Taylor, MJ, Reilly, D and Wren, C

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Article

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M. Taylor (corresponding author)
Department of Computer Science
Liverpool John Moores University
Liverpool, L3 3AF, UK
Email: m.taylor@ljmu.ac.uk
Tel: 0151 231 2215

D. Reilly
Department of Computer Science
Liverpool John Moores University
Liverpool, L3 3AF, UK
Email: d.reilly@ljmu.ac.uk
Tel: 0151 231 2279

C. Wren
Department of Computer Science
Liverpool John Moores University
Liverpool, L3 3AF, UK
Email: c.wren@ljmu.ac.uk
Tel: 0151 231 2110

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Abstract

Internet enabled consumer devices are beginning to be developed by manufacturers. In this paper, we examine how the internet of things can support marketing activities including customer relationship management, business intelligence and product design. In particular, the research reported in this paper examines how the internet of things can provide communication channels to support targeted marketing for product owners and enhance customer relationship management and product support. In addition, in this paper we examine how data gained from the operational use of internet-enabled devices can support business intelligence in terms of how consumers actually use a product, and can also support new product design in terms what features of current internet enabled products are most commonly used, and how they are used.

Key words: IoT, Consumer experience, Customer service / care, Technology

Introduction

The concept of the "Internet of Things" originated in1999 from work examining how to link objects to the Internet through an RFID (Radio-frequency Identification) tag (Ashton, 2009). RFID uses electromagnetic fields to identify tags attached to objects. The tags can be passive whereby they use energy from a nearby reader's radio waves, or can be active whereby they have a local power source such as a battery and may operate at distances up to hundreds of meters from the RFID reader. Wireless sensor technologies now allow objects to provide information about their environment, context, and location (Ng and Wakenshaw, 2017). Kannan (2017) commented that Internet of Things (IoT), promises significant transformations of consumers' lives in the near future. The internet of things has the potential to extend the scope of market research dramatically (Woodside and Sood, 2017) since data from internet enabled devices produced by a manufacturer can be analysed to identify usage patterns, not just when the device is used, but also how the device is used, and via geo-location, where the device is used. In addition, if the geo-location data from internet-enabled devices is combined with socio-economic datasets such as Mosaic (Mosaic, 2017), the socio-economic identification of the users of the devices can be determined and analysed. Ng and Wakenshaw (2017) commented upon the data potentially available to marketers from internet of things devices. However, as Bi and Cochran (2014) commented, there is a need to consider the confidentiality of data gathered from internet of things devices in terms of data protection legislation such as the UK Data Protection Act 1998 (DPA, 1998), and the European Union General Data Protection Regulations (GDPR, 2107).

The multi-variate data from internet enabled devices can indicate when the device is in operation, in addition, low-cost load sensors, motion sensors, temperature sensors and other types of sensors can be used to identify how the device is being used. Also any data entered by a user of the internet enabled device, for example which setting is chosen when operating a cooker, central heating system or washing machine can also be available via the internet. A low-cost geo-location function within an internet-enabled device can indicate the geographical position of the device and via combination with geo-coded socio-economic datasets, the socio-economic group of the device user can be available. Chang (2011) had stated the importance of the internet for marketing research in terms of web content. Saarijarvi et al (2013) discussed the evolving role of internet gathered customer data for customer relationship management.

Internet of things household devices can be supported by smartphone applications provided by the manufacturer that can allow the user to monitor and control the internet enabled device (for example, the Hive application (Hive, 2017) for controlling household heating and lighting). Such smartphone applications could then be used by the manufacturer to communicate with the user of the internet-enabled device to provide a new avenue for customer relationship management. For example, in terms of product support to advise how the internet enabled product could be optimally used e.g. which settings on a washing machine might be suitable for different washing loads. Sensors in the internet enabled device could also monitor the operation of the device and advise the customer if servicing might be required e.g. if a washing machine takes too long to fill up with water, or if the drum does not rotate smoothly.

In addition, analysis of usage patterns of internet enabled devices could be used to inform new product design via identification of which functions are most commonly used on the device, how frequently they are used, and the different parameters of their usage. Haverila and Ashill (2011) discussed the importance of market intelligence on new product design success. Filieri (2013) commented upon the generic use of the web to gather customer data on new product design. The internet of things can provide a higher level of market intelligence to support new product design, since actual product usage data can be gathered from all the devices of a given type in current use. Porter and Heppelmann (2014) commented that smart, connected products allow companies to analyze product usage data and gain new insights into how products create value for customers.

