megacity is already configured including general data defining its own characteristics and including among the other electric average consumptions (e.g. daily average consumption per capita) related to its population and services; all these parameters could be modified by the players. The user is entitled to choose among different options in order to satisfy electric power demand; the energy available sources in the library are:

- Thermal Power Stations
  - With CCS (carbon capture and storage)
  - Without CCS
- Wind Farms
  - On shore
  - Off shore
- Solar Panel Farms
- Nuclear Power Plants

For example for what concerns wind turbines, several different choices are available, with different power productions, sizes, costs and impact as proposed in the following figure.

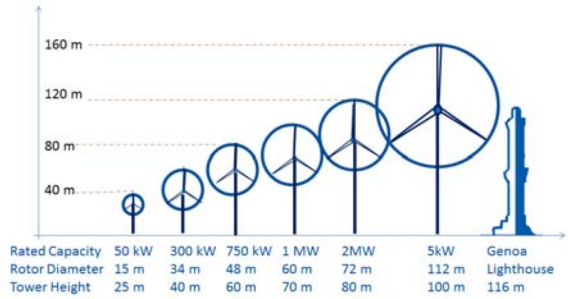

Figure 6: Models used for Wind Turbine in MS2G


Figure 7: GUI on Wind Turbine Parameters

Each alternative is characterized by different parameters including:

- Space occupancy
- Emissions
- Energy costs
- Installation costs
- Managing costs
- Power curves

The scenario has one Hot-Spot for each kind of power plant located in different parts of the megacity virtual world; for instance there are Hot-Spots corresponding to:

- Breeding area
- Agriculture area
- Desalination area
- Port Area

By clicking on the Hot-Spots user is entitled to set access to the setup of the related parameters while in City Hall Hot Spot it is possible to define:

- % of energy production by Wind
- % of energy production by Fossil
- % of energy production by Solar
- % of energy production by Nuclear
- % of energy Imported from outside

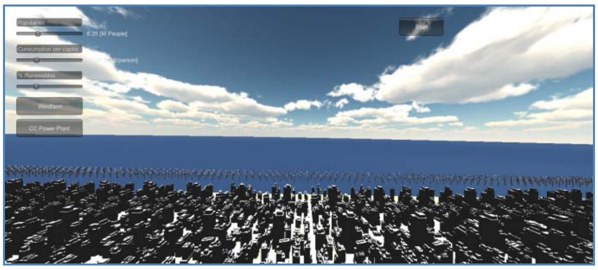
Figure 8: MS2G presenting Wind Farms immersed in the Megacity

In reference to the proposed scenario it was carried out a simulation scenario addressing wind farms as proposed in figure 7; indeed the model presents the results immersed in the virtual world as presented in the following figure 8.

Examples of Megacity Parameters		
Population	20'000'000	inhab.
City Area	3000	km^2
Wind Behavior	Statistical Distributed	m/s
Density	6'666	inhab. /km^2
Per capita Consumption	17'445	kWh/year
Population Growth	3	%
Taxation Rate	50	%

Examples of Wind Farm Parameters		
Tower height	50	m
Base size	100	m^2
Power curve slope	100	(kW/turbine)/(m/s)
Maximum power	1000	kW/turbine
Min Wind threshold	5	m/s
Max Wind threshold	27	m/s
Installation cost	180'000	€/turbine
Managing cost	3'000	€/turbine per year
Rotor diameter	42	M
Nominal power	600	kW/turbine
Power Curve	0,05	%
Life Cycle	20	year
Investment horizon\	15	year
BEP	0,05	%
Percentage of Power supply by Wind Farm	60	%
Slope limit	15	m/s

Examples of Simulation Output		
Wind efficiency	85,47	%
Number of Wind Turbines	55'913	
Energy cost pro capita	2'563	€/year
Active hours	7'488	h/year
Unit Power	156'000	kW
Energy generated	3'744'000	kWh/year
UAC	863'501'680	€/year
Annual revenue required	1'025'534'539	€/year
Energy required	2,0934E+11	kWh/year
Energy cost	0,1469	€/kWh

The development of offshore wind farms guarnatees better energy density and lesser interference with other local systems; this leads to an interesting solution for realization of the wind potential.
The simulator results include the number of wind tower, UAC, annual revenue and the energy cost.

The MS2G has been implemented in Java, C# and by using Unity as virtual engine and experimented over a virtual expansion of a large Mediterranean town currently counting over 4 million inhabitants and expected to growth in the future years; ANOVA was used in order to validate experimental results (Montgomery 2010).

7. CONCLUSIONS

The authors present an innovative approach to support crowdsourcing in relation to strategic problem solving; the combined use of M&S, SG and IA is proposed in terms of architecture.
The system has been developed and implemented as a web service that could be easily accessed through web browser and even deployed on mobile platforms; currently the authors are proceeding in extending the models integrated in the scenario and in carrying out experimental analysis to finalize the validation and verification process along the dynamic development phase. The MS2G approach is currently under development also in relation to other application fields such as logistics and emergency management.

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