Internet of services-based business model: a case study in the livestock industry

Jacqueline Zonichenn Reis and Rodrigo Franco Goncalves
Universidade Paulista, São Paulo, Brazil

Epaminondas de Souza Lage
Cefet, Belo Horizonte, Brazil, and

Irenilza de Alencar Nääs
Universidade Paulista, São Paulo, Brazil

Abstract

Purpose – Considering the relevance of innovative business models in the digitally transformed market and the lack of clarity on the internet of services (IoS) contribution for a business model deployment in current literature, this study aims to fill this gap by evaluating a business model that converges to an IoS adoption in a direct sale of free-range eggs from farmers to consumers.

Design/methodology/approach – From the bibliographical research regarding the IoS and business model, the authors developed an IoS-based model framework. The framework has been evaluated in a real business scenario by using a single case study through an interview with the entrepreneur and documental analysis.

Findings – As the main result, a framework with the attributes can be considered a tool for an IoS-based business model deployment. The case study concluded that the business is aligned with the IoS adoption, and the framework presents adherence to it.

Research limitations/implications – The case study was limited to only one company owing to the IoS's novelty and the lack of correlated business models. Although the case study limits to the agriculture field, the proposed framework may be broadly applied.

Originality/value – Considering that the lack of a comprehensive business model causes new businesses to face challenges, it is relevant bringing up the present case study of the IoS-based business model, which correlates these two subjects, still poorly explored in the scientific literature: IoS and business models.

Keywords Business model, Digital transformation, Agriculture 4.0, Internet of services

Paper type Research paper

A case study
in the livestock
industry

401

1. Introduction

Information and communication technology (ICT) plays a substantial role in catalyzing economic growth, especially in today's age of internet and mobile telecommunication (Pradhan, Mallik, & Bagchi, 2018). Nevertheless, enterprise growth's critical challenge relies on integrating digital technologies and their use in new business models (Bouncken, Kraus, & Roig-Tierno, 2019).

The digital transformation strategies have four essential dimensions: use of technologies, changes in value creation, structural changes and financial aspects. Thus, research should seek to identify and concretize elements attributed to these four dimensions (Matt, Hess, & Benlian, 2015). However, there is still little research on business models intending to create new structures for an innovative market. Furthermore, little is known about how a shift toward service-driven models affects the firm's existing business model and which would be the structure to support the new business model (Schiavi & Behr, 2018). This paper aims to fill this gap by correlating two still poorly explored subjects: business models and the internet of services (IoS).

Although to form the IoS, the services must be described in a way that the business and the technology dimension gather (Wahlster, Grallert, Wess, Friedrich, & Widenka, 2014), the scarce literature on IoS focuses on the technological infrastructure and the programming codes to develop applications.

The innovative technologies expanded to rural food production, enabling the digitalization in agricultural production systems (Smith, 2020). In research related to the advances in agriculture and livestock production, the solutions more explored are related to the internet of things (IoT), covering remote sensing and traceability, rarely the IoS domain.

From the bibliographical research regarding the IoS and business models, the present paper brings an IoS-based business model framework. The framework has been evaluated in a real business scenario in the livestock industry by employing a single case study.

Considering that the lack of a comprehensive business model causes new businesses to face crippling challenges (Asadnezhad, Hejazi, Akbari, & Hadizadeh, 2017), it is relevant to bring the study of an IoS-based business model. This paper's research agenda presents a framework application empirically by describing how the organization can create, deliver and capture value through the IoS adoption in a direct sale of free-range eggs from farmers to consumers.

Owing to the novelty of the IoS, the little research available related to a correlated business model, and the absence of studies that investigate Brazilian companies in such an innovative field, this case study presents a significant contribution by evaluating the IoS to support a Brazilian free-range egg production enterprise during the business model deployment.

2. Conceptual foundation

2.1 Internet of services

The relevance of the IoS comes from its role as an essential component of the so-called industry 4.0 jointly with the IoT and cyber-physical systems (CPS) (Kagermann, Wahlster, & Helbig, 2013; Hofmann & Rüsch, 2017; Satyro et al., