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Creating Value By Object Hyperlinking Along The Consumer Buying Decision Process In The IoT Era

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ABSTRACT

Within the IoT scope, a new application named 'object hyperlinking' has evolved. Object hyperlinking is the pervasive presence of different things or objects identified by tags, sensors, and mobile phones that can interact with each other as well as with their neighbors through unique addressing schemes for business purpose. Enabled by Automatic Identification and Data Capture (AIDC) technologies such as QR code and NFC, object hyperlinking services make it possible link any object or location to a more comprehensive and editable information. While tagging technologies have good prospects to offer more opportunities in a company's interaction with its consumers, how this capability can be best applied and what innovative business services be created with object hyperlinking remain to be discovered. This study surveys and examines 76 projects of object hyperlinking in Taiwan and provides a framework to figure out business value and issues of object hyperlinking along the five stages of a consumer buying decision process. Based on the functionality and purpose of object hyperlinking services, this framework is conducted in dimensions of value creation, value orientation, functionality, key factor and challenges, key activities within organization, and managerial issues concerned. Some innovative business models enabled by object hyperlinking will also be introduced. The research results found that only when the information gathered by identified objects is used, analyzed, and distributed into wide business activities in term of marketing, customer service and firm level strategy planning, the effectiveness and value of object hyperlinking services can be realized at its maximum. The integration across different consumer buying decision process is also important. The more applications of object hyperlinking in different buying decisions, the more benefits will be created for customers. Managers can use the list of dimensions proposed in the framework to develop rich IoT business from enhancing service operations with object hyperlinking.

Keywords: Object hyperlinking, Internet of things, consumer buying decision process, AIDC, value creation.

INSTRUCTION

The growing availability of open wireless, actuator nodes, and tagging system embedded in mobile devices present lots of opportunities to improve business processes as well as to enable new service [1], [2]. Such ubiquitous identifiers and connectivity lead to a new scenario, the Internet of Things (IoT). Today, IoT has stepped out of its infancy and is on the verge of transforming the static Internet into a fully integrated one [7]. All objects, people or animals, physical or digital, are all converged in IoT, allowing firms to dynamically generate, analyze, and communicate intelligence data, increasing operational efficiencies, and powering new and greatly improved business models [4]. This offers the ability to measure, infer and understand environmental indicators, from delicate ecologies and natural resources to urban environments [7]. The idea of extending the Internet to the real world creates a new application named 'Object Hyperlinking.' A 'hyperlinking object' can represent itself digitally to become something greater than the object itself. Object hyperlinking can be seen as one of the key part of IoT which emphasizing creating data by things (objects) rather than by human being through embedded sensor and actuator nodes.

Transactions via object hyperlinking are service-oriented, facilitating a flow of information that enhances service execution [9]. However, most academic literature concerning tagging system has concentrated on technical issues, and the literature examining the business side focuses mainly on very specific topics [1], [2]; lacking a well-rounded view of the managerial issues concerning related services enabled by tagging system. Thus, the purpose of this study is to provide a holistic view of the applications and managerial issues affecting the deployment of object hyperlinking services utilizing Automatic Identification and Data Capture (AIDC) technologies. With such analyses, we hope to create better understanding on how successful, full-scale implementations of new mobile services can be accomplished in the IoT era.

Also, even lots of applications of object hyperlinking have emerged in reality. Object hyperlinking has not been listed as a critical service research topic yet. As such, service management researchers still are in need of theoretical foundations and comprehensive frameworks for subsequent empirical works. In light with this, this study has created a framework based on a consumer buying decision process to discover and illuminate key issues that will face practitioners as they approach business opportunities resulting from object hyperlinking. We have considered these issues along the dimensions of value creations, value orientation, functionality, and managerial concerns of implementing object hyperlinking services. In conducting the analyses, we also noted some issues persist during the implementation, particularly in the case of the need of integration along the buying process and across different business activities.

By analyzing 76 projects of object hyperlinking supported by a subsidy program of Taiwan government and conducting a comprehensive framework of object hyperlinking service, this study contributes to practice by identifying what kind of services AIDC technologies can provide to increase business value. The framework helps demonstrate the breadth of opportunities available to managers to adopt object hyperlinking enhanced service and applications.