Although the internet of things can provide new avenues for marketing activities with far higher levels of richer data for analysis, in general as Nguyen and Simkin (2017) commented, there has been only limited research into the marketing aspects of the internet of things.

Literature review

Internet of things

The term “Internet of Things” was conceived in 1999 by Kevin Ashton who was part of a team that discovered how to link objects to the Internet through an RFID (Radio-frequency Identification) tag (Ashton, 2009). The internet of things is beginning to incorporate a growing number of home-based internet enabled devices (Crabtree and Tolmie, 2016; Jara et al, 2014; Yun et al, 2015; Li et al, 2012). The internet of things involves embedding tags, sensors and actuators in objects that are networked through an open standard Internet protocol (Crowley and Coutaz, 2015). Household devices will no longer be simply physical objects, but will carry more information with them and become information and communication technologies as well as physical objects (Dutton, 2014). Porter and Heppelmann (2014) commented that smart connected products offer opportunities for new functionality, higher product utilization and capabilities that cut across and transcend traditional product boundaries. Borgia (2014) stated that the expected huge number of internet enabled devices and the significant amount of available data open new opportunities to create services that will bring tangible benefits to companies and consumers.

The low cost and low energy usage of sensors and actuators enables them to be easily and cheaply embedded into household devices by manufacturers (Gubbi et al, 2013; Zanella et al, 2014). Chen at el (2012) stated that internet-enabled devices are opening up exciting new streams of innovative applications that can support highly mobile, location-aware, person-centered, and context-relevant operations and transactions and will offer new research

challenges and opportunities. Data obtained via internet of things devices can be integrated with geographical information systems to provide detailed geographical-based analyses (Jin et al, 2014). Gao and Bai (2014) commented that in terms of sales of internet of things enabled consumer devices, consumer acceptance of such devices can relate to their perceived usefulness, their perceived ease of use, and trust.

Internet of things new product design

Hsu (2011) stated the importance of innovative new product design for companies. Ng (2005) commented that many companies might not consider the costs of new product development as part of marketing costs, and further proposed that through informed new product design companies might need to rely less upon traditional direct marketing techniques. Althuizen et al (2016) commented in general upon the beneficial aspects of using data from customers for new product design. Feng et al (2012) stated that using customer data for new product development is becoming increasingly important for organizations to gain and maintain a competitive advantage in the marketplace and hence sustain high levels of profits and long-term competitiveness. Nishikawa et al (2013) commented that in recent years, more and more consumer goods firms have started to tap into the creative potential of their user communities to fuel their new product development pipelines. Calabretta and Kleinsmann (2017) noted the increasing role of the internet in changes in new product design practices. Schweitzer and Van den Hende (2016) commented that intervention design, that is, a product design that allows consumers to intervene in the actions of smart product can increase customer satisfaction. Goa and Bai (2014) argued that consumer acceptance of new internet of things products concerned perceived usefulness, perceived ease of use, and trust. Mani and Chouk (2016) found that perceived uselessness, perceived price, intrusiveness, privacy, perceived novelty and self-efficacy have an impact on consumer resistance to smart products. Kumar, and Ghodeswar (2015) commented that there can be a variety of factors that affect consumers' purchasing decisions regarding new products, including environmental concerns. Jones et al (2008) commented that marketing can contribute to the development of sustainable consumption via more environmentally friendly new product design.

Internet of things marketing support

Hofacker et al (2016) commented that in marketing, the main driver of the interest in data from internet of things enabled devices is the potential usefulness of it for informing marketing decisions and executing marketing campaigns. Jara et al (2013) commented upon the potential for participative marketing via the internet of things which presents an evolution of marketing through the capabilities offered by the ubiquitous identification and interaction capabilities enabled by the internet of things. However, as Weber (2015) and Michael et al (2014) commented, there is a growing need for appropriate regulatory as well as technical measures to ensure that the rights of individuals are protected when they may be unaware of the potential privacy risk from internet of things devices to which they are exposed (DPA, 1998, GDPR, 2017). Lee and Lee (2015) stated that internet of things devices can provide a vast amount of data on device users' location and movements, health conditions, and purchasing preferences, all of which have significant privacy concerns. Hofacker and Belanche (2016) commented upon the increasing concerns regarding geolocation data provided by internet of things devices. Wedel and Kannan (2016) stated that data analytics in the context of the internet of things must address customers' privacy and data security.

