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NEW PRODUCT DEVELOPMENT WITH INTERNET-BASED INFORMATION MARKETS: THEORY AND EMPIRICAL APPLICATION

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Abstract

Successful new product development is crucial for firms' competitive advantage. Despite various sophisticated methods and high investments, new products still face notoriously high failure rates. A very critical stage in new product development is product concept testing for the go/no-go decision in further product development. Since there is a high number of different product concepts to test, there obviously is a need for a reliable, valid and efficient method, which can benefit from the scalability and interactivity of Internet-based technologies. Internet-based information markets are a new method to support new product development, based on the market efficiency hypothesis. We empirically evaluate product concepts with information markets. Further, we compare the results of the information markets with traditional research methods.

Keywords: Information Markets, Prediction Markets, Virtual Stock Markets, New Product Development, Product Innovation, Product Concept Testing

1   INTRODUCTION

Successful new product development (NPD) is a crucial factor for a company's profitability and competitive advantage in the marketplace. New products can be responsible for up to of 50% of companies' revenues (Di Benedetto 1999). Developing successful new products therefore has a top managerial priority for companies. Still, new products face notoriously high failure rates, surpassing more than 70% in many product categories, with little evidence for improvement over the last decades (Urban and Hauser 1993).

The NPD process is a very dispersed and complex process with R&D, engineering, finance, marketing and sales teams spread throughout a company, both in organisational and geographical location. Therefore, efficient communication and early interaction between the participants is essential for the success of new products (Dahan and Hauser 2002a). Internet technologies provide the basis for new methods for NPD. They are widely adopted by consumers and companies and offer additional advantages such as visualization with multi media enriched content, interactivity and personalization (Dahan and Hauser 2002b). Most importantly, they allow the scalable connection and interaction of a potentially large and dispersed network of knowledgeable consumers or experts. While a single expert might not always be able to provide a reliable and valid decision, the interconnection of a sufficiently large group of experts may be able to do so.

Information markets (also called prediction or virtual stock markets) are a new Internet-based method to support NPD. They allow for the connection of a large network of experts (both consumers and managers), which interact based on their trading of information and expectations. Thereby, the information of participants can be efficiently elicited and aggregated by the underlying market mechanism. Information markets can thus exploit the dispersed information of a broad network of knowledgeable employees and consumers, making them a promising tool for NPD.

Today, information markets are mainly used for forecasting short- and mid-term events, e.g. elections and business outcomes, and have demonstrated a very good predictive validity (Forsythe et al. 1999, Spann and Skiera 2003). The basic idea of information markets is to make future events or business outcomes expressible and tradable through virtual stocks. Yet, none of the studies focussing on forecasting has analysed the use of information markets to support NPD. The application of information markets to NPD is a new approach. Chan et al. (2002) proposed an information market for the evaluation of product concepts. Based on their encouraging results, a thorough analysis of the opportunities of information markets for NPD is necessary, comprising a theoretical framework for the optimal design and a technological architecture throughout the whole NPD process.

The goal of our paper is to outline the theoretical foundations and technological requirements for information markets as an Internet-based tool to support NPD. We develop a flexible software architecture for information markets and a design for the application to new product concept evaluation, which we empirically test for reliability as well as internal and external validity.

2   INFORMATION MARKETS

2.1   Theoretical Background

Internet-based information markets are a novel approach for the prediction of future events. The virtual stocks traded on such a market represent a bet on the outcome of event, e.g. a market outcome such as product revenues or sales. As in betting markets, the terminal value of the virtual stocks depends on the actual realization of the respective market situations.

The trading process on an information market can elicit and aggregate true assessments of its participants concerning future market developments reflected in market prices. This ability of information markets is based on the efficient market hypothesis. A market is efficient if all available information is fully reflected in the prices at any time (Fama 1991). According to the Hayek hypothesis, the price mechanism on a competitive market is the most efficient instrument to aggregate the asymmetrically dispersed information of market participants (Hayek 1945). Empirical and experimental studies have confirmed the informational efficiency of markets (e.g. Plott and Sunder 1988, Fama 1991). If an information market is efficient, it can aggregate the individual assessments of traders. In this case, the price of a specific stock reveals all information on the future market outcome and, therefore, can serve as a forecast.