LITERATURE AND RELATED CONCEPTS

The use of mobile devices and AIDC technologies to link physical objects in the real world to the digital one has impacted several models like object hyperlinking. Related concepts are described in this section. The five stages in a consumer buying decision process are also introduced.

Internet of Things (IoT) and Object Hyperlinking

The IoT concept defines a new paradigm to identify and communicate with smart objects. In other words, IoT describes a world that physical objects can be connected to the Internet and be able to identify themselves to diverse devices [2], [4]. Given the advanced connectivity of open wireless technologies, interconnected objects not only can generate information from the environment (by sensing) and interact with the physical world (by actuating / commanding / controlling), but also provide services for information transfer, analyses, applications and communications [7]. Seamless and large scale sensing, smart connectivity, context-aware computation, advanced big data analytics and information representation are all taking the potential value of IoT applications and services to a whole new era [7]. The term, 'Internet of Things,' shows the most key words in the IoT world, Internet and things. However, Atzori et al. [2] had proposed that an IoT vision can be realized not only by 'Internet-oriented' and 'object-oriented' paradigms but equal importantly by a 'semantic-oriented' paradigm. 'Semantic oriented" IoT focuses issues related to the methods of representing, storing, interpreting, and organizing information generated in IoT [2], [19].

Focusing on the 'thing-oriented' aspect and the communication and linking among things (An object is not necessary linking to the Internet), a phenomenon called Object Hyperlinking is emerged. Object Hyperlinking is based on the idea of IoT that the pervasive presence of different things or objects identified by tags, sensors, and mobile phones can interact with each other as well as with their neighbors through unique addressing schemes to reach common goals [2]. Like digital hyperlinks on web pages are linked to information on the Internet, object hyperlinking is the link of objects in the physical world to the information in the digital space. "Object Hyperlinks transform physical media into live links for accessing information and entertainment online." [5]. Enabled by Automatic Identification and Data Capture (AIDC) technologies such as QR code and NFC, object hyperlinking services make it possible link any object or location to a more comprehensive and editable information. AIDC is the method that using tagging technologies to identify objects, obtain data from objects, and enter that data directly into computer systems without little human involvement [20]. AIDC techniques provide fast, easy and accurate data collection methods. People can use the data collected for other purpose such as for analysis or distribution. These technologies are used not only for facilitating data entering, but also for allowing interactions with people, places and things with the mobile devices which in turn enhancing the usability and usefulness of these devices [20]. Lots of tagging technologies are considered as AIDC techniques, such as bar codes, Radio Frequency Identification (RFID), biometrics, magnetic stripes, and voice recognition. However, linking an object or a location to the digital world is a more involved process than linking two web pages [15].

Consumer Buying Decision Process

The five recognized steps of a buying decision process are problem or need recognition, information search, evaluation of alternatives, purchase, and post-purchase behavior [11]. This means that there are five key points at which sales and marketing teams and their efforts can either win or lose sales for a company [18].

(1). Need / problem recognition: A problem or need recognition always arises when there is a gap between the current state of affairs and some ideal and desired state. A consumer's need may be triggered by internal or external stimuli [11]. Internal stimuli are physiological needs perceived by a consumer such as hunger or thirst [16]. Consumers may be also stimulated by external stimuli such as exposure to an advertisement and a need of something is then emerged [8]. (2). Information search: A consumer may seek to make her/his opinions to guide his choice and his decision-making process with internal or external information. Internal information is the information that already collected earlier and stored in a consumer's memory. It comes from previous experiences a consumer had with a product or brand and the opinions she/he may have of the brand. But when it comes to a major purchase with a level of uncertainty or stronger involvement, internal information is usually not enough in the search for appropriate data [8], [16]. External information is related to a product or brand received from external source. Sources of external information include personal, public, experiential, and commercial sources [8]. However, not every search of a consumer is purposive and some search could be just for fun or interesting. (3). Alternative evaluation: Once the information collected, a consumer will be able to evaluate the different alternatives that offer to her/him, involving examination and comparison of product attributes [8]. All the alternatives a consumer knows are called an 'evoked set' and the ones that are actually being considered are the 'consideration set' which is mostly just a comparable small number of the evoked set [13], [14]. (4). Purchase decision: Factors such as past shopping experience or store atmosphere, promotion provided, extent of purchase involvement, and return policy will affect a consumer's final decision [17]. In this stage a consumer not only decides what to buy, but also determines when to buy and where to buy. The purchasing decision depends also very much on the level of involvement of a purchase. (5). Post-purchase behavior: Post-purchase evaluations may have important consequences for a brand, given that a satisfied customer is very likely to become a loyal one.

