

## EPEDC ELEGAME: AN INTEGRATED MODEL USING GAMIFICATION AND DATA MINING TO REVOLUTIONIZE UTILITIES' FUNCTIONS

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### ABSTRACT

*This paper has been presented an integrated model that increase energy efficiency via consumers engagement. Moreover, the model has revolutionized some essential functions of the electric utilities –billing, after sale services, synchronizing- and has led to decrease expenses of the functions dramatically. In return, utilities have offered rewards and discounts to high score consumers, and have performed their social responsibilities more targeted. The methodology that is enough powerful to achieve above, is Gamification which supported by big data analysis. Accordingly, a mobile application/game titled by EPEDC ELEGAME has been designed base on the gamification mechanics and other features. Expected results after a year are attained as follows: cost of the billing process decreased more than 48%, energy consumption decreased 14%, not in-person service registration by consumers increased 62%, along with, 23% fewer calls to contact center about the billing.*

### INTRODUCTION

Rate of energy consumption is following an increasing trend all over the world. Functions of electric utilities impose heavy expenses to the utilities and their customers. On the other hand, improving level of ICT (information and communication technology) knowledge in the societies, as well as people growing usage of ICT and multimedia instruments, provide to the utilities an usable opportunity in order to fundamental improvements in the fields those required customer relationship. Electricity Distribution Company of Esfahan Province (EPEDC), Iran, serves more than 1,360,000 electricity consumers in an area of 91,000 km<sup>2</sup>, which is divided to 23 townships. Meters of the consumers are read 6 times a year, and paper bills are printed and delivered bimonthly. The process of consumers' meter reading and paper bill preparing and delivering, expended more than \$1,700,000 in 2015. In addition, the company doesn't have an integrated system to manage energy demand of the consumers (DSM) and increase efficiency of the energy. However, the EPEDC has planed strategic map, and also defined, selected and performed some improvement projects –applying management science techniques– these years [1], [2], [3]. Moreover, the EPEDC has tried to institutionalize people to request and track the after sale services not in-person, and alternate electronic ways.

### LITERATURE REVIEW

### Game and gamification

Games are one of the most powerful and widespread ways that human beings interact, communicate, and have fun. Many people play them, and many are captivated by them [4]. According to the Entertainment Software Association, 51% of American households own at least one game console. Surprisingly, 48% of gamers are female. There are actually more female gamers over 18 (36% of the total number of players) than male gamers under 18 (17% of players) [5].

Gamification refers to the incorporation of game design elements or strategies into real world applications [6]. In the other words, turning something into a game—using the features of games to accomplish a real-world objective—is called gamification. [4].

Gamification imports the elements that normally operate in game worlds into real-world contexts like classrooms, offices, hospitals, and homes. Gamified solutions transform everyday activities into game-like experiences [4]. Zichermann and Cunningham (2011) defined the term gamification as follows: *The process of game-thinking and game mechanics to engage users and solve problems* [7]. Robson et al. (2015) presented a framework of three gamification principles –Mechanics, Dynamics, and Emotions (MDE) — to explain how gamified experiences can be created [8]. Paharia (2013) counted 10 most important individual gamification mechanics, which are inspired from the world of video games but have been proven to work in any context, and they hit on both intrinsic and extrinsic motivations. Those are: 1- fast feedback 2- transparency 3- goals 4- badges 5- leveling up 6- on boarding 7- competition 8- collaboration 9- community 10- and finally, points [9].

### Gamification and the energy

Academic research and management practice have paid little attention to the challenges of how best to design, implement, manage, and optimize gamification strategies [8]. Figure 1 illustrates annual ratio of published papers about the gamification. Base on the information of the chart, 90 percent of the gamification papers have been published in last three years (2014- 2016).

Figure 2 displays thematic ratio of the gamification published papers, between 2011 and 2016. As it considered in the Figure 2, 99.2% of the gamification applications are related to 11 fields. “Energy” has placed

on the rank 8th with 3.6% of the gamification literature. Gamification researches on the field of the energy have discussed about the energy and electricity consumption, energy efficiency, energy behavior, and energy conservation.