The basic idea behind information markets is that the price of one share of a virtual stock should correspond to the aggregate expectations of the event outcome because participants use their individual assessment of the particular event to derive an expectation of the true value of the related share of virtual stock. While the average trader might be biased or make mistakes, the market-based aggregation is able to detect such inefficiencies and determine the "right" prices (Forsythe et al. 1999). In various scientific and commercial applications information markets are predominantly used for forecasting short-term events, such as election results, product revenues or sales. Information markets have demonstrated encouraging results for the validity and reliability of their forecasts compared to polls or expert opinions (e.g. Forsythe et al. 1999, Spann and Skiera 2003). However, the ability of information markets to provide reliable forecasts depends on the following prerequisites: (i) the pay-off of virtual stocks that is clear to participants, (ii) the information market provides incentives for participation and information revelation, and (iii) (at least some) participants possess knowledge on respective market outcomes (Spann and Skiera 2003).

2.2   Application of Information Markets for New Product Development

In this section we analyse the opportunities of information markets to support NPD throughout an idealized five stage process (Figure 1, Skiera and Spann 2004).

In the *Idea Generation and Screening stage* the integration of (knowledgeable) consumers in the product development process has been identified as one of the most critical success factors for NPD (Spann et al. 2005). The identification of these consumers as an origin for new product ideas has to be elicited and aggregated efficiently in order to significantly enhance the NPD. An increasing number of companies, like Procter and Gamble or Nike, use online communities as a source for new product ideas because the Internet attracts a large number of informed consumers that can contribute to the development of new products and the improvement of existing ones (Füller et al. 2004). Participating on the information market can stimulate consumers to express and discuss new product ideas and new product success factors.

In the *Product Concept Stage* more and more companies present their product concepts on the Internet in order to receive early customer input. Multi-media product concept presentation enables a more realistic customer experience. An information market can try to assess consumers' aggregated preferences for different new product concepts (see Section 2.3). In many product categories (such as automobiles or smart phones) an increasing number of different product features can be included in a single product. Scalability of Internet technologies may allow to evaluate such a large number of product features efficiently in an information market.

In the *Design and Engineering Stage* different design and development solutions can be evaluated at an Intranet information market. For example, the assessments on the feasibility and efficiency of different engineering solutions can be traded by R&D teams. Further, the inclusion of members for the marketing or sales department can add market-related information. Information markets might especially be beneficial in such situations, because the aggregation of the individual estimates will not be

biased due to different positions in a company's hierarchy. Spann and Skiera (2003) demonstrate that even 12 participants were able to provide good forecasts.

Within the *Product Testing Stage* product prototypes can be tested in an information market so that participants can trade their assessments on the market success of these different prototypes.

In the *Product Launch Stage* information markets can be used for pre-launch forecasting of a product's market success. Such forecasts are very helpful in order to optimize company's product-launch related marketing instruments. For example, a movie studio can use this information to decide on promotions and advertising related to the movie's release (Spann and Skiera 2003).
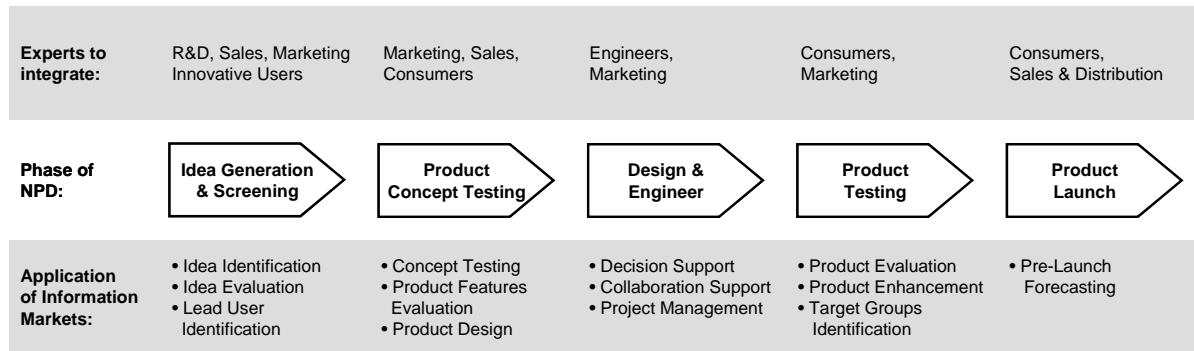
Experts to integrate:	R&D, Sales, Marketing Innovative Users	Marketing, Sales, Consumers	Engineers, Marketing	Consumers, Marketing	Consumers, Sales & Distribution
Phase of NPD:	Idea Generation & Screening	Product Concept Testing	Design & Engineer	Product Testing	Product Launch
Application of Information Markets:	• Idea Identification • Idea Evaluation • Lead User Identification	• Concept Testing • Product Features Evaluation • Product Design	• Decision Support • Collaboration Support • Project Management	• Product Evaluation • Product Enhancement • Target Groups Identification	• Pre-Launch Forecasting