METHOD

Qualitative method was adopted and projects surveyed were based on a big government subsidy project executed by Taiwan government. It was a 4-years program began in 2011 and finally 77 projects got the subsidies from government (one of the project

failed and discontinued in the 3rd year of the program). All the projects applied AIDC technologies in their service innovation. We are a team formed by 10 researchers in information management and business areas and accepted the authorization of the government to evaluate the project performance starting from the second year to the final year of the program. Data were collected by interview, archival analysis of project proposal, and APPs (applications) use. Secondary data such as news and reports were also used to have a more understanding the projects.

A FRAMEWORK OF OBJECT HYPERLINKING SERVIC

Analysis Dimensionsof Object Hyperlinking Services

After surveying and examining 76 projects of object hyperlinking services. We conducted a framework to figure out the business value, issues and managerial concerns of object hyperlinking along the five stages of a consumer buying decision process. The conducted framework was divided in dimensions including value creation, value orientation, functionality, related tagging technologies, and managerial concerns (issues concerned, key factors and challenges, and key activities within organization) along the buying process. Some innovative applications of the 76 projects enabled by object hyperlinking are also introduced.

I. AIDC technologies: The 76 projects used a wide range of tagging technologies, including QR code, bar-code, RFID, Biometric, GPS, iBeacon/Beacon, NFC, image recognition, voice recognition, and sound wave. The most adopted AIDC technologies are QR code and RFID. In the final two years of the subsidy program, there was a trend that firms used QR code to replace RFID in their projects as the e-tickets of movie, baseball game or amusement parks. Given that graphical tags require low cost and are easy to implement and produce than physical tag like RFID, it is these graphical tags that are of particular interest to object hyperlinking services today.

II. Identified object: As the Ashton said: "If we had computers that knew everything there was to know about things - using data they gathered without any help from us - we would be able to track and count everything, and greatly reduce waste, loss and cost."[1] For different roles, being it product/service providers or consumers, the things or objects need to be discovered are various. We found the identified objects in the 76 surveyed projects including people, place, product, and service. (1). *People* (by biometric verification): The most important people a firm interested are undoubted the customers or potential customers. In one of the projects, a firm used biometric technology to identify its customers' face and provided recommendations of skin care products according to a customer's sex, age, and face conditions. (2). *Place* (by GPS, or iBeacon): Using GPS technology, one project identified a customer's location in a golf course and push value-added information in terms of weather, shape topography, and playing tactics to the customer's mobile phone. (3). *Products* (tagged with QR code, RFID): Tags are embedded in a product and consumers can scan the tags with mobile devices to get more information about the products. In many surveyed projects, QR code was included on products for linking to additional valuable information, e.g., videos, product certifications or spec sheets. (4). Service (by QR code, RFID, AR, iBeacon, NFC etc.): The 'object' interested in these applications is not a person, place, or location, but rather the service itself. Tags were used as e-tickets, certifications, reward points, or a bank account.

