Prediction Markets in the Energy Sector: a Case-Study

Filipe S. Silveira
Department of Industrial Engineering
Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516, Portugal

António C. B. Grilo
UNIDEMI, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa,
2829-516 Caparica, Portugal

Abstract

Corporate decision making processes face inevitably the impact from ecosystem´s uncertainty and complexity. Given that, information availability in dimensions such as time, quality and diversity assumes critical importance to accurately support management teams.

Growing interest in prediction markets can be justified by two main features. On one hand, the mechanism manages to stay continuously close to meaningful information. On the other, all bits of dispersed knowledge are aggregated via market, which economic theory has proven very effective.

This paper attempts to assess prediction markets value contribution to energy sector decision making activities, evaluating the benefits and drawbacks that would result from its implementation to different management challenges encountered inside EDP, a leading Portuguese energy company. The research concludes that the Prediction Markets can add value when compared to other methods available in the management toolkit, bypassing the shortcomings from group methods like deliberation. The resulting findings also highlight the importance of context, top management nurturing as well as an adequate incentives engine as crucial to the success of its implementation.

Keywords

Prediction Markets, Decision Making, Information Management, Innovation.

1. Introduction

1.1 Corporate Decision Making

Historically, organizations do poorly getting at the truth about their employees' thinking on critical business questions. What is the likelihood that a product or service will get to the market on time, be a success in the market, be sold in large enough quantity to generate expected revenue, be met with customer satisfaction or even meet the company's key performance goals? Successful decision making relies on timely and accurate information, often just partially captured by a small group of people responsible for a specific decision task and far too distant from corporate ground reality [1].

Communication up and down, as well as between collaborating divisions is not always optimal despite cross-functional teams, project management processes and open feedback systems to ensure forthright information flows. Overconfidence, optimism, Wall Street pressures, sales quotas, pleasing the boss, fear of failure, risk aversion, blaming the messenger bearing bad news all conspire to reduce the truth - the product or service will make or miss the mark [2].

Being aware of these issues doesn't solve the problem, but simply undervaluing and running away from all this pool of inside knowledge within complex corporate layers deprive leaders from information that could enrich their analysis and reduce the risk of out of context decision making.

1.2 Prediction Markets

Prediction markets is an innovative real-time tool that gathers and aggregates meaningful dispersed information, shaping it in objective and usable ways in order to support decision making management teams. We can see it as a place where information is aggregated via market (or other) mechanisms for the primary purpose of forecasting events, or the probability that an event will occur [3].

The key idea behind a prediction market is pooling the knowledge of many people within a company, with a diverse pocket of expertise and widely dispersed or isolated workforce, and use this valuable collective knowledge to improve corporate decision making activities.

1

A prediction market is an exchange in which participants vote on a possible outcome by buying and selling shares that correspond to a particular forecast, similar to trading in the stock market. The tool ties up the outcome of a trading contract with the probability that the event will occur so that shares in a forecast that participants believe is most likely, trade for a higher price than shares in a less likely scenario. In this way market traders can continuously adjust the price and hence the probability of the event is conditioned to the new market information [4]. This creates a dynamic forecasting and near real-time application that attempts to incorporate all information amongst traders. A more in-depth discussion on theoretical issues regarding prediction markets can be found on [2,4,5,6].

1.3 Corporate Applications
So far, most of the companies using prediction markets are doing so in limited ways, in one or two departments, testing the concept to see how it goes. But in the last few years, corporate experimentation has moved beyond high-tech businesses into other industries, including retailing, hotels, health care, steelmaking and telecommunications.
Examples on corporate applications [7-9] show that prediction markets are starting to move into the mainstream, and they will really change the way companies are run in the future. On the other hand, like any social media or enterprise 2.0 tools, they are only as good as the organizational cultures using them and many authors believe that high performing companies good at adopting and implementing new processes will benefit the most from prediction markets.
Once the decision to implement a prediction market is made, it is important to consider a number of design variables that can impact the type and quality of information revealed by the market. This work takes into account the guidelines for market design in [10] and follows the detailed framework suggested by [11] allowing an in-depth analysis of the key considerations involving the following design elements: Forecast Objectives, Participation, Trading Mechanisms, Claim Structures, Claim Definitions, Incentives and the Trading Interface.
Despite the exploding corporate growth of interest in the tool, few results are shared and discussed openly, making it hard to assess the real potential of prediction markets and the importance that key elements (context, innovation culture, organizational information flows, executive nurturing, others) have in assuring its implementation success.

1.4 The Energy Sector
The energy sector is particularly interesting for the recent shift from a highly regulated industry with monopoly-like structures to a liberalized market with new emerging competitors and European legislation influencing the national markets. In addition, the climate change debate triggered awareness about environmental issues amongst the energy customers. Given this scenario, European energy companies urge to capture insights pre-emptively and use them in organizationally useful ways, defining their value proposition and decision making processes accordingly.

2. Objectives and Methodology
Given the importance of context and exhaustive planning before implementing prediction markets in an organization, this paper attempts to evaluate the attractiveness in applying such a tool in the energy sector decision making activities. Focusing on the corporate context and reality of "EDP – Energias de Portugal", a leading utility company in the Portuguese energy market, this paper explores three different market approaches addressing specific management challenges encountered in the company consumer area. Under this framework, some possible benefits and draw-backs are further analyzed leading to final conclusions.
In order to explore a field that is relatively new or about which knowledge is comparably limited, case studies are recommended as the research method [12]. Furthermore, single case studies are particularly powerful in exploring a phenomenon in its context while retaining the richness of the studied incident [13]. Accordingly, prediction markets are not a turnkey solution, as different organizational or corporate impacts (both positive and negative) can arise.
In order to sense the business ecosystem, to correctly structure different market designs and also to assess the corporate benefits/drawbacks from further implementation, several interviews with EDP´s managers were conducted and contacts were made with software provider companies. This paper summarizes the conclusions found in [14], a MSc thesis dissertation from the same author and where all topics discussed are further and extensively detailed.

3. Results
3.1 Demand Forecasting
Under a different legal framework, microgeneration is gradually convincing Portuguese energy consumer's investment. Facing this new reality, EDP have responded immediately and launched "My Energy", offering domestic solutions in solar photovoltaic and micro wind turbine technologies.

2

During a reasonable long process and interactions with multiple entities, EDP wants to be actively involved and maximize brand exposure to clients. In order to continuously reformulate its value proposition, define the best strategy, anticipate behaviors and also to manage B2B partnerships, one crucial task of Marketing Intelligence Division is to gain insights about microgeneration consumers and forecast future demand for this segment.

Prediction markets can help the company effectively achieve this goal. Figure 1 maps the forecasting process mentioned, where all relevant information inputs are gathered and attempt to support management decision making activities. Notice that a diverse and complex quantity of information seems to be dispersed among multiple entities, interacting differently with distinct components of the problem, analyzing information, adding individual judgments, past experiences or additional outputs from other forecasting methods, to their individual belief.
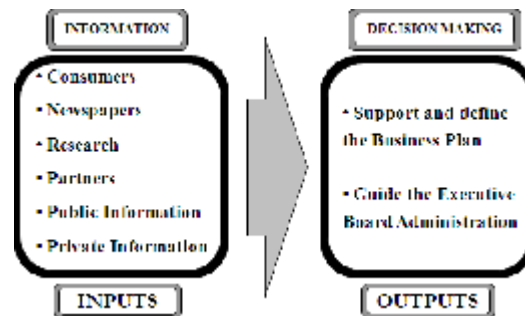

Figure 1: Process Mapping - Prediction Markets for EDP´s Microgeneration Management Challenge.

