Co-design Practice in a Smart City Context Through the Gamification Approach: A Survey About the Most Suitable Applications

Antonio Opromolla[1,2(✉)], Valentina Volpi[1,2], Andrea Ingrosso[1], and Carlo Maria Medaglia[1]

[1] Link Campus University, Via Nomentana 335,
00162 Rome, Italy
{a.opromolla, v.volpi, a.ingrosso,
c.medaglia}@unilink.it
[2] ISIA Roma Design, Piazza della Maddalena 53,
00196 Rome, Italy

Abstract. In a "smart" city context, citizens' participation allows to create public services and products meeting the real people's needs. In this regard, the co-design process is a useful practice for encouraging city users to co-create new effective solutions. However, it is fundamental to renovate methodologies and tools for citizens' engagement. In this paper, we argue that the gamification approach could increase the willingness of city users in getting involved in Public Administration (PA) decision-making processes and in co-design practices. Assuming that, we present the main findings of a survey conducted to investigate city users' behaviours and needs on gamification and co-design issues. These findings will be useful to identify the most suitable applications combining these two practices.

Keywords: Co-design · Gamification · Game design · Survey · Smart city · Decision-making processes · Citizen engagement and participation

1 Introduction

The academic literature has widely discussed the "smart city" phenomenon, focusing on various factors (e.g.: technology, governance, economy, etc.), mainly depending on different disciplinary areas. According to Chourabi et al. [1], the quality of life of people and communities is one of the essential components of a city that aims to be defined "smart".

In this field, citizens' participation is an important factor, since it allows to create public services and products meeting the real people's needs. In order to do that, it is fundamental to use specific tools and methodologies aiming to engage city users in city issues. The *co-design* process, i.e. a design approach in which the different stakeholders of a city (e.g.: citizens, institutions, enterprises, associations, etc.) work together in order to ideate new services and products [2], is useful to encourage city users to co-create new solutions [3].

Therefore, renovating approaches, methodologies and tools for the citizens' engagement could increase their participation in decision-making processes. In this regard, the hypothesis we support in this work is that the *gamification* approach, which consists in "the use of game elements in non-game context" [4], could increase the willingness of the city users in getting involved in these processes.

Indeed, according to McGonigal [5], games can really be used in order to improve the world and to solve real problems in a real environment. From this points of view, the gamification approach aims to encourage an active behaviour by motivating people to achieve specific purposes (mainly in activities that could be boring or uninspiring) through specific game mechanics (e.g.: point, levels, badges, etc.).

Although the gamification approach was applied mainly in marketing and education fields, the urban context is becoming an increasingly important sector of implementation. In details, the purpose of the gamification approach applied to the city context is making people aware of the issues affecting the territory in which they live. In this regard, as we pointed out in a previous study [6], the current academic contributions underestimated the application of this approach to engage citizens and co-design new solutions.

So, with this work we intend to proceed with the research toward that unexplored direction by observing how gamification can be combined with co-design. In the next section we report the basic game design elements we considered as the more suitable in the implementation of new co-design solutions. In the third section we report the methodology followed for the design of a survey aiming to investigate city users' behaviours and needs on gamification and co-design issues. In the fourth section we focus on the main findings of this survey. Finally, in the fifth section the conclusions and the future work.

2 Defining the Basic Design Elements to Use for Combining Co-design and Gamification

In order to identify how the gamification approach can be integrated in co-design practice to increase city users' participation in decision-making processes, it was necessary to define the "boundaries" within which the possible solutions should move.

For this purpose, we investigated in depth the main characteristics of "co-design" and "gamification", by identifying, for both of them, the related practices, tools, purposes, involved stakeholders, fields of application, etc., and by pointing out the connections between the single characteristics. On the basis of these connections, we identified some basic required features that we consider as the more suitable in combining co-design and gamification. In detail, they are summarized in the following game design elements.

1. *Multiplayer mode*: the "gamified" applications should involve several people, playing simultaneously or not. Indeed, the presence of more than one person is fundamental both in a co-design practice, where new solutions arise from the consideration of more than one perspective, and in a gamification approach, where "the other" is a central element.

2. *Roles*: in the "gamified" solutions any player should "play a role". Indeed, on the one hand, co-design practice considers the joined work of different stakeholders, with different characteristics; on the other hand, the "role" is an important element of specific typologies of games.