Figure 1.   Application of Information Markets in the NPD process

2.3   Application of Information Markets for Product Concept Testing

The identification of products or product features that will best meet consumers' future needs in the market place is a very critical task. The challenge is to identify the "right" product ideas or the "right" set of possible product feature combinations for the new product. Consumer needs are evolving over time, new needs can arise and new technologies can stimulate future needs, making the detection of these future needs a difficult task (Chan et al. 2002, Dahan and Hauser 2002a). Given time and cost constraints, an efficient method for testing a large number of product concepts at an early stage of the NPD process is crucial. The goal of product concept testing methods is to provide an objective managerial instrument for incorporating consumers' assessments (Page and Rosenbaum 1992).

The most common market research techniques for product concept testing are survey-based preference elicitation methods like conjoint analysis. These methods collect preference statements regarding product concepts at the individual level (e.g. a preference based ranking of a set of possible product concepts) and try to aggregate these to the market level in a second, statistical step. In comparison to these methods, information markets thus elicit estimations directly for the market level. Another point worth stressing here is that information markets do not require participants to be representative for the target market. Contrary to this, preference elicitation methods require such representativeness, e.g. a sufficiently large number of respondents, for their predictions. Therefore, information markets are similar to expert prediction methods like Delphi-analysis. The main difference lies in the market-based aggregation of different assessments by the trading mechanism of a stock market, as opposed to an experimenter's conducted weighting of expert judgments.

Information markets are a new approach for evaluating product concepts. The idea is to collect aggregated assessments of the participants on the product concepts' estimated market success. Participants – experts or consumers – are asked to trade their expectations on market shares or sales of the product concepts. Participants are not trading on their individual preferences but according to their overall assessments of the market outcome. The application of information markets to product concept testing requires a specific market design. In previously conducted prediction markets the pay-off of a stock was always defined as a transformation of specified actual events. Since the realization of an event is

not available in the near future or the event might never occur (i.e. the product is never introduced), new benchmarks are needed for stocks' pay-off. The efficient design of the pay-off rule is therefore an important task in applying information markets to product concept testing. Skiera and Spann (2004) propose a design modification, which uses the results of two parallel experimental groups with each group's final stock price as the pay-off for the stock prices of the other group and vice versa.

3 SOFTWARE ARCHITECTURE FOR INFORMATION MARKETS

The provision of a flexible software application for information markets plays a pivotal role in supporting NPD. Our key goal is to develop such a software for information markets applicable at every stage of the NPD process.

The range of possible design options for information markets is very broad. The application of virtual stock markets for different uses within the NPD process requires a specific design at each stage and for every goal. Up to now, political stock markets and most other applications of information markets for forecasting have used a very similar market design due to the mostly short term nature of the forecasts. However, each stage of the NPD process poses different managerial problems. Determinants of managerial decisions for the screening of future product ideas differ from the selection of product prototypes to go into the final development stage. With a wide range of possible applications in business environments and yet-to-analyse design variations, an engineering approach for information markets' design is required (Roth 2002). Spann and Skiera (2003) introduce a design procedure for business forecasting markets that consists of the (i) choice of the forecasting goal, (ii) incentives for participation and information revelation and (iii) financial market design.