III. Value creations and value orientation: 4 value categories firms hope to create by object hyperlinking service in different buying process are figured out. (1). *Automating transactions / operational-orientation:* Firm provide services such as e-payment, e-passport or e-authorization for automating a transaction. This value is more operational-oriented and can easily be realized by firms with little implementation risk and strategic value. (2). *Facilitating transactions / information-orientation:* The link from an offline object to an online website or APP, firms assist consumers to easily evaluate product/service attributes like the features and functionality. By AIDC techniques, firms can also provide complete product information, such as product traceability or certifications to increase the information visibility of a transaction and reduce consumers' searching efforts. In other words, object hyperlinking can facilitate the process of information search and alternatives evaluation by reducing time and effort required. By so doing, object hyperlinking can further enable consumers to buy directly from the landing online pages. (3). *Stimulating needs / marketing-orientation:* With context aware computing, object hyperlinking can also help marketing persons to stimulate a consumer's needs by accurately identifying a consumer and the place she/he located. Firms can provide context-dependent information or advertisement accordingly to trigger a consumer's aware of desired need and boost further transactions. Some projects provided location relevant promotion or coupon with GPS and iBeacon tagging system. (4). *Increasing customer loyalty / service-orientation:* This sub-dimension aims to enhance customer loyalty, satisfaction, and better service experience by object hyperlinking. Some projects use tags as the certification of reward points in their loyalty program. Some projects combine object hyperlinking service with company APPs and provide value added service. In the project of a pharmacy, uses can get more drugs information by scanning a QR code on the drug bag to login to an APP. The pharmacy APP would remind the user when and how to have the drug on the right time in a right way.

A Framework of Object Hyperlinking along a Consumer Buying Decision Process

Object hyperlink can be used to help firms enhance their sales effectiveness and in the different stages of the buying cycle. Here, we identify the range of possible applications practitioners are likely to confront in fully applying object hyperlinking. In order to examine the challenges and opportunities for practitioners in object hyperlinking, it is useful to follow the process a consumer making decision for choosing a product or brand that seems most appropriate to her/his needs. Details regarding of object hyperlinking services at each stage of buying process on each dimension are presented in Tables 1 and 2.

Table 1. A Framework of Object Hyperlinking

	Value Dimensions	Functionality	Tagging Technologies	Service Examples in the Projects
Need Recognition	**Value Creation:** Stimulating needs **Value Orientation:** Marketing-orientation: Changing consumers from awareness to interest	- Providing recommendation, guide, game, or advertisement to boost further transactions, such as recommending location-based service or coupon. - Providing 'audience targeting' advertisement or coupon by biometric verification. - Scanning QR code via a unique reading APP, a consumer can get special coupons or discount which may trigger a further buying behavior.	QR code, RFID, Biometric, GPS, NFC, iBeacon / Beacon, image/sound /video recognition (image matching)	- -Using incentives to attract customer participate in a map-based game. QR code was printed in the poster in key traffic stations and consumers can get reward points and some incentives by finishing the requirements in the game hyperlinked via QR code. - -In a project implemented by a well-known coffee chain, consumers can buy QR Code based electronic coupons through an APP developed by the coffee chain. The QR Code can be then transferred through the phone to someone else who can use the code for exchanging a cup of coffee. With a sharing mechanism, a consumer would be trigged for buying more cups of coffee when she/he enters into a coffee shop.
Information Search	**Value Creation:** Facilitating transactions **Value Orientation:** Information-orientation: Assisting consumers to gather information efficiently	- Providing object-centered information, such as product traceability, certifications, and location-based information. - Making information search easier and quicker via AIDC techniques.	QR code, RFID, iBeacon / Beacon, GPS, AR	- A magazine advertisement or point-of-purchase sign can generate awareness of the new product, and then a QR code can link an interested consumer to a video or analysis that provides more information. In a project, a demo of product operation, a scientific expert's view of the product, and user review were available for customers by QR code connection. This is an efficient way to educate consumers about highly innovative or technical products. - In a project, the object hyperlinking service provided a platform for anglers to exchange or sale fresh fish. By scanning a QR code in the fish market, consumers can link to the website for information about a fresh fish, including landing sites, anglers' presentation, processing time, delivery time, nutrients, recommend cooking methods, and other information.
Alternative Evaluation	**Value Creation:** Facilitating transactions **Value Orientation:** Information-orientation: Assisting consumers to use information effectively	- Providing detail and comparative attributes of alternative stores or products, such as product test reviews or experience reports by scanning an QR code. - Trying to influence an alternative evaluation and move a particular product from an 'evoked set' to a 'consideration set'. - Facilitating evaluation processes by hyperlinking into a well-design APP	QR code, RFID, GPS, iBeacon / Beacon, Biometric	- Providing easily way for product comparison in various attributes by connecting tags to an APP or website. - Using iBeacon technology, a professional hardware manufacturer developed an object hyperlinking service by providing most recommended or best buy products list around an individual's position in an outlet. - Combined with QR code, RFID, and GPS technologies in the project, a shoe chain provided personalized service by recommending product mix for assisting purchasing choice of shoes. - Adopting QR code technology, a pharmacy provided stock and detail drug information for its customers. If customers provide health condition, the APP will recommend a mix of goods according to the health status of the customers.