3. *Cooperative gameplay*: the solutions should involve players working together to reach a common goal. The "gameplay" identify the modes through which players interact with a game [7] and the relations with the others. In the solutions combining co-design and gamification players should have the same importance, as well as the different perspectives of the participants of a co-design session are on the same level of relevance.

4. *Dynamic game balancing*: during the co-design session the single player should receive benefits, awards, and acknowledgments. Since the single player may not be strongly motivated in realizing new "co-designed" products and services, the use of game mechanics (e.g.: points, badges, awards, etc.) is a key requirement for increasing participation. Indeed, during a co-design session, or during consecutive co-design sessions (that could be considered as different levels of a game), the user arises his/her abilities and he/she should be rewarded as a consequence.

5. *Socializer players*: the solutions should be firstly addressed to the players that Bartle define "socializer" [8], i.e. those who within the game are interested in people, rather than only in the game. Indeed, the interaction among participants of a co-design session is more important than the single perspective, as well as "socializer" focuses on human relations.

6. *Emergent gameplay*: in the solutions the actions and the creativity of the players should influence the game process and its result. Indeed, their ideas, needs, and thoughts should be the most important game tools.

7. *Story-based game*: the solutions should be based on an open and a "not defined a priori" process, because it should be built by the interaction among participants.

8. *Results*: the solutions should aim to achieve a clear goal, which consists in the creation of a new product or service. So, it is important not only the "game" side (e.g.: declaring a winner), but also obtaining useful elements for the real implementation of the identified outputs.

9. *Clear rules*, allowing to really reach a result.

10. *Real or virtual mentor*, who should follow the process without direct it, as well as during a co-design practice designers drive users and in some "gamified" solutions a "master" presents and maintains game settings.

On the basis of these elements, we identified five typologies of games that present the basic required features to proper combine co-design and gamification. They are: *role-playing games* (*RPG*), *serious games*, *board games*, *videogames*, *urban games*. Although the aim of the "gamification" approach is to offer a gameful experience and not to create a real game, the list in the Table 1 was useful to observe (as a speculative reference) existing game solutions and game elements that appear to be really close to the scope of the solutions combining co-design and gamification.

Table 1. Five typologies of games that present the basic required features to proper combine co-design and gamification.

Games	Characteristics of the games
RPGs	Unpredictability of the results; clear rules; story-based; collective consciousness shared among players; central role of the mentor; different players with different roles; social interaction; creativity as a central element.
	Examples of RPGs: *massively multiplayer online role-playing games* (MMORPG), *role-playing video game*, *live action role-playing game* (LARP), *game committee*.
Serious games	"Serious" purposes; adaptability to different devices; clear goals; improvement of player conditions; different typologies of players as users.
Board games	Different game tools (e.g.: game table, tokens, bricks, etc.); social interactions; possibility to realize a story; clear rules; focus on the player abilities; high flexibility.
	Example of board games: *cooperative board games*.
Videogames	Different typologies of videogames; possibility to employ different devices, platforms, and controllers; high interactivity; focus on the game environment; clear rules; possibility to create a story.
	Examples of videogames: *role-playing video game*, *city building games*, *government simulation games*.
Urban games	Real city as game environment; possibility to use different mobile technologies (e.g.: GPS, NFC, mobile social network, etc.); usually organized as a team game.

3   A Survey on Gamification and Co-design Issues: The Followed Methodology

Identifying the basic game design elements useful to combine co-design and gamification led us to the identification of the "boundaries" within which the possible solutions should move. The next step was to investigate, within these "boundaries", people's behaviours and needs on both gamification and co-design issues. So, we create a survey to collect the related data.

We decided to administer the questionnaire to Italian people potentially willing in being involved in Public Administration (PA) decision-making processes and/or more interested in games. To identify the characteristics of this target, we considered as variables age, gender, and education level. On the one hand, according to the ISTAT (Italian National Institute of Statistics) [9], the age groups more willing to an active participation in public and/or social issues are 25–34, 35–44, and 45–54 years old, with an education level equal or higher than a high school diploma, and without a significant difference between males and females. On the other hand, according to the Osservatorio gioco online [10], the more active Italian gamers belong to the age group 25–34 and 35–44 (followed by 18–24 and 45–54 age groups) and they are mostly males. However, some studies (e.g. that of ISFE [11]) show that women players are on the rise also in the Italian context.

So, the respondents of our survey had the following characteristics: age range between 25 and 54 years old; education level equal or higher than a high school diploma; uniform distribution between males and females.