Wu et al (2017) stated that the internet of things will enable new services for consumers such as alerts and notifications of product changes. Porter and Heppelmann (2014) commented that smart, connected products allow companies to form new kinds of relationships with customers, requiring new marketing practices and skill sets. However, Nguyen and Simkin (2017) stated that overall there has been only limited research into the marketing aspects of the internet of things.

Methodology

A multi-disciplinary literature review was undertaken to develop a framework for use by organisations for internet of things support for marketing activities including customer relationship management, business intelligence and new product design. An internet enabled washing machine example is used to demonstrate proof of concept of the internet of things marketing support framework in terms of:

- How the internet of things can provide communication channels to support targeted marketing for product owners and enhance customer relationship management and product support.

- How data gained from the operational use of internet-enabled devices can support business intelligence in terms of how consumers actually use a product.

- How data gained from operational use of internet-enabled devices can support new product design in terms what features of current products are most commonly used, and how they are used by consumers.

The theoretical contribution of the research reported in this paper is the development of marketing theory in the area of internet of things, in particular a theoretical framework for internet of things marketing support that encompasses:

- Internet of things customer relationship management derived through operational product device usage patterns.

- Internet of things product support derived through operational product device monitoring.

- Internet of things business intelligence that includes analysis of operational usage patterns by geographic area and region, and by socio-economic group (when combined with geographic postcode based socio-economic group datasets such as Mosaic (Mosaic, 2017)).

- Internet of things derived new product design derived from operational usage patterns to optimise the design of new products that better fit actual usage patterns.

This is an important area of marketing research since the internet of things can enable greater communication with and support for customers, and provide rich data concerning customer product usage patterns, without the usual costs associated with customer surveys and focus groups. In this manner, the internet of things can greatly enhance marketing activities, and provide data from all the users of a given internet enabled device, rather than from a small sample of customers via customer surveys and focus groups who may not be particularly

representative of the whole customer base and therefore provide potentially statistically unreliable data.

Results

We shall demonstrate the application of a framework for internet of things enhanced marketing activities via the example of an internet-enabled washing machine, in order to demonstrate proof of concept for the internet of things marketing framework discussed in this paper.

Internet of things support for marketing activities

Data available from internet of things devices

The first aspect of the framework for internet of things enhanced marketing is to determine what data potentially available from internet of things enabled devices might be of use for marketing purposes, and the nature of such data. There can be a variety of data from internet of things devices that can be used for marketing purpose. This can include: setting or control data entered by the product owner, sensor data within the product that can include temperature, load, speed (both linear and rotational), and location data from GPS. The data from internet of things devices can be large in volume, and can be a mixture of structured and unstructured elements. The data can potentially arrive at real-time speed, and could potentially be of uncertain provenance. Such data might be unsuitable for processing using traditional SQL-queried relational database management systems (RDBMSs), but might instead require storage and processing via more flexible platforms such as Hadoop (Hadoop, 2017) which is a framework that allows for the distributed processing of large data sets across clusters of computers using simple programming models. Data from internet of things devices can replace sampling and surveys with actual usage data, which can be more cost-effective and comprehensive.

Analysis of data from internet of things devices

The second aspect of the framework for internet of things enhanced marketing is to determine what analysis approaches for the data potentially available from internet of things enabled devices might be of use for marketing purposes. Since the data from internet of things devices can be large in volume, a mixture of structured and unstructured elements, and can potentially arrive at real-time speed it is important to determine appropriate data analysis approaches. The methods of analysis of data from internet of things devices can be varied, and can depend upon the data available, the type of product, and the purposes for which the data may be useful for marketing purposes. Chen et al (2012) commented that the underlying analytics and location and context-aware techniques for collecting, processing, analysing and visualizing largescale and fluid sensor data from internet of things devices are still unknown. Dijkman et al (2015) stated the importance of analysing the data collected from internet of things enabled devices to determine the building blocks and specific building block types for business models for the internet of things and to determine their relative importance. Stanton and Stanton (2016) commented that crunching numbers without understanding the context in which they were gathered or understanding the business context of the patterns in the data can be a waste of time and money.