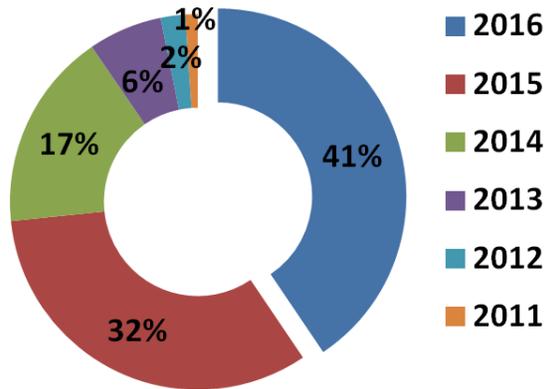


Fig. 1. Annual ratio of the Gamification published papers

Kuntz et al. (2012) suggested a game-based approach to environmental sustainability. Their program has implemented corporate “gamification” strategies that re-frame energy-saving activities in organizational settings to be more engaging and compelling [10]. A research also has begun to apply cooperative and competitive gaming strategies on order to save energy at work, for instance, have built on the success of residential smart metering programs to develop Climate Race, a game that achieves energy behavior change through monitoring and feedback among workplace peers [11]. Grossberg et al. (2015) reviewed the literature on gamified energy efficiency programs and energy reduction competitions. Individual programs were primarily documented in the grey literature (program web-sites, conferences, program evaluation reports, etc.), and only a few papers on these programs were published in the academic literature [4]. Lopes et al. (2015) presented an integrative modeling

approach to residential energy consumption in Europe, towards more effective behavioral energy policy. Their results support the need to consider an integrative perspective when addressing energy behaviors and designing effective behavioral change interventions and energy efficiency policies [12].

Competition has become an increasingly popular strategy to engage individuals in energy and resource conservation [13]. Vine and Jones (2016) assessed the energy savings potential of energy efficiency competitions. This paper reviews a representative selection of completed and ongoing energy reduction competitions in the United States and uses the lessons learned to provide best practice guidance on the design, implementation, and evaluation of future programs [13]. Loi and Loo (2016) investigated the impact of Singapore’s residential electricity conservation efforts and drew the way forward. This article provides fresh empirical evidence of residential electricity demand in Singapore over the period of 1980–2014, using the bounds testing procedure to co-integration. The residential electricity demand comprises of income, price, temperature, rainy days, old-age dependency and the impact of energy efficiency policies [14].

Much of the literature on reducing commercial plug loads is focused on technology-based solutions, while the literature on changing occupant behavior is focused on residential occupants. Multiple studies show that non-financial incentives, such as games, can motivate behavior change [15]. An online sustainability game, Cool Choices, was initiated on-site with 30 occupants, where players competed on teams to earn points for completing resource-saving actions. The analysis revealed that because occupants were already engaging in relevant energy saving behaviors (e.g. turning equipment off at the end of the day), there was limited opportunity for further behavior-based reductions. This study highlights the need for additional research in commercial buildings examining how to motivate occupant behavior change through non-financial incentives [15].

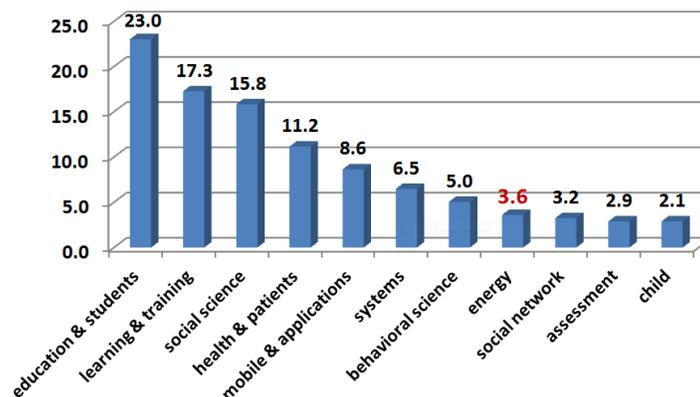


Fig. 2. Percentage of the Gamification researches on various fields between 2011 and 2016