A *structured survey questionnaire* composed of the following 5 sections was administrated to them:

1. *Personal details*. Investigation on: age, gender, educational level and job.
2. *Participation in decision-making processes*. Investigation on: consideration of co-design practice, perceived advantages and disadvantages of this practice, willingness in being involved in decision-making processes, evaluation of the co-design experiences already carried out. In order to get the respondents familiar with the participation in decision-making processes issue, we showed them videos and images explaining the main concepts and procedures of the co-design practice.
3. *Game experience*. Investigation on: frequency of play, types of games conducted more frequently.
4. *Gamification approach*. Investigation on: consideration of the gamification approach, willingness in using applications and services based on the gamification approach, evaluation of the "gamified" experiences already carried out. Also in this section, we showed the respondents videos and images, in order to get them familiar with the gamification concepts and procedures.
5. *Gamification in urban area.* Investigation on: consideration of the solutions involving citizens, businesses, associations, etc. in PA decision-making processes through the gamification approach and user needs about the most suitable co-design activities, organization modes, fields of application, game mechanics and tools, etc. in the solutions combining co-design and gamification.

The questionnaire was composed of multiple choice questions with only one answer allowed or with more than one answer allowed, open questions and 5-point Likert scale questions. The latter were used in order to identify the agreement/disagreement level with different design alternatives regarding specific elements. The survey questionnaire was administered online to a sample of 200 respondents.

4   The Main Findings from the Survey

In this section, we show the main findings from the survey, according to the 5 sections investigated: personal details, participation in decision-making processes, game experience, gamification approach, and gamification in urban area.

4.1   Respondents' Personal Details

The respondents have an average age of 34 years. The most part of them has a master degree (38 %). People with a PhD (24,5 %), a bachelor degree (19 %) and a high school diploma (18,5 %) follow. They are equally distributed in males (51 %) and females (49 %).

4.2   Participation in Decision-Making Processes

83,5 % of the respondents consider positive or totally positive the possibility of involving citizens, businesses, organizations, etc. in the PA decision-making processes, 13,5 % consider this possibility neither positive nor negative, and 3 % negative or totally negative.

The three main perceived advantages of co-design practice are: "increasing the sense of belonging to a community" (65 % of the respondents), "creating products and services really useful" (61 %), and "making people aware of the issues related to the territory in which they live" (59 %).

On the contrary, the three main perceived disadvantages of this practice are: "the lack of interest on the part of the PA" (59 %), "the difficulties in meeting all the people needs" (46 %), and "the difficulty in finding people willing to get involved in co-design practice" (45 %).

71,5 % of the respondents are willing or absolutely willing to be involved in decision-making processes aiming to develop products/services in a given area. However, only 24 % of the respondents took part in these processes in the past. The main purpose of the co-design sessions in which they have been involved, were: the urban regeneration of public places (squares, urban gardens, shared spaces, train station, etc.), buildings, neighbourhoods; the (re)design of digital services; the design of public services in environment, mobility, and touristic fields. 52,1 % of the respondents that took part in these processes describe this experience positive or totally positive, defining it "effective", "activating", "involving", "connecting citizens", "meeting people needs", and "low-cost". On the other hand, 27,1 % of the respondents that took part in these processes describe their experience negative or totally negative, defining it "ineffective", "without a real involvement", "complicated", "confused", "unstructured", "excessively driven", and "without a real participation". Finally, 20,8 % of the respondents who already took part in these processes consider this experience neither positive nor negative.

4.3   Game Experience

56 % of the respondents consider themselves fans of games. The three main types of game conducted are: board games (49 %), mind games (41 %), and card games (41 %). 24 % of the respondents declare to play daily, 41 % at least once a week, 19,5 % at least once a month, 11 % at least once every six months, 3,5 % at least once a year, 0,5 % less than once a year, and 0,5 % never.

4.4   Gamification Approach

78 % of the respondents consider positive or totally positive the use of the game mechanics with the aim to engage people in different fields of application, 18 % consider this possibility neither positive nor negative, and 4 % negative or totally negative.

73,5 % are willing or absolutely willing to use applications and services based on a gamification approach. However, only 28 % of the respondents used them in the past. The main fields of application of the solutions they used were: marketing (loyalty features), learning (primarily foreign languages), work (team building, skills development, and evaluation of work activities purposes), well-being (e.g.: sport, diet, etc.), and organization of daily activities. In the city environment the main aims of the employed applications were: traffic control, public works construction, and conflict resolution (between two neighbourhoods).