	Value Dimensions	Functionality	Tagging Technologies	Service Examples in the Projects
Purchase Decision	**Value Creation:** Automating transactions **Value Orientation:** Transaction-orientation: Making transactions easier and safe	Providing safe and convenient payment. - Using actuator nodes, and tags as passports or authorization, such as transportation pass and e-ticket. - Managing and exchanging reward points easily by tagging system.	Sound wave, QR code, RFID	- Several projects integrate RFID and QR code with POS devices for payment and reward points management. - In some projects, consumers can scan the QR code on the product package in the outlet to order related product immediately. - A travel agent used RFID technology to integrate various vendors such as attractions, restaurants, hotels, transportation to provide Taiwan-specific tourism package. All the certifications and tickets were available online and then were stored in an APP with RFID tags after online ordering.
Post-purchase Behavior	**Value Creation:** Increasing customer loyalty **Value Orientation:** Service- orientation; information-orientation	- Providing further promotion after purchase, such as "scan this code and input your receipt number for 30% off your next purchase." - Encoded customer service phone number in QR code. - Quickly scanning for accessing product instruction or linking to customer service center. - Providing interactive game or social network.	QR code, RFID, GPS, NFC, AR	- Positioning with GPS and Wi-Fi, a professional baseball team provided its fans interactive information about the players and real time analysis of the game. This service enhanced interaction and repurchase intention of the fans. Fans can scan the QR code printed on the baseball game tickets after the end of game. The QR code will redirect to an APP of the fan's selected team to get rewards points. The rewards points can be used to exchange team posters or products and the loyalty of the fans might be strengthened. - Added QR code to the product package and linking customers to a website with useful resources – like customer service phone numbers or user manuals. - By integrated with electronic payment, a project provided an APP to the users for shopping records management and budget planning.

I. Need recognition: Need recognition is considered as the most important aspect in a purchasing process since a consumer does not perceive a problem or need, she/he generally will not move forward with considering a product purchase. Object hyperlinking can play as an external stimulation to trigger a consumers' need, creating a marketing-oriented value. In this stage, firms identify objects (e.g., people or place) and the context an object embedded. Firms then adopt customized actions to response to the context awareness. A famous example is the object hyperlinking application of E-mart. E-mart is the largest retailer in South Korea and had introduced an innovative Sun-based QR code which would only be revealed between 12 pm and 1 pm. Every day the sale in the form of special offers, coupon downloads and other promotions were different by the connection of QR code. The final results were excited that sales during lunch time by a whopping twenty five percent increased [3].

II. Information Search: In this stage, firms can create value to their customers by facilitating transaction with easier information accessibility and more complete and structured information. Therefore, object hyperlinking services providing information-orientation services to consumers. Taking an example, firms can offer object-centered information like product traceability, certifications, location-based information and so on.

III. Alternative evaluation: Similar to information search stage, object hyperlinking services facilitate the process of alternative evaluation and offer information-oriented value to consumers. By read the embedded sensor and actuator nodes, individuals can access detail and comparative attributes of alternative stores or products, such as product test reviews or experience reports and the alternatives in the evoked set may be decided.