Andrews and Johnson (2016) reviewed studies of energy behavior in businesses, and suggested areas for additional social science research [16]. Game-based feedback and monitoring initiatives have seen limited testing in workplace settings and have generally produced conservation improvements [16]. Moreno-Munoz et al. (2016) discussed and offered guidance for utilities in creating a social roadmap for the smart grid, emphasizing “prosumer” role [17]. Information and Communication Technologies (ICT) have an important role to play in reducing the energy intensity and therefore increasing the energy efficiency of the economy, contributing to sustainable growth. The emphasis of the smart grid in social media through mobile apps could give utilities a collection of new instruments to improve their customer engagement. To preserve long-term customer fidelity, utilities should transform themselves from energy suppliers to energy service advisor [17].

## METHODOLOGY

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### Questions and goals

According to information above, the main problems of the EPEDC are defined as following four questions.

- 1- How can manage energy demand of the consumers, more effectively?
- 2- How can institutionalize people to request and track the services, electronically (not in-person)?
- 3- How can decrease the costs of the process of consumers’ meter reading and bill delivering?
- 4- How can execute the social responsibility of the company, efficiently and systematically?

In addition, nine following main goals should be complied by the solution.

- 1- To improve financial turnover of the company
- 2- Environmental friendship: to omit the paper bills, and decrease fuel consumption.
- 3- To reduce the occupational risks and accidents of the meter readers, because of decreasing their traffic.
- 4- To save more than 60% of expenses of the meter reading and bill delivering process equaled to \$ 1,000,000 each year.
- 5- To motivate the customers to optimize their energy consumption (DSM).
- 6- To decrease the number of “not read meters” in each two mounts period.
- 7- To synchronize reading of the meters, with reading the related transformer.
- 8- To institutionalize people to request and track the services, electronically (not in-person).
- 9- To motivate the customers to e-pay the bills of energy

and services –via online systems.

It has been ages that computer games engaged their users and occupied many hours of their daily time. Games are such exciting that users will not only spend their time and energy on that but they also spend some hardware, software, and game’s leveling-up expenses. Where does this excitement come from? How can games’ mechanism be used for improvement in the real world? The solely method can respond the above questions is Gamification, which uses the game mechanics to improve real world processes.

On the other hand, data banks of the utility companies are full of costumers’ data. There is huge amount of personal data, geographical data, energy consumption data, etc. which is left unanalyzed, while new data is always collecting and saving. Data mining techniques enable us to reach to wonderful result by analyzing existing big data instead of spending enormous cost for collecting new data.

Smart phones as well as their communication infrastructure (mobile internet) are an existing platform that along with above techniques –Gamification and data mining– can be used to change the threat to an opportunity. Our design is a procedure which leads to decrease in energy consumption through costumers’ engagement. Also, through data analysis and predicting energy consumption pattern, crucial functions of utility companies has been completely revolutionized and leads in reduction in many expenses. In return, utility companies have offered some discounts and rewards of energy optimization to the costumers and act their own social responsibilities purposefully.

### Solution

Base on the information above, the methodology that is enough powerful to solve the problems and achieve the goals, is gamification which supported by data mining. After a widespread researches as well as professional analyzing and discussions the EPEDC experts made a serious decision to design and implement a mobile application/game, *EPEDC ELEGAME*, using the gamification mechanics and features.

In addition, database of the billing, customer service software, and the *ELEGAME*, have been connected together, by a mediate software, as follows:

1- the mediate software receives and analyses specified data fields from billing database and customer service software, and sends the results to the *ELEGAME*, with graphical and text structure.

2- the mediate software receives customers’ input data, from the *ELEGAME* application and sends them to the billing and customer service software.