Figure 2 illustrates the design space for the application of information markets to NPD. Information market design depends on the factors: NPD stage, access type and incentive structure. Market access can be limited to experts or open to public, in order to attract a large number of participants. If confidential information is at stake, participation can be limited to a closed community (e.g., company's Intranet) (Spann and Skiera 2003). There are two basic categories of incentives: money investment and tournament. Money investments are predominantly used in experimental economics and require the participants to "play" with their own money. In business applications the risk of losing own money might, however, deter potential traders from participation. In addition to the administrative costs for managing money investments it could be regarded as illegal gambling as well. In a rank-order tournament best participants are rewarded with monetary or non-monetary prizes. Several studies demonstrate that such "virtual money" markets are able to provide accurate predictions and perform as good as "real money" markets (Servan-Schreiber et al. 2004, Spann and Skiera 2003).
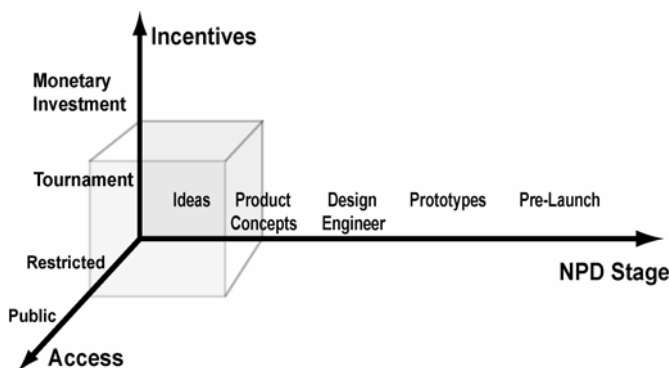

Figure 2.   Design Space for Information Markets for NPD

The necessary design for an application of information markets to product concept testing is highlighted in Figure 2. Due to the highly confidential information at stake, product concept testing is usually restricted to managers or a small group of consumers. Since participants may be reluctant to invest

own money, performance-based incentives should be related to an endowment or tournament. As in case with traditional methods for product concept testing, a short duration and easy-to-understand rules are important for participants to elicit their assessments.

Additionally, the integration of future research developments for information markets raises requirements for a maintainable and generic software architecture design. An essential factor for operational use is a flexible and easy-to-use configuration for a specific NPD problem.

Implementation of the described design space for information markets calls for an open software architecture. Extensibility of information markets enables the use of third-party applications (e.g. via web services) or integration of external information sources (e.g. data on events). Scalability and security of market transactions are further technical requirements for the software application since confidential information can be at stake.

Only component-based software architectures are able to achieve high modifiability for current and future requirements as well as to provide a robust maintenance. Figure 3 presents the structure of the developed software architecture. An example of the user interface can be seen in Figure 4. The components are grouped in several independent service-oriented layers. Each layer provides services to the above layer and uses services of the subjacent layer based on pre-defined interfaces.
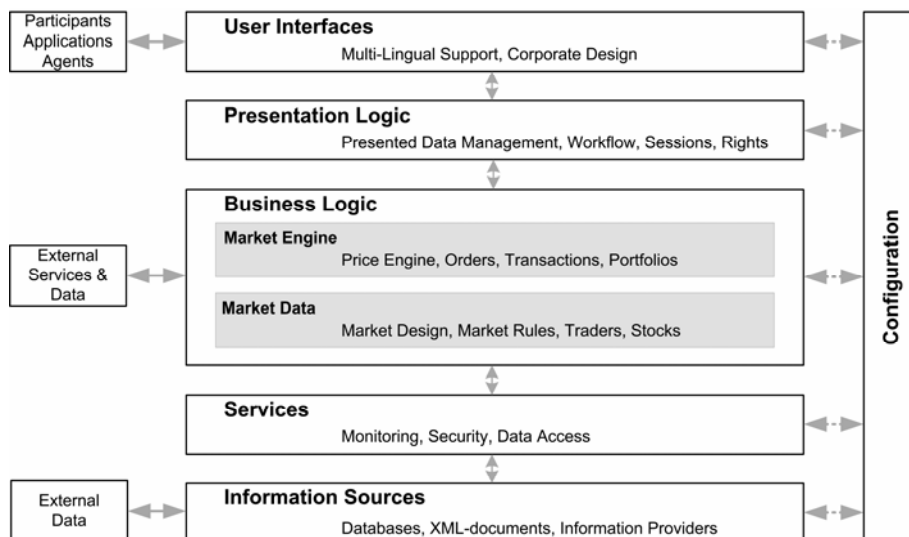

Figure 3.   Information Markets Software Architecture

The layer *User Interfaces* generates web-based user interfaces depending on different corporate designs or different languages. In addition, this layer provides gateways for requests of external applications.