Surely that insights from customer service, the regulatory board or external partners selected for on-site installation will be both different and valuable to the forecasting problem. Therefore, they should all be motivated to interact and share information in the market, contributing to the real-time market price formation.

On the other hand, it is important that management teams immediately become aware of new information revealed or any unexpected change in the business environment. Prediction markets allow traders to instantaneously update their beliefs and measure the impacts of those changes in the forecast output.

Using a continuous double-auctions mechanism [11], where a buyer and a seller must agree upon a specified price and quantity for a trade to be made, a family of claims should now be structured. A claim is a statement about the future that is traded like a stock within a prediction market.

Asking the market "How many Megawatts of power will be assigned to microgeneration consumers in 2009?" generates a finite number of possible outcomes as described in figure 2. Notice that in this problem, a family of "All-or-Nothing" claims is being used. Therefore, the price on such a market represents the market's expectation of the probability that an event will occur (assuming risk neutrality) [4].

For example, a B contract costs $p and pays off $1 if and only if the quantity of MW assigned to costumers in 2009 falls between the 8 and 10 interval. Bids are made according to the value of $p, which varies depending on buyers and sellers behavior. If in a given moment p = 0.2, but my individual convictions expect B claim to occur with a 50% chance (my personal expected payoff for contract B would then be E(x) = $0.5), I would have incentives to buy now undervalued B contracts and expect a profit of $0.3 per share.
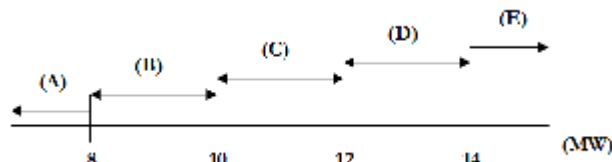

Figure 2: Different market contracts: (A): Power below 8 MW, (B): Power between 8 MW and 10 MW, (C): Power between10 MW and 12 MW, (D): Power between 12 MW and 14 MW, (E): Power above 14 MW.

It is crucial the market design addresses accurately the forecasting objectives. Additional issues must be considered:

- Type of Output: using a set of All-or-Nothing claims creates a probability distribution that can yield insights about the expected mean, variance and percentile values related to microgeneration future demand figures. This output hopes to enrich and support decision making analysis.

3

- Market Resolution: After defining the market question, the space of possible outcomes was partitioned into a finite number of contracts. Each contract was "tied" to a claim about the future. Notice on figure 2 that contracts have a 2 MW range. This value has to accommodate two criteria: 1) Level of detail required for the forecast, 2) Sensitiveness of participants to distinguish different outcomes.
- Trading Horizon: Given that significant relevant information is spread throughout market participants and new bits of information arise in frequent but uncertain time periods, the market should be open for longer periods of time, continuously revising price of contracts based on all available information. Another relevant question is when to close the market. In order to be a valuable forecasting output, the market will be closed six months before the end of the year, time when the Marketing Intelligence team needs to discuss possible deviations and if necessary, plan corrective actions.

3.2 Internal Concept Testing

Framed within the Electricity Market Division responsibilities, costumer e-billing payment transactions is a high priority challenge regarding global service cost reduction targets.

As a service provider, EDP sends the bill to 98% of its clients using post mail. This situation represents annual costs of 10 million Euros. Being aware of the resulting savings the company may have, EDP efforts to stress to costumers the benefits of such a conversion, including: service liability, process simplicity and also environmental advantages.

Addressing this issue, management teams are facing significant challenges. It is widely recognized that a tailored marketing strategy needs to be put in place, however it is still unclear which may be the best alternative in order to maximize the company's profit. According to the information gathered, two main variables must be carefully defined, as they should strongly influence the upcoming results:

1. Level/ Degree of Effort: while there is a natural rate of client conversion (additional corporate effort = 0 €), the company can foster more clients to e-billing payment solutions, rewarding them with a small gift - such as a mp3 reader or a USB drive – of no more than 4 € a piece. This value was thought reasonable, as it matches the annual conversion savings per client (additional corporate effort = 4 €).
2. Market Segment: Several studies indicate that depending on the segment (Medium/High Wage Residential, Other Residential, and Small Businesses) clients may react differently in their willingness to adopt e-billing solutions.