Among the respondents who used these applications or services, 8,9 % consider this experience negative or totally negative. They define it "ineffective", "disadvantageous", "unwieldy", "complicated", "not exciting", "trivial", "repetitive", and "boring". 62,5 % of the respondents who used these applications or services consider their experience with these systems positive or totally positive, by defining it "captivating", "pleasant", "engaging", "leading to collaborate", "motivating", "enjoyable", "improving", "mild-expanding", "outside the box", "learning", "activating", "effective", and "fascinating". Finally, 28,6 % of the respondents who used these applications or services consider their experience neither positive nor negative.

4.5   Gamification in Urban Area

76,5 % of the respondents consider positive or totally positive the application of gamification approach with the aim of involving citizens, businesses, associations, etc. in PA decision-making processes. See Fig. 1.
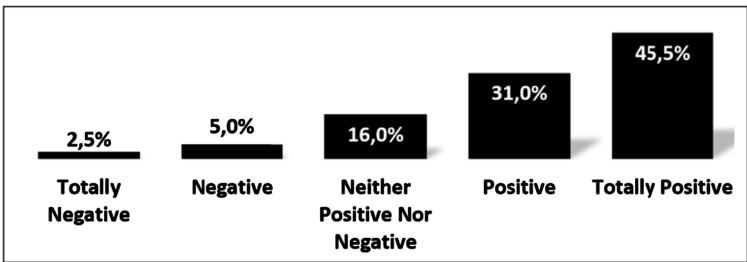

Fig. 1.   Online structured questionnaire. Question: "In the range of 1 to 5, how do you consider a game involving citizens, businesses, associations in PA decision-making processes? (1: totally negative; 5: totally positive)". Total: 200 respondents.

70,5 % of respondents declare that the gamification approach could increase their involvement in PA decision-making processes. See Fig. 2.

The respondents who would increase their involvement in these processes through the gamification approach are:
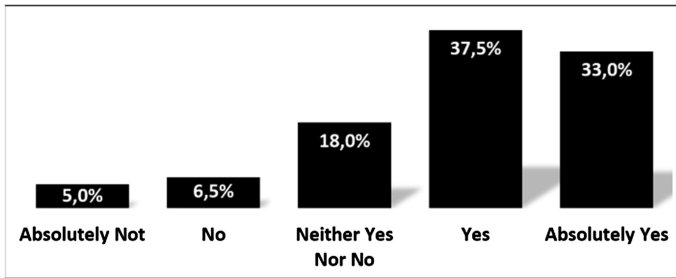
Fig. 2. Online structured questionnaire. Question: "In theory, such a game could increase your participation in PA decision-making processes? (1: absolutely not; 5: absolutely yes)". Total: 200 respondents.

1. considering the age, 72,2 % of the respondents belonging to the 25–34 years age range, 70,8 % of the respondents belonging to the 35–44 years age range, and 64 % of the respondents belonging to the 45–54 years age range;
2. considering the gender, they are 72,4 % of the females and 68,6 % of the males;
3. considering the education qualification level, they are 65,7 % of the respondents with a high school diploma, 63,2 % of the respondents with a bachelor degree, 77,6 % of the respondents with a master degree, and 67,3 % of the respondents with a PhD;
4. 76,2 % of the respondents willing to be involved in PA decision-making processes and 50 % of the respondents not willing (or absolutely not willing) to be involved in PA decision-making processes;
5. 64,6 % of the respondents already involved in PA decision-making processes and 71,5 % of the respondents not involved, neither in the past, in these processes;
6. 77,7 % of the game fans and 61,4 % of the respondents who do not consider themselves fans of games;
7. 79,6 % of the respondents willing to use services and applications based on the gamification approach and 21,4 % of the respondents not willing to use them;
8. 69,6 % of the respondents who used services and applications based on the gamification approach and 68,6 % of the respondents who did not use them.

The following data identify the respondents' agreement/disagreement level, in the range of 1 to 5 (1: strongly disagree; 5: strongly agree), with different options related to 5 elements regarding the combination between co-design and gamification. These 5 elements are: the more suitable activities, application areas, people categories, game tools, and game mechanics.

In each of the following table the findings about each of the 5 investigated elements are summarized. In details, each table illustrates the results about the different options provided for one of the 5 different investigated elements, showing the average (from 1 to 5) value calculated on a total of 200 answers.