IV. Purchase decision: In this process, object hyperlinking services help consumers finish transactions automatically in a more quick and convenient way. Payment and transportation tickets are common applications adopted in this decision stage. This is a transaction-oriented service. It is better to combine tags with online services to bring consumers from online to offline (O2O) and quickly complete the purchase with AIDC technologies. To smooth the transaction, the data generated by tags must be integrated with other enterprise system such as ERP system to make the data generated consist and accurate.

V. Post-purchase behavior: Firms try to provide value added and interactive services to customers in this stage. Both service-oriented value and information-oriented value are offered to increase customer loyalty. Firms may use customer behavior analysis and relationship management program to improve purchase experience of their consumers.

Table 2. Managerial Concerns of Object Hyperlinking

	Managerial Issues Concerned	Key Factors and Challenges	Key Activities within Organization
Need Recognition	- Context aware: How accurate and effective a stimulus can be offered after identifying an object? - Cross-selling: align with other brands to increase the perceived benefits of users. - Offline to Online: Combining with other online services to let an offline customer have motivations to make transactions online soon. - Novel marketing for enhancing consumers' motivation to use tagging technologies	- The qualified and relevant recommendations and customized ads. - Technology and method to sense the context dynamically of an object. - Applying big data and data mining technologies	- Data collection, analysis, and applications - Context aware computing. - Marketing (especially promotion) - Strategy planning
Information Search	- Information collection, analysis, representation, and accessibility	- Providing value added (e.g., comprehensive, useful, and real time) information. - The accessibility of information and systems (e.g., ease of use).	- Marketing - IT (APP design)
Alternative Evaluation	- Designing mechanisms for facilitating evaluation.	- The usefulness and convenience of Apps in helping evaluating alternative.	- Marketing - IT (APP design)
Purchase Decision	- Combining with online services to bring consumers from online to offline (O2O). - Integrated with other enterprise system to make the data consistent and accurate. The integration can make the overall purchase process be optimized.	- Security, reliability and convenience of transactions.	- IT management - Accounting - Sales - Strategy planning
Post-purchase Behavior	- Integrated with other customer service (such as loyalty program and social marketing) - Customer behavior analysis and relationshiop management	- Providing value added and interactive services to customers.	- Customer service - Strategy planning - Big data

CONCLUSION

Recently Internet has been shaping people live in a tighter way by extending the Internet to objects or locations in the real world. In light with this, this study uses a framework of a consumer buying decision process to discover and illuminate key issues that practitioners may face as they approach business changes resulting from the diffusion of AIDC technologies. We have considered these issues along the dimensions of value creation, value orientation, functionality, key factor and challenges, key activities within organization, and managerial issues concerned. In conducting this analysis, we also noted some challenges that firms need to face across the buying process, particularly in the case of the required integration within and between organizations. AIDC technologies can automatically and easily collect transaction and customer data. Moreover, despite the wide availability of AIDC technologies, many skeptics have also pointed out how pointless and boring some tagging system such as QR code marketing have turned into. According to the survey, we found that only when the information gathered by identified objects is used, analyzed, and distributed into wide business activities in term of marketing, customer service and firm level strategy planning, the effectiveness and value of object hyperlinking services can be realized at its maximum. As one can imagine, an advance and effective application of object hyperlinking must necessarily be the synergetic results conducted in different business activities, including marketing, information management, customer service, logistics, and strategy planning. The integration across different consumer buying decision process is also important. The more applications of object hyperlinking in different buying decisions, the more benefits will be created for customers.

The survey results of 76 projects also found that many SME (small and middle enterprise) discontinuous their projects after 2-3 years later from the project initiated. It is because no immediate performance was produced from object hyperlinking applications and the return on investment (ROI) was difficult to evaluate. Few reliable ROI analyses of AIDC applications are available [12]. Just like Ferguson puts it, "the business case spending on RFID is a raw guess," making return on investment (ROI) difficult to evaluate [6], [10]. This is truth for all AIDC technologies. Posed with uncertainty regarding whether AIDC technologies are in fact ready to support their needs, managers may put off adoption of AIDC technologies. Firms limited with manpower and financial resource may stop to adopt object hyperlinking service.

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