Should the company reward all clients willing to make such a conversion? Which segment is expected to behave strongly in terms of natural rate conversion? How significantly may clients react to the small gift currently being considered? Prediction Markets could help the company answer these questions and better understand which marketing strategy is best suited for the problem in hands, leading to optimized revenue for the company.

In order to construct the appropriate market architecture, claims should be designed considering the variables previously detailed and enabling the execution of a cost benefit analysis to all possible marketing strategy alternatives. This is only possible when a heterogeneous group of participants gather a significantly complex and dispersed amount of information. Figure 3 attempts to identify the various sources of information participants may be exposed and bring to the market (these can result from their specific role in the company, their ability to search for relevant problem-oriented bits of information or other publicly available sources), in order to support the considered management decision making challenge.
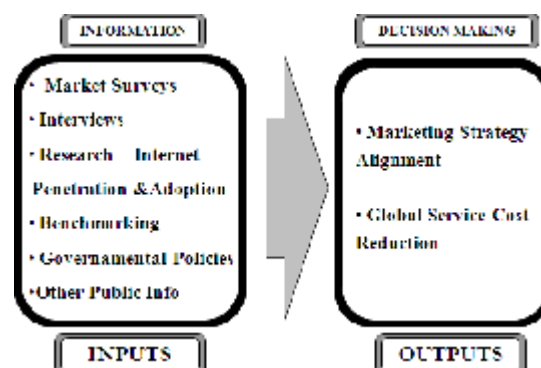

Figure 3: Process Mapping - Prediction Markets for EDP´s E-billing Conversion Management Challenge.

4

Notice that during the market design, the challenge is converted into a problem oriented forecast, supported on a claim which attaches different possible future scenarios to trading contracts. The claim has a start and a finishing date, leading to a single result which clearly distinguishes the winning participants (holding the winning contract) and the afflicted ones. Therefore, precise forecasts results in superior individual revenue.

One critical issue when designing a prediction market is the claim definition. If it were asked to participants what is the most beneficial incentive plan to EDP, it wouldn't be possible to assure that the selected alternative would overcome the remaining untested ones. Furthermore, how can EDP reward correct judgments from participants if ultimately cannot assure that the option identified is the best existing one? Notice that any decision making activity is unique, unrepeatable in time and context, and therefore the existing options available are mutually exclusive.

Hence, in order to overcome this issue, the market should ask participants "Which action will the management team take in order to address e-billing client conversion?". The related claim should also include when the decision is taking place, all the existing alternatives considered and which members are included in the referred decision team.

All the relevant information, distinct perspectives, opinions, scenario construction, cost benefit analysis and other open discussions can be added and updated by all participants, turning the tool output a valuable insight to support the decision making activity. Notice that the management team has a toolkit of methods and decision making systems, as well as their own knowledge, understanding and past experience, more or less aligned with the market output. The management team is prohibited to participate in the market and hopes to enrich their analysis with all the meaningful tools, leading to better decisions and ultimately to business success.

Regarding the universe of feasible outcomes, figure 4 illustrates the combination of possible variable states. Hence, different market segments (square for Medium/High Wage Residential, diamond for Other Residential and triangle for Small Businesses) can be marked as green or red, whether they have or have not been assigned with an additional marketing effort, corresponding to a gift campaign delivered to all new e-billing clients. ID number tag for each contract representation is placed below.
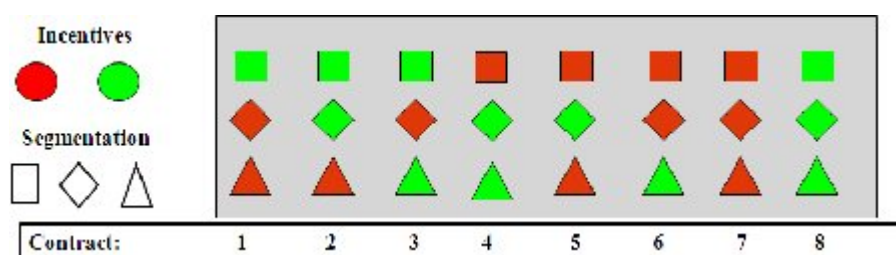