Customer segmentation (Rundle-Thiele, 2015) can be performed through categories of use of internet enabled products (e.g. is the product used frequently or infrequently by different groups

of people, is the product used at different settings by different groups of people). The geolocation data available from internet of things enabled devices can be analysed by areas and regions, and can be combined with geographic socio-economic datasets to analyse the data by socio-economic groupings. Statistical comparisons of customer segments using techniques such as ANOVA (Analysis of Variance) (Gardiner et al, 2013; Nayeem and Casidy, 2013; Persaud and Azhar, 2012), or frequency analyses using techniques such as Chi-square analysis (Pérez and Rodriguez del Bosque, 2015; Lade et al, 2017)) can be used identify differences between customer segments using a given internet enabled device. Predictive statistical techniques, such as multiple linear regression or logistic regression (Firdaus and Kanyan, 2014) can be used to predict actual values of variables relating to new customers for internet enabled devices, or the likelihood of certain actions by new customers based upon analyses of product usage data obtained from internet enabled devices. Artificial neural networks can be used to model more complex non-linear relationships in the data from internet enabled devices (Bughin, 2017; Forrest and Hoanca, 2015; Chowdhury and Samuel, 2014). It is also important to determine the required frequency of such analyses for marketing support, for example, daily, monthly, quarterly, and yearly. Rather than merely analysing data from a sample or survey of consumers, with data from internet of things devices it is possible to evaluate the whole population of consumers, and anomalies may be easier to detect.

Communication channels with owners of internet of things devices

Internet of things devices are often controlled or monitored from an app on a smartphone that can be provided by the manufacturer. This then provides a potential communication channel between the company and the owner of the internet of things device. The third aspect of the framework for internet of things enhanced marketing is to determine what communications through the smartphone app might be of use for marketing purposes. This could simply be for straightforward marketing of new products or services, but could also cover customer support in terms of targeted communications based upon analysis of usage data by the individual product owner. Saarijavi and Karjaluoto (2013) argued that the role of customer relationship management has become more important as companies increasingly shift their attention from goods to services and from selling to serving. As a result, the role of data in managing customer relationships represents a strategic issue for companies in order to protect their existing customer base.

In summary, it is important to understand how the internet of things can be useful for supporting marketing by:

- Determining what data is potentially available from internet of things devices, and the nature of such data.

- Determining appropriate data analysis approaches for the data obtained from internet of things enabled devices and the required frequency of such analyses.

- Determining appropriate marketing communication strategies for communications with owners of internet of things enabled devices.

Framework for internet of things enhanced marketing

The framework for internet of things enhanced marketing involves mechanisms for improved customer relationship management, business intelligence, and support for new product design.

The customer relationship management mechanisms concern targeted communications with customers via smartphone apps provided by the manufacture to monitor and control the internet enabled device. The business intelligence mechanisms concern the collection and analysis of usage pattern data from the internet enabled devices and geo-location data combined with geographical socio-economic data sets to provide enhanced geographic information systems that can analyse consumer behaviour by a variety of factors. The new product design support mechanisms concern detailed analysis of usage patterns of internet enabled devices to determine the optimal features to include in new product designs.

In outline the framework for internet of things enhanced marketing involves:

Customer relationship management mechanisms

- An internet-enabled device can pass usage data from the device to the manufacturer and to a smartphone app provided by the manufacturer, which could then advise the consumer regarding optimal usage of the device.

- Product support for an internet enabled device can be provided by embedded software within the device monitoring the operation of the device and advising the consumer via a smartphone app provided by the manufacturer if servicing or replacement is necessary.

- The consumer could be encouraged to install the smartphone app for the internet enabled device as part of product registration, and also as a means to remotely monitor or control the device.

Internet of things business intelligence mechanisms

- Usage patterns of internet enabled devices could be obtained from all consumers using a given type of device from a given manufacturer. The data could include all consumer entered data, and data from a variety of embedded sensors in the device.

- Geo-location incorporated within internet enabled devices can provide geographical data to support spatial geographic analyses of usage patterns of the devices.

