Special Session: Grid Responsive Society Through Building Automation Systems

National End-User Awareness Analysis on Demand Response and Gamification

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I. Gamification of Demand Response

Gamification: Application of game design elements and techniques in non-game environments.

- Mostly preferred for digital product and services; but examples can be find also in
  - Education
  - Banking
  - Healthcare
  - Engineering
  ... and many more
I. Gamification of Demand Response

- **General Approaches**: Motivation, behavior change, detailed statistics and feedback, performance improvement, Mechanic-Dynamics-Aesthetics, skills/challenge balance, customer segmentation

- **Fundamental Elements**: Points, achievements, badges, levels, teams, challenges, quests, tournaments, feedbacks, rewards

![Gamification Diagram]
I. Gamification of Demand Response

approach: Gamification for more effective use of energy in residential and commercial buildings using automation systems

Discover the most suitable solutions for you

Team up with other people for achieving higher goals

Improve your performance with specialized feedback and suggestions

Combine multiple solutions for advanced energy management

Tip of the Day
Use a lower temperature for your washing machine to achieve savings without postponing the operation!
I. Gamification of Demand Response

• **Design Steps** (Combination of two widely known design frameworks (Werbach* and Burke **)):

1. Definition of Objectives
2. Determination of Target Behaviors
3. Description of Player Goals
4. Division of Activity Cycles
5. Game Economy
6. Deployment of Appropriate Tools


II. Survey Design

• Motivation
  • Demand response is one of the most customer-dependent options among innovative smart grid technologies.
  • Effective strategies aiming to achieve effective and reliable DR participation can be developed through deep understanding of customer awareness, expectations, concerns, biases etc.
  • However, these important factors may vary due to demographic characteristics of the society.
II. Survey Design

- Motivation
  - There are also important diversities due to cultural differences of countries.
  - A comprehensive survey study* done by a company in 2010 reveals the national differences in customer segments. (17 countries, around 500 respondents from each)
  - Proactive segment has the majority in Brazil with 33%, while it is 6% of the respondents in Japan.
  - On the other hand, cost conscious segment is 35% in Japan, but it is only 10% of customers in Brazil.
  - The highest percentage of eco-rationalists are in Italy with 26%, but that segment is only 5% of the customers in UK.
  - Another important segment of many countries, skepticals are the minority in South Korea. France has the lowest percentage of indifferents with only 6%.

II. Survey Design

• Motivation
  • Therefore, it is crucial to conduct national (side-specific) surveys covering different demographic groups.
  • The national survey has a total of 29 questions under three main sections:
    - General information
    - Energy awareness and consumption habits
    - Expectations and acceptance of gamified DR solutions
III. Implementation

- Printed on papers
- Added an introductory information (very brief)
- Conducted with 309 people
- The ones with missing or conflicting answers were eliminated
- Remaining 184 results are analysed
- The respondents represent different demographic characteristics of the society
IV. National End User Survey (Turkey)

Single question analysis- Expectations and preferences

- People are generally sensitive (above 59%) about current challenges in the electricity grid except environmental impacts (only 22%). A considerable amount (above 9%) has no clear idea.
- Most of the customers (41%) do not know their electricity tariff. There is a significant percentage of people who are in ToU (24%), but most of them do not change their habits (72%).
- A very high percentage of respondents (96%) would like to participate in DR programs. 56% want automation, while 40% prefer manual control.
- The main concerns are details, benefits and time that should be allocated.
- Expectations other than monetary benefits:
  - 38% reduce negative impact on environment,
  - 30% user-friendly interface,
  - 28% comfort,
  - 3%, social media interaction
IV. National End User Survey (Turkey)

Single question analysis - Expectations and preferences

- **Donation** is widely (94.5%) accepted. The top fields for donation are **education** (41%), **health** (27%) and **social solidarity** (18%). However, **environmental foundations** are the last with (0.4%).
- **DR can change** the daily consumption **habits** of 80%
- Majority of respondents can spare time **weekly** (45%) or **monthly** (40%). Still there is a considerable amount of people (15%) that can use the system every day.
- Point spending options: 52% reduction from energy bill, cash conversion 14%, collection of a certain amount 16%, use for special offers 18%
- Communication channels: Many of them are acceptable.
- The lowest acceptance is special DR device with 7%
IV. National End User Survey (Turkey)

Single question analysis - Expectations and preferences

Summary of findings

- Trusted institutions
  - Universities 40%
  - Government 30%
  - Private sector 2%

- Positive experience perception
  - 38% family and relatives
  - 32% friends
  - 24% many users
  - Only 2% celebrities
  - 4% own evaluation

- Comfort or more money?
  - 74% comfort
  - 26% more money

- Additional earning options
IV. National End User Survey (Turkey)