Figure 4: Prediction Markets Claims for Markets for EDP´s E-billing Conversion Management Challenge.

Hence, considering the previous combinatorial representation from left to right, traders buy the first contract if they believe the best strategy would be to encourage Medium/High Wage Residential clients to adopt e-billing payment methods (offering them a small gift), while on the other hand, expect a natural rate of conversion from the remaining segments. If ultimately the management team reaches similar conclusions, they will be rewarded by the market.

Depending on trader's behavior, all the possible events will be associated will their probability of occurring, providing valuable information to decision makers, as well as the information being shared among participants.

3.3 Consumer Experience Awareness

Besides the valuable insights to decision making activities, other corporate benefits can be obtained using prediction markets. So far this paper attempts to illustrate how the tool can succeed gathering a significant amount of dispersed corporate embedded meaningful information, but seeing it on the other way, it also becomes an extremely effective method to share knowledge, communicate internally and forward desired behaviors aligned with specific corporate goals, strategy, values and culture.

Historically, EDP is used to being a leading company in the energy market. In the past recent years business environment have changed considerably and so marketing activities have been developing and gaining superior importance within the company. Hence, Marketing Division is struggling to diffuse new concepts, behaviors and business perspectives totally aligned with consumer needs, expectations and his "experience" with the company.

Prediction Markets can be structured to help promote a strong consumer awareness within all employees. Collecting similar information found in market surveys -only this time aiming internally-, the tool provides a continuous monitor of consumer indicators such as brand awareness, popularity, communication, positioning, satisfaction, level of service, etc, and at the same time, calibrating employees sensitivity between consumer experience with internal

5

processes, technology, products, corporate decisions& strategies. Under this framework, it should be used the same market mechanism and claims structure described previously.

For example, the market could ask participants what will be the word-of-mouth company share disclosed by clients in the next quarter, according to the future survey X? Or making participants forecast the client satisfaction rates per market segment, etc. Notice that several questions can induce the desirable objective.

Strengthen a consumer oriented organizational culture can surely bring long-term tacit value. Although hard to fill return on investment reports, these benefits are critical to assure an objective and strong corporate alignment with defined targets, strategy and culture.

4. Cost Benefit Analysis

Using Prediction Markets to support corporate decision making is challenging to accomplish. But once correctly implemented, the effort to maintain and keep it running properly decreases, while the accuracy and value of the tool rises significantly. Given that, a number or relevant variables were considered when assessing prediction markets value contribution to EDP's corporate environment. Table 1 summarizes the cost benefit analysis performed.

Table 1: Cost benefit analysis

Prediction Markets Implementation	
Cost/Barriers	Benefits/Value Creation
Technological Solution + Assistance & Maintenance	Organizational Decision Making
Internal Market Team	Human Capital Involvement and Motivation
Formation, Teaching, Questions	Alignment with Corporate Objectives
Cultural Barriers & Top Management	Information Flow

As for costs, prediction markets require a technological interface where the market place is available to participants. After analysing different solutions from two "Software as a Service" providers, an average fee can be disclosed: €4.000 for initial setup costs and €3.000 per month for operational costs. These fees are expected to include technical assistance packages, tailored initial configuration and up to 500-1.000 active users. Besides that, an additional €4.000 budget is required in order to structure an internal market team, responsible for crucial tasks such as promoting the tool value contribution inside the company, capture participant's awareness and motivation, feed the market platform with more challenges, as well as establishing and diffusing market incentives and prizes. Additionally and given its unique corporate context and culture, organizational barriers are expected to be high. Therefore, capturing top management nurturing from the beginning is crucial to a successful implementation.