As presented in Table 2, the respondents believe that solutions combining co-design and gamification could mainly facilitate the identification of the problems in a specific area. Indeed, almost 78 % of the respondents are agree or strongly agree to use these solutions with this aim. (Please note that the activities listed in Table 2 are the main phases of a co-design session).

Table 2. Evaluation through 5-points Likert scale. Question: "Which of the following activities could be facilitated by a game? For each of the activities, express your agreement/disagreement level in a range of 1 (strongly disagree) to 5 (strongly agree)". Total: 200 respondents.

Activities	Average
Identification of people needs	3,89
Identification of the problems in a specific area	4,15
Collaboration with other people	3,69
Design of new products and services	3,85
Development of new products and services	3,76

Considering the gender, females are more interested in the "design phase" than males. Moreover, the age range 45–54 years old is more inclined towards the "development of new products and services".

Table 3 shows the city application areas in which respondents would like the solutions to be implemented. Environment and mobility are the favourite ones: almost 76 % of the respondents are agree or strongly agree to use these solutions in the environment area and the 75 % in the mobility area. The listed city application areas are those identified by Giffinger et al. [12].

Table 3. Evaluation through 5-points Likert scale. Question: "Which of the following application areas could be affected by a game? For each of the application areas, express your agreement/disagreement level in a range of 1 (strongly disagree) to 5 (strongly agree)". Total: 200 respondents.

Application Areas	Average
Mobility	4,02
Environment	4,11
Governance	3,62
Living	3,84
People	3,84
Economy	3,59

Considering the age range, the respondents belonging to the age group 45–54 years old prefer "Governance" as main city application area; on the contrary, the respondents with a high school diploma expressed interest for "Economy" and "Living" areas.

The respondents consider also that young adults are the most suitable category for the solutions combining co-design and gamification (see Table 4). Almost 90 % of the respondents are agree or strongly agree with this category.

Table 5 shows the tools considered as the most suitable for the solutions combining co-design and gamification. Digital tools in the mobility environment (mobile applications, smartphone, etc.) are the preferred ones.

Table 4. Evaluation through 5-points Likert scale. Question: "in your opinion, which of the following categories would be the most suitable for solutions combining co-design and gamification? For each of the categories, express your agreement/disagreement level in a range of 1 (strongly disagree) to 5 (strongly agree)". Total: 200 respondents.

Categories	Average
Children	3,16
Teens	3,78
Young adults	4,33
Adults	3,80
Elderly	2,68

Table 5. Evaluation through 5-points Likert scale. Question: "in your opinion, which of the following tools are the most suitable for solutions combining co-design and gamification? For each of the tools, express your agreement/disagreement level in a range of 1 (strongly disagree) to 5 (strongly agree)". Total: 200 respondents.

Tools	Average
PC (Personal Computer)	3,61
Playing cards	2,57
Videogames	2,97
Internet	4,06
Mobile applications	4,15
Pen and paper	2,89
Dice	2,10
Toy models (e.g. of the city furniture)	2,98
Smart objects	3,81
Smartphone	4,17
Augmented reality	3,34
Tablet	3,95
Virtual reality	3,17
3D graphics	3,10
Console	2,59
Totem/Interactive screens	3,34
NFC (Near Field Communication)	2,76
GPS (Global Positioning System)	3,37
Board game	2,77
Tokens	2,64
Game table	2,57
Bricks	2,93
Social networks	3,90

In details, males prefer videogames and consoles. Females instead prefer social networks, totem, toy models, and bricks. Moreover, by increasing with age, the preference for videogames and no-digital tools (playing cards, pen and paper, toy models, board game, tokens) rises, while the preference for digital tools (mobile, PC, totem, smart objects) decreases. Finally, respondents with a more high education qualification level prefer augmented and virtual reality and 3D graphics, to the detriment of PC, toy models, tokens, game table.

The respondents also indicated additional tools they would like to use. Among them: everyday and wearable objects (e.g.: bracelets, watches, odometer, fidelity cards, etc.) that could interact with the physical environment; urban furniture; open data (i.e., the data released by the PAs); photos.

The preference for tools usually used in mobility is confirmed by the fact that the respondents (especially the younger) would like to use these solutions all around the city rather than in a dedicated place.

Moreover, the respondents prefer solutions organized in "micro-goals" rather than in "one final goal".