Single question analysis - Expectations and preferences

- Acceptance of gamification techniques (mostly several of them are selected)

![Pie chart showing acceptance of gamification techniques]

- Joining as a team: 23%
- Additional earnings for consecutive participation: 12%
- Comparison with friends: 15%
- Comparison with similar members: 12%
- Rewarding for ranking: 7%
- Additional points for specific tasks: 11%
- Special events: 20%
IV. National End User Survey (Turkey)

Single question analysis- Expectations and preferences

• Summary of findings
  - Majority of the respondents (65%) can make investments with a payback period of 1 year.
  - Developed additional earning and gamification options are accepted with high percentages and found motivating.
IV. National End User Survey (Turkey)

Multiple-questions based analysis - Explored patterns

- 3 focus for finding similarities with Accenture customer segmentation studies
- 8 focus for a group of respondents that have specific preferences
- 14 focus for a group of respondents with distinct demographic characteristics
## IV. National End User Survey (Turkey)

### Multiple-questions based analysis - Explored patterns

- **3 focus for finding similarities with Accenture customer segmentation studies**
- **The Most Extreme**/ Good / Challenging / Bad

<table>
<thead>
<tr>
<th>Focus</th>
<th>%</th>
<th>DR Acceptance (%)</th>
<th>Donate</th>
<th>Invest</th>
<th>Trust</th>
<th>Consider</th>
<th>Priority</th>
<th>Extra Earning</th>
<th>Gamification</th>
</tr>
</thead>
<tbody>
<tr>
<td>High income, less motivation</td>
<td>9</td>
<td>94</td>
<td><strong>National &amp; environment</strong></td>
<td>Less &amp; short</td>
<td>Low: Consumer</td>
<td>Less: All</td>
<td>Similar</td>
<td>Loyalty (generally all low)</td>
<td>Additional goals (generally all low)</td>
</tr>
<tr>
<td>Young, women, low/middle income</td>
<td>9</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Comfort</td>
<td>Low loyalty</td>
<td>Generally all high</td>
</tr>
<tr>
<td>Motivated, but do not have time</td>
<td>33</td>
<td>64</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Comfort</td>
<td>Similar</td>
<td>Special events, additional goals (generally promising)</td>
</tr>
</tbody>
</table>
### IV. National End User Survey (Turkey)

**Multiple-questions based analysis - Explored patterns**

- 8 focus for a group of respondents that have specific preferences

<table>
<thead>
<tr>
<th>Focus</th>
<th>%</th>
<th>Income</th>
<th>Marital Status</th>
<th>Age</th>
<th>Trust</th>
<th>Electricity problems at home</th>
<th>Care about tariff rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special offer lovers</td>
<td>18</td>
<td>Mostly high</td>
<td>Mostly singles</td>
<td>-</td>
<td>Low: Consumer</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anti-investment people</td>
<td>27</td>
<td>-</td>
<td>Mostly married</td>
<td>-</td>
<td>-</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Big investors</td>
<td>6</td>
<td>-</td>
<td>Mostly singles</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Anti-advice takers</td>
<td>5</td>
<td>Mostly high</td>
<td>Mostly singles</td>
<td>18-24 &amp; 50+</td>
<td>-</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Comfort lovers</td>
<td>74</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Profit lovers</td>
<td>26</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Extreme profit seekers</td>
<td>12</td>
<td>Mostly high</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Extreme game lovers</td>
<td>7</td>
<td>Mostly high</td>
<td>Mostly married</td>
<td>25-34 &amp; 65+</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
IV. National End User Survey (Turkey)

Multiple-questions based analysis - Explored patterns
- 14 focus for a group of respondents with distinct demographic characteristics