The *Presentation Logic* layer implements session and workflow management. The data generated for the *User Interfaces* has to be set up with regard to information transparency, trading restrictions, trader groups or rights management. Therefore, this functionality is separated from the *User Interfaces* layer.

The *Business Logic* layer is divided in *Market Engine* and *Market Data*. The *Market Data* handles information on traders, virtual stocks, events and market design. The *Market Engine* implements the market transactions like market or price setting mechanisms, order, transaction and portfolio-management. Encapsulation of components for market mechanisms enables the integration of external market or auction mechanisms with using internal portfolio or transaction components. At the same time, our application allows external applications to use our market mechanisms, i.e. for simulations.

The *Services* and *Information sources* layers contain general-purpose components such as security mechanisms, data-, file-access wrappers or e-mail broadcasting.

The requirement of flexibility is most critical for the application since a large number of different parameters has to be set for a specific information market design. Therefore, the *Configuration* layer is encapsulated in a single component because it interacts with each layer of the application. For example, the selection of a certain market mechanism and respective market restrictions determines the business logic and the user forms for order placement as well.
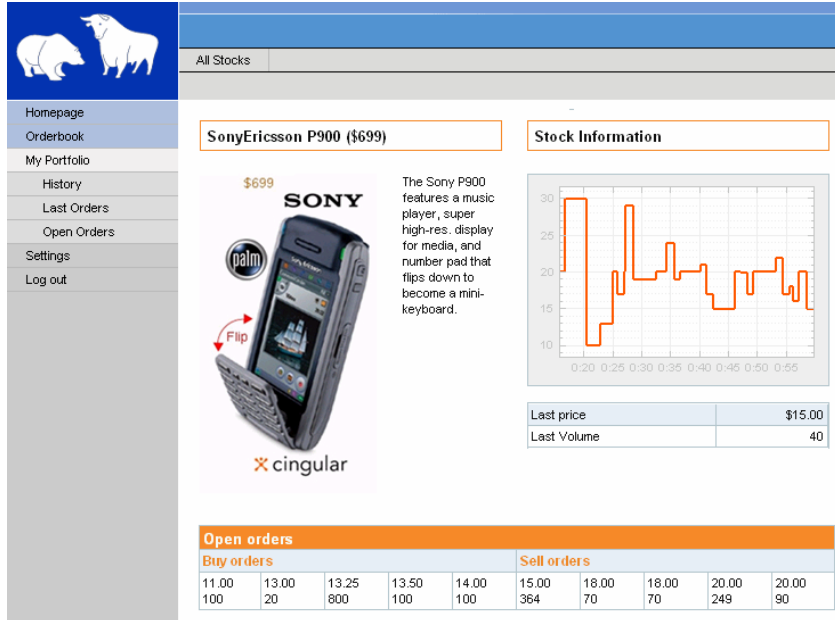

Figure 4.   User Interface for Information Markets

4   EXPERIMENTAL DESIGN

In our empirical study we want to validate the theoretically derived applicability of information markets for NPD. Our goal is to test the reliability as well as the internal and external validity of product concept testing with information markets at a selected stage of the NPD process. We test the reliability of the method by applying four independent information markets. To test for internal validity, we compare the results with self-explicated assessments of traders. Further, we test external validity by comparing the results from our information markets to the predictions of a conjoint analysis as benchmark.

4.1   MP3 Player Market and Product Concepts

For our product concept evaluation we chose portable MP3 players. As storage capacities rise and unit prices fall, MP3 players are a new product category with growing consumer interest. The MP3 player market started to take-off with the introduction of Apple's iPod in late 2001. IDC's latest study predicts an annual market growth rate of 20% in the next five years with $58 billion in expected revenues by 2008 (IDC 2004).

Basically, the market for portable MP3 players can be divided into devices with flash memory or harddrive. The difference between these two types of players is very significant with storage capacity ranging from 32 MB up to 80 GB. Therefore, we focused on hard drive-based MP3 players in a retail price range 250 - 400 €and storage capacity range 1 GB - 20 GB (status May 2004). Weight is another very important feature for portable devices. Some products integrate an FM tuner as well. Additionally, a colour video display offers a comfortable navigation menu with detailed song information and the facility to play movies. For our study, we selected the following product attributes: price, weight, stor-

age, FM tuner and video display. In our survey, respondents were also asked to mention other important features. Attribute "size" was stated by 8.97% but this feature is highly correlated with weight. "Brand" was only mentioned by 4.20%.