Considering potential benefits, prediction markets attempts to improve decision making activities, leading to incremental cost reductions or revenue improvements. Besides that, corporate information flows becomes more structured, decentralized and aligned with the company's main objectives, boosting employee's involvement and motivation, which ultimately leads to better results, talent retention, and other positive tacit advantages.

5. Conclusions

Decision making in the energy sector is mature, well developed and uses a diverse set of decision support systems and forecasting techniques. Prediction markets should be understood amongst other methods available in the management toolkit.

The mechanism proves to efficiently wage knowledge and conviction from participants, bypassing the shortcomings from group methods like deliberation. On the other hand, significant barriers may arise, as the tool proves to be far from a turnkey solution. Hence, this paper illustrates the importance given to context as crucial to the success of implementation of the tool. Top management nurturing as well as an adequate incentives engine should also be assured in the design phase.

The present paper provides unique contributions in assessing prediction markets implementation in the energy sector decision making processes, proving its valuable capabilities in the design phase when addressing a diverse set of corporate challenges. Given its different mechanisms and claim structures, the tool showed positive responses to convert a widely dispersed, irregularly distributed and complex amount of information into valuable insights for specific decision making activities underway. Following this research, a pilot-project was recommended to EDP, using a wider range of corporate challenges and aiming to test the tool value creation in the implementation phase. Also, the scope should take in consideration other decision support tools used internally, assessing the relative contribution of prediction markets, given different decision making scenarios.

References

1. Dye, R., 2008, "The Promise of Prediction Markets: A Roundtable. The McKinsey Quarterly", 83-93.
2. Hahn, R. W., Tetlock, P. C., 2006, "Information Markets: A New Way of Making Decisions." Washington DC. AEI Press, 21-48.
3. Abramowicz, M., 2007, "Predictocracy – Market Mechanisms for Public and Private Decision Making." Yale University Press: New Haven and London, 18-31.
4. Hanson, R., 2003, "Combinatorial information market design. Information Systems Frontiers", 107–119.
5. Chistiansen, J. D., 2007, "Prediction Markets: Practical Experiments in Small Markets and Behaviours Observed", The Journal of Prediction Markets, volume 1, 17-41.
6. Berg, R., Forsythe, F. and Rietz, T., 2000, "Results from a dozen years of election futures market research". University of Iowa. Working Paper.
7. Cowgill, B., Wolfers, J., Zitzewitz, E., 2008, "Using Prediction Markets to Track Information Flows: Evidence from Google", Social Psychology: The Second Edition, New York: Free Press.
8. Chen, K. Y., 2005, "Markets as an information aggregation mechanism for decision support", Ph.D. dissertation, School of Information Sciences and Technology, The Pennsylvania State University, Pennsylvania.
9. Manique, R., 2008, "How Can Innovation Outcomes Be Increased Within a Company Trough an Idea System?" MSc Thesis Faculdade de Economia, Universidade Nova de Lisboa.
10. Spann, V., Skiera, B., 2003, "Internet-based virtual stock markets for business forecasting". Management Science 49.
11. Schreiber S., 2004, "The application of prediction markets to business". MSc Thesis, Engineering Systems Division, MIT.
12. Yin, R.K., 2003, "Case study research: design and methods", 3rd edition, Applied social research methods series, Thousand Oaks, Calif.: Sage Publications, chapter 16, 180-181.
13. Eisenhardt, K. M., Graebner, M. E., 2007, "Theory building from cases: Opportunities and challenges." Academy of Management Journal, 50(1), 25-32.
14. Silveira, F., 2010, "A Aplicação dos Mercados de Previsão no Sector Energético – O Caso de Estudo da EDP". MSc Thesis Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa.

7