<table>
<thead>
<tr>
<th>Focus</th>
<th>%</th>
<th>Manual or Auto</th>
<th>Usage</th>
<th>Spending Style</th>
<th>Comms.</th>
<th>Comfort/Money</th>
<th>Consd.</th>
<th>For more profits</th>
<th>Gamification</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-34 years old</td>
<td>7</td>
<td>Auto</td>
<td>Weekly</td>
<td>Special offers</td>
<td>Phone app</td>
<td>Comfort</td>
<td>Family &amp; frien.</td>
<td>Surprise</td>
<td>Team &amp; event/comparison</td>
</tr>
<tr>
<td>50+</td>
<td>28</td>
<td>Both</td>
<td>Daily &amp; W.</td>
<td>Bill discount</td>
<td>SMS &amp; e-mail</td>
<td>Money</td>
<td>Family</td>
<td>Loyalty/surprise</td>
<td>Comp. with similar/comp. with friends</td>
</tr>
<tr>
<td>Less than uni.</td>
<td>30</td>
<td>Manual</td>
<td>Monthly</td>
<td>Bill discount</td>
<td>SMS &amp; Phone app</td>
<td>Money</td>
<td>Family</td>
<td>Lottery &amp; new mem.</td>
<td>Leaderboard &amp; event/team</td>
</tr>
<tr>
<td>University</td>
<td>46</td>
<td>Auto</td>
<td>Daily</td>
<td>Bill disc. &amp; special off.</td>
<td>Social m. &amp; phone app</td>
<td>Comfort</td>
<td>Friends</td>
<td>Surprise &amp; loyalty</td>
<td>Team &amp; goals</td>
</tr>
<tr>
<td>Master and PhD</td>
<td>18</td>
<td>Both-auto</td>
<td>Weekly</td>
<td>Bill disc. &amp; special off.</td>
<td>SMS &amp; e-mail</td>
<td>Comfort</td>
<td>Family &amp; cstm</td>
<td>Surprise &amp; loyalty</td>
<td>Team &amp; comp. with similar &amp; goals</td>
</tr>
<tr>
<td>Single living</td>
<td>9</td>
<td>Auto-less</td>
<td>Monthly-weekly</td>
<td>Bill disc. &amp; special off.</td>
<td>SMS &amp; e-mail &amp; Phone app</td>
<td>Comfort</td>
<td>Friends &amp; nbdy</td>
<td>Surprise &amp; lottery</td>
<td>Team &amp; event &amp; combo</td>
</tr>
<tr>
<td>Living w. family</td>
<td>65</td>
<td>Both-auto</td>
<td>Daily</td>
<td>Bill discount</td>
<td>SMS &amp; SM &amp; e-mail &amp; Phone app</td>
<td>Comfort</td>
<td>Family</td>
<td>Surprise &amp; loyalty</td>
<td>Goals &amp; teams &amp; comp. With similar</td>
</tr>
</tbody>
</table>
IV. National End User Survey (Turkey)

Multiple-questions based analysis

- Summary of findings
  - There are many groups with different preferences
  - Some groups have common trends
  - Our methods in the survey are widely accepted by different groups
V. Commercial Field Survey (Portugal)

- Conducted with employees at INESC TEC Porto.
- Google Questionnaire
  - 176 respondents
V. Commercial Field Survey (Portugal)

- 64% thinks it is important to decrease the energy consumption at work, while 33% emphasizes it should be done without affecting their comfort.
- 27% have no idea about the costs related to energy consumption at work.
- 66% would like to have an app that provides insight about their energy consumption, costs and ways for more effective use of energy, while 19% is hesitant
- 66% is concerned about using electricity in a more effective way, while 25% need more information about how to do it and 6% has no clear idea.
V. Commercial Field Survey (Portugal)

How would you like to be notified in what it concerns the routines, challenges and results from this App?

- 42% A - E-mail
- 33% B - INESC Intranet
- 23% C - Mobile App
- 2% Other
V. Commercial Field Survey (Portugal)

What do you think it is the electrical equipment that consumes more energy in the INESC TEC building?
V. Commercial Field Survey (Portugal)

Normally, what is your main reason why you feel uncomfortable at work?

- A - Noise
- B - Luminosity
- C - Air conditioning
- D - None
- Other

- 39% for Other
- 35% for None
- 13% for Air conditioning
- 7% for Luminosity
- 6% for Noise
- 0% for Other (as indicated by the pie chart)
V. Commercial Field Survey (Portugal)

• 19% do not turn off their computer and screen when they leave for long break or finish the working day.
• 15% leave their computer on because,
  • they forget,
  • do not want to wait for a slow start the next time that they use it,
  • do not have any reason to turn it off.
• 17% do not use stairs instead of using the elevator, 8% of which are dependant to their social environment
• 14% use natural and artificial light together, while 2% always use artificial light and 2% are dependant to their colleagues
V. Commercial Field Survey (Portugal)

From the following thematic days to improve competition and fun, which one motivates you the most?

- A - No elevators day
- B - Warm clothes day
- C - Natural lighting day
- D - Light clothes day
- Other

52% for A - No elevators day
31% for C - Natural lighting day
6% for B - Warm clothes day
6% for D - Light clothes day
5% for Other
VI. Conclusion

- There is **high willingness** to use energy in more effective ways in both residential and commercial buildings.
- An important percentage **has intention**; but need further insight about management methods.
- A considerable percentage has **no clear idea** and can be motivated.
- Performance of **existing energy-aware consumers** can also be improved with innovative methods.
- Proposed gamified options are **widely accepted** by the community.
- Field test will provide **valuable experience** about challenges in implementation.
Thank you

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