Moreover, page of the *ELEGAME* application has designed and established on the portal (website) of the company, which makes it possible for the customers to view their personal profile and interact with the *ELEGAME* application.

### **Applied gamification mechanics**

Regarding to meet nine goals of the project, in order to engage and motivate the customers, gamification mechanics are defined both to design and develop the mobile application, as well as, in process of interacting with the customers. Ten applied mechanics are as follows:

- 1- Fast feedback: online feedback about percent of energy saving (daily, weekly, monthly), and meter reading accuracy.
- 2- Transparency: presenting the statistics and situation of the participant/ consumers of the related transformer/ all of consumers
- 3- Goals and leader boards: a list of objectives, challenges, missions and actions as well as their points and awards, is provided for each participant. In addition, daily and weekly schedule about how to apply electrical devices is personalized for consumers.
- 4- Badges: the brand of *EPEDC ELEGAME* in three different colors is granted to participants in each field of improvement, yearly.
- 5- Leveling up: a) participants will go one level up by earning 900 points in a month, b) participants will go two levels up by earning 900 points + special meter reading in a month.
- 6- On boarding: explanation the bill items, how to read the meter, power tariffs, electrical devices consumption, etc.
- 7- Competition: which is divided into two categories: a) the participants related to each transformer, b) all of consumers.
- 8- Community: to inform the achievements, badges, awards, as well as high point and high level participants to all members.
- 9- Points: the *ELEGAME* allocates various amount of points at different time periods (daily, weekly, monthly) to the participants: a) energy saving, b) meter reading, c) not in-person service request (via: call centre/ cell phone application/ portal), d) to e-pay the bills. Earned points of current level and whole game, are displayed.
- 10- Awards: a variety of rewards are presented which are attractive to participants with various ages, sexes and favorites which are categorized into three. 1- to visit power plans, solar fields, dams, exhibitions, etc 2- to pay the cost of training courses and workshops such as language courses and power related subjects like: smart grids, demand side management, photo voltaic, energy market.3-bill discount and cash rewards.

### **DISCUSSION AND CONCLUSION**

Energy consumption has had an ascending process in Iran and the world. Since raw energy sources and also power plants capacity are limited and also establishing new power plants have always imposed enormous expenses, effective actions in energy consumption management

seems as an essential need. Additionally, it is the time for the practical functions of utility companies to experience a fundamental revolution. Functions those are so costly and hadn't experience some basic improvements through years.

Using of modern technologies and efficient motivational tools plays a crucial role in solving the above problems. Smart phones and their communication networks have provided a proper infrastructure for expanding relationship with the costumers. Existing experiences about warm welcoming of the users to social media, as well as computer and mobile games, has established gamification as an efficient methodology on improving real world processes, with the use of existing criteria in computer games.

Also, huge amount of costumers' data has been saved in data banks of utility companies which is increasing and updating continuously, can be considered as a worthy help in adjusting companies behaviors with their costumers. Presenting the previous trend as well as predicting the future of energy consumption and its expenses, make the customers sensitive to the energy issue and change their energy consumption behavior. Adding the "reward" and "competition" parameters blows new soul to the subject and leads to costumers engagement and motivation towards achieving goals which have been determined by the electricity distribution companies.

According to what mentioned above, a new model is presented in this paper through which costumers' consumption decreased in the case of their engagement. In addition, essential functions of the electricity distribution companies such as billing, after sale services, and synchronizing, revolutionized dramatically and decreased many of the processes costs. The above model was a foundation for designing a mobile application under the name of "*EPEDC ELEGAME*". The benefits of this application both in the sides of the power industry as well as costumers and society can be considered in figure number 3.

Expected results after a year are attained as follows: cost of the billing process decreased more than 48%, energy consumption decreased 14%, not in-person service registration by consumers increased 62%, along with, 23% fewer calls to contact center about the billing.

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Fig. 3. Benefits of the EPEDC ELEGAME application