- Cross-referencing with socio-economic datasets can enable determination of the socio-economic groups of internet enabled product purchasers, and can be used to provide socio-economic group based usage patterns.

Internet of things support for new product design mechanisms

- Data gathered from internet of things enabled devices can be used to analyse device generic usage patterns and different consumer group usage patterns which can be used to inform the optimal design of new products.

In order to demonstrate proof of concept of the framework for internet of things enhanced marketing, we shall use the example of an internet enabled washing machine to illustrate how the data collected from such a device can be collected and analysed to support business intelligence and the design of new washing machines. In addition, we demonstrate how a smartphone app provided by the manufacturer of an internet enabled washing machine to

monitor and control the device can act as a communication channel for enhanced customer relationship management.

Customer relationship management

An internet-enabled washing machine could pass washing load information (from a load sensor in the washing machine) and wash setting information (entered by the customer) to the manufacturer and to a smartphone app provided by the manufacturer, which could then advise the consumer regarding optimal usage of the washing machine to support energy efficient use. This could be done for single washes, or could analyse washing patterns over a period of time for a given washing machine.

In terms of on-going product support for an internet enabled washing machine, embedded software within the washing machine could monitor the operation of the different parts of the washing machine and advise the consumer via a smartphone app provided by the manufacturer if particular parts might require servicing or replacement (e.g. drum not rotating smoothly).

The customer could be encouraged to install the smartphone app for the internet enabled washing machine as a means of product registration, and also potentially as a means to remotely control the washing machine.

Internet of things support for business intelligence

Organisations would like to know how consumers actually use their products. Via the internet of things, patterns of usage of washing machines produced by a manufacturer could be obtained from all consumers using the washing machine, rather than just a small sample as currently done through market surveys (which can potentially provide data that may not be particularly representative of the consumer group). Using the data obtained from all the users of the internet enabled washing machine it could be determined what typical loads are washed (via a load sensor in the washing machine), what settings are most commonly used (via data entered by the consumer) and how frequently these occur.

If geo-location was incorporated within the internet enabled washing machines, usage patterns could be determined by area and region. The geo-location could be cross-referenced with socio-economic datasets, for example, Mosaic from Experian (Mosaic, 2017) to determine the socio-economic groups who purchase the washing machines and also examine different washing patterns between different socio-economic groups.

Internet of things support for new product design

Via data gathered from internet of things enabled washing machines, the manufacturer could alter the design of new washing machines to cater for the typical wash loads (weights) and settings (e.g. temperature and wash cycle settings) used by customers based upon operational usage data from such machines. For example, if the data gathered indicated that larger loads are more commonly washed, then new larger capacity washing machines might be developed. Conversely if there were significant patterns of smaller load washes for some consumers then smaller capacity new washing machines might be developed. In addition, if certain settings were very rarely used (e.g. woollen settings) then these might be removed from new washing machines. Also, by appropriate analysis of usage pattern data new more energy efficient washing machines designs could be developed.

Conclusions

The originality of the research reported in this paper is the development of marketing theory in the area of the internet of things, in particular the development of a theoretical framework for internet of things marketing support. The framework enables enhanced customer relationship management through operational internet enabled product device usage pattern analysis, and operational product device monitoring, as well as supporting business intelligence via analysis of operational usage patterns by geographic area and region, and by socio-economic group (when combined with geographic postcode based socio-economic group datasets such as Mosaic). Finally, the framework also supports new product design via analysis of operational usage patterns to optimise the design of new internet enabled products that better fit actual usage patterns.

Data privacy and confidentiality for consumers with regard to the data obtained from internet enabled household devices would need to comply with relevant data protection legislation (such as the UK Data Protection Act 1998, and the European General Data Protection Regulations) in the countries where the product was sold and used.

This is an important area of marketing research, since the internet of things is likely to provide access to large amounts of data from consumers regarding how they actually use products. Such data has the potential to transform marketing activities via analysis of product usage patterns to a scale and level of detail that previously would be unimaginable.

It is hoped that the framework for internet of things marketing support examined in this paper might be of benefit to organisations developing internet of things enabled household devices, and ultimately the consumers of such devices. With appropriate care and consideration of the collection, analysis and use of data collected from internet of things devices, more suitable devices can be developed that better match consumer needs and also offer opportunities for more environmentally aware design and operation of such devices.

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