4.2 Information Market Experiments

4.2.1 Information Market Design

Four independent trading experiments were conducted in a centralized location. Two groups consisted of students as participants. Two other groups were recruited from non-student subjects. A short introduction was provided on information markets and our web-application to each group. Additionally, traders filled out a survey on their expected market shares.

Participants traded four concepts of MP3 players labelled {A,B,C,D} as stocks shown in Table 1. The forecasting goal was to predict the potential market share of product concepts in a hypothetical market.

Stock prices ranged from 1 € to 100 € (i.e. 100 times market share). Each trader was endowed with 1,500 of (virtual) € and 20 stocks of each MP3 player product concept. To keep market rules simple, no short selling or borrowing were allowed. Except for the restriction of a maximum order volume of 10 stocks, no other trading restrictions such as trading fees applied.

The market institution was a double auction trading mechanism, where traders could only place limit orders. All four stocks started with an identical initial price of 25 € Market information available to traders included the last transaction price as well as an open order book with best five bid and ask orders. The information market closed as the trading activity stopped. To provide incentives, best traders were rewarded with DVD- and cinema vouchers.

Concepts / Virtual Stocks	Concept A	Concept B	Concept C	Concept D
1. Retail Price	250 €	400 €	325 €	325 €
2. Weight	240 gr (8.4 oz)	80 gr (2.8 oz)	160 gr (5.6 oz)	240 gr (8.4 oz)
3. Storage	1 GB	20 GB	1 GB	5 GB
4. FM Tuner	Not integrated	Integrated	Not integrated	Integrated
5. Video Display	Not integrated	Integrated	Not integrated	Not integrated

Table 1.   MP3 Player Product Concepts traded on the Information Markets

4.2.2 Benchmark Studies: Conjoint Analysis and Self-Explicated Approach

We test external validity by comparing the results from our information markets to the predictions of a conjoint analysis as benchmark. Conjoint analysis is one of the most popular methods to design new products among both practitioners and academics (Urban and Hauser 1993). The goal of conjoint analysis is to estimate consumers' reactions to new products and to identify the most important product features. The basic idea of conjoint analysis is to extract individual preference statements for product concepts and to decompose overall utility to the specific feature levels. Conjoint analysis assumes that the product's attractiveness is the sum of all part-worth utilities of each product feature. The respondents are not directly asked on the importance of each product feature, instead they judge presented profiles of product concepts. The estimated part-worth utilities for product features can be used to predict the utility and market shares of new product concepts (Green and Srinivasan 1978). However, conjoint analysis requires a large number of participants to obtain valid results. Furthermore, the experimenter has the choice between different methods for the prediction of market shares for the product concepts (see Section 5.2). We constructed the different profiles from the product features and their levels selected in section 4.1. Respondents were requested to rank the 16 profiles from an orthogonal fractional factorial design according to the attractiveness of the product concepts. To test the

conjoint analysis the self-explicated analysis was conducted with the same respondents who were asked to directly evaluate the product features.

5 RESULTS

5.1 Reliability and Internal Validity of Information Markets

An overview of the trading activity of the four information market experiments is provided in Table 2. Thereby, we had a varying number of traders, as well as different total and per trader number of contracts (trades).

Expe-riment	Group	Traders	Duration (Minutes)	Orders	Contracts (Shares)	Volume (Price*Shares)	Contracts / Trader
1	Students	12	30:03	340	129	23,686	10.75
2	Non-students	8	27:52	277	114	19,081	14.25
3	Students	8	21:33	197	109	12,772	13.64
4	Non-students	8	24:01	217	104	16,726	13.00

Table 2.   Information Market Experiments Overview

Table 3 presents market share predictions based on the average final standardised prices for each stock as well as their variation over the four experiments. We use the final price, because it is the predominate measure in information market research (Forsythe et al. 1999, Spann and Skiera 2003). Product concept B, which has the most desirable product features, but also the highest price, has the highest predicted market share across the four experiments. However, the predicted market share of product concept A with the least desirable product features and the lowest price is only 1.14% lower on average. Product concept D, with a higher price, better storage and an integrated FM tuner is evaluated almost equal to product concept A. The information market clearly evaluates concept C, with equal features as A, lower weight but a higher price, less favourable. Apparently, usage features such as large storage, FM tuner and video display are important for consumers and their lack can only be compensated for by a strong price reduction.