About that, the respondents have preference for solutions that allow them to play (and co-design) while performing other activities at the same time (e.g.: a walk, visit a place, etc.), rather than to play during a dedicated co-design session.

Finally, Table 6 shows the game mechanics considered the most suitable ones for the solutions combining co-design and gamification.

Table 6. Evaluation through 5-points Likert scale. Question: "in your opinion, which of the following games mechanics are the most suitable for solutions combining co-design and gamification? For each of the tools, express your agreement/disagreement level in a range of 1 (strongly disagree) to 5 (strongly agree)". Total: 200 respondents.

Tools	Average
Points and leader boards	3,57
Badges	2,97
Prizes and rewards	3,82
Challenges	3,55

5   Conclusion and Future Work

In this paper we assumed that the gamification approach could be integrated in co-design practice to increase city users' participation in decision-making processes. On the basis of this hypothesis, we showed the main findings from a survey conducted in the Italian context aiming to investigate city users' behaviours and needs on gamification and co-design issues.

In general, the respondents are strongly willing to be involved in a co-design practice through a "gamified" solution. One of the main results emerged from the survey is the interest of the respondents in mobility and environment city issues (e.g.:

accessibility, sustainability and innovation of transport systems, pollution, environmental protection, etc.) and in mobile digital game tools (e.g.: smartphone, mobile applications, smart object, etc.). Moreover, the respondents prefer to play (and co-design) while performing other activities at the same time, rather than to play during a dedicated co-design session, as well as all around the city rather than in a dedicated place. Finally, the respondents declare that such a game could be implemented in order to identify the specific problems of a given area.

So, in the future, we will use the findings of this survey in order to design at least three "gamified" solutions meeting the behaviours and needs of the identified target. In details, we intend to realize these solutions not only for the people who declared to be willing to use these solutions, but also for people not willing. Indeed, the aim is to identify how the applications that combine gamification and co-design could be useful in involving also this category.

Finally, we are identifying a specific urban area in the Italian territory, with the aim to realize and test in this area the designed solutions.

References

1. Chourabi, H., Taewoo, N., Walker, S., Gil-Garcia, J.R., Mellouli, S., Nahon, K., Pardo, D. A., Scholl, H.J.: Understanding smart cities: an integrative framework. In: 45th Hawaii International Conference on System Science, pp. 2289–2297. IEEE Computer Society, Washington (2012)
2. Sanders, E.B.-N., Stappers, P.J.: Co-Creation and the new landscapes of design. Co-design Int. J co-creation Des. arts **4**(1), 5–18 (2008)
3. Smart cities: Co-Design in Smart Cities. A Guide for Municipalities from Smart Cities (2011)
4. Deterding, S., Sicart, M., Nacke, L., O'Hara, K., Dixon, D.: Gamification. using game design elements in non-gaming contexts. In: CHI 2011 Extended Abstracts on Human Factors in Computing Systems, pp. 2425–2428. ACM, New York (2011)
5. McGonigal, J.: Reality is broken: Why Games Make us Better and How They Can Change the World. Penguin Books, USA (2010)
6. Opromolla, A., Ingrosso, A., Volpi, V., Medaglia, C.M., Palatucci, M., Pazzola, M.: Gamification in a smart city context. An analysis and a proposal for its application in co-design processes. In: Games and Learning Alliance Conference (2014)
7. Lindley, C.A.: Narrative, game play, and alternative time structures for virtual environments. In: Göbel, S., Spierling, U., Hoffmann, A., Iurgel, I., Schneider, O., Dechau, J., Feix, A. (eds.) TIDSE 2004. LNCS, vol. 3105, pp. 183–194. Springer, Heidelberg (2004)
8. Bartle, R.: Hearts, clubs, diamonds, spades: players who suit MUDs'. J. MUD Res. **1**(1), (1996)
9. ISTAT (Italian National Institute of Statistics): La Partecipazione Politica in Italia. Report, ISTAT (2014)
10. Osservatorio Gioco Online: Il Gioco Online in Italia: tra Maturità e Innovazione. Report, Politecnico di Milano (2014)
11. ISFE (Interactive Software Federation of Europe): Videogames in Europe: Consumer study-Italy. Report, ISFE (2012)
12. Giffinger, R., Pichler-Milanovic, N.: Smart Cities, Ranking of European Medium-Sized Cities. Report, Centre of Regional Science Vienna (2007)