The repeated use of an information market for the same set of product concepts allows analysing the reliability of the measure. The mean variation of the same concept's forecast over the 4 rounds of the experiment is 11.95%. Compared to the mean variation of traders' self-explicated expectations between experiments, of 11.10%, the inter-experiment variation of the information market is similar. Thus, we assess the reliability of our experimental information markets as acceptable (see Table 3).

Experiment	Concept A	Concept B	Concept C	Concept D	Mean
Information Markets					
Final prices [a]	27.96%	29.10%	15.13%	27.81%	
Coeff. Variation [b]	11.09%	9.85%	19.02%	7.86%	11.95%
Survey					
Avg. Price Expectation	28.78%	29.52%	14.00%	28.01%	
Coeff. Variation [b]	11.45%	8.01%	15.82%	9.41%	11.10%
Comparison					
MPD [c]	0.84%	7.85%	3.24%	10.83%	5.69%
[a] mean price of 4 experiments standardized to 100% [b] standard deviation divided by mean [c] mean percentage deviation between market prices and traders' self-explicated expectations for each stock and experiment					

Table 3.   Market Shares of Information Markets and Pre-trade survey

We analyse the internal validity by comparing the average market share predictions for the product concepts based on the stock prices of the information market experiments with the average self-explicated expectations of traders. The internal validity of experiments is very high. The mean percentage deviation (MPD) between predicted shares of the information markets and the pre-trade survey is 5.69%. Even though the results are similar for both procedures, stock markets provide additional information for analyses such as price volatility, different price measures, individual portfolios, market dynamics, order book spreads and outstanding orders.

5.2 External Validity of Information Markets

Since no market data is available for the product concepts we analyse the external validity of the information markets with the results of the benchmark conjoint study. The attribute-based conjoint study was conducted in May 2004 with a sample of 307 students. The average respondent's age was 24.38 (SE 0.18). 26.71% owned an MP3 player already and 22.74% intended to buy one in the next six months. Internal validity of conjoint analysis can be assessed positively, with correlation measures of 0.979 for Pearson's R and 0.867 for Kendall's Tau, both highly significant (p-value = .00).

	Concept A	Concept B	Concept C	Concept D	Mean
Conjoint Analysis					
a. First Choice Model	36.51%	57.89%	0.33%	5.26%	
b. Average Choice Model	24.97%	34.92%	17.97%	22.14%	
c. Logit Model	34.48%	56.49%	1.82%	7.20%	
Average Market Share	31.99%	49.77%	6.71%	11.53%	
Coefficient of Variation	*19.26%*	*25.87%*	*145.85%*	*80.06%*	*67.76%*

Table 4.   Predicted Market Shares of Conjoint Analysis

Table 4 provides the results of different aggregation methods for the prediction of market shares based on conjoint analysis. The most common choice simulator models for predicting the performance of products or concepts are the first choice model (maximum utility), average choice model and the logit model. The first choice model assumes that the consumer only selects the product with the highest utility as the product of choice. The average choice model calculates the purchase probability as the utility of the product concept relative to the sum of utilities of all products. In a similar way, the logit model calculates the choice probability based on exponential utility functions. The results of Table 4 display the strong influence of the choice of aggregation method on the predicted market shares for the different product concepts. Consequently, the average variation of market shares between instruments is 67.76%. As can be seen from Table 4, there is quite some uncertainty related to the choice of the aggregation method.

However, also in case of information markets, there is a choice to make in order to derive forecasts of market shares. Besides using the market's final prices, unweighted and volume weighted average prices (VWAP) may be used as alternative measures. The calculation of average prices can use all the prices of all transactions of an individual stock, or just a subset, e.g., the last 50% of transactions.

Figure 5 compares the predicted market shares between the different aggregation methods of conjoint analysis and the different price measures of information markets. Obviously, information markets are much more robust to different price measures than conjoint analysis to different aggregation methods. The mean coefficient of variation for the three different conjoint aggregation methods depicted here is 67.76% in comparison to 3.29% for the five different information market price measures. Due to the high variability of the conjoint analysis market share predictions, a direct comparison with the predictions of the information markets is dependent on the choice of method.

The market share predictions for each concept of the conjoint analysis (based on the average choice model) and the information markets (based on the final price) correlate with .71. Thus, the predictions

of information markets yield an acceptable consistency with the results of traditional methods in new product planning.

Conjoint Analysis
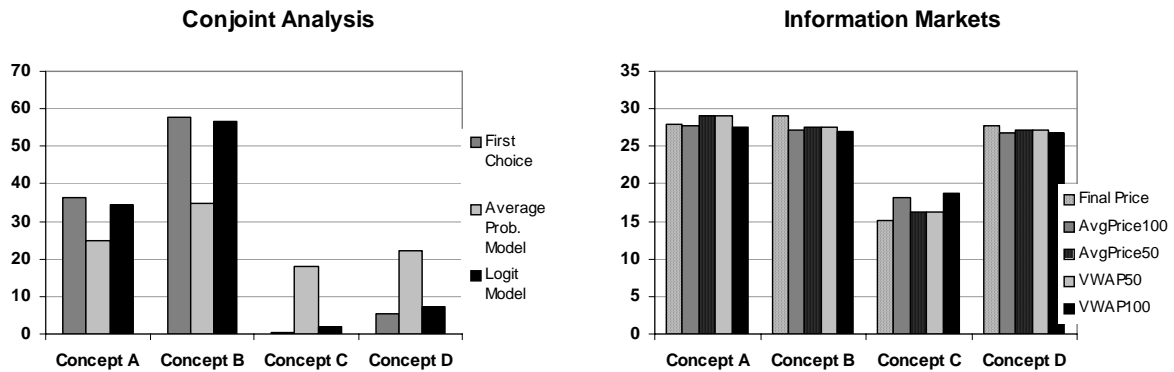
Information Markets

Figure 5.   Comparison of predicted market shares between Conjoint Analysis and Information Markets for different measures (final prices, unweighted average prices [AvgPrice] and volume weighted average prices [VWAP] for 100% and last 50% of transactions)

6   CONCLUSION

In this paper we evaluate information markets as a new methodology for new product development. Thereby, we show that information markets can provide beneficial applications at each stage of the NPD process. We further demonstrate that based on the desired application and restrictions on incentives and the set of participants, different design requirements arise. Therefore, a flexible software architecture is necessary, which can be applied at every stage of the NPD process. We develop such an architecture and ready-to-use software, which we use in our empirical study. The goal of the empirical study is to assess the reliability and validity of information markets for NPD by applying our software to product concept testing.

Our experimental results indicate the capability of information markets to support NPD. We obtained reliable and robust results in an application for MP3 player product concepts. We find internal validity, evaluated in comparison to traders' self-explicated expectations, as acceptable. Further, the predictions of information markets are robust to the application of different price measures. This result is important compared to the forecasts of our benchmark study applying conjoint analysis. The prediction of market shares based on the results of the conjoint study requires the choice of an aggregation method, which strongly influences concept-specific predictions. The market-based aggregation of information markets, thus, reduces the need and uncertainty of experimenter decisions on the aggregation method and can provide reliable results, which possess internal validity. Due to the lack of real market data on these product concepts and the uncertainty related to the benchmark conjoint analysis, a final assessment of external validity is not possible. However, it is interesting to note that information markets provided predictions with the use of 8-12 traders compared to our extensive conjoint analysis using 307 respondents. Additionally, lower costs result from the relative ease of recruiting respondents to play simulated stock market games, as compared with traditional market research methods. Based on further positive evaluations of the validity of information markets, this method can be used for concept testing with a more efficient use of consumers or managers as subjects than survey-based methods such as conjoint-analysis.

Finally, we conclude that information markets are a promising tool for NPD, which offer a variety of possible applications within the NPD process. Although more research is needed on the validity of information markets compared to traditional market research methods for new product planning problems, our software-platform allows easy replications and modifications of such studies. Therefore, we

expect that information markets will gain a greater interest in the area of NPD with an increasing number of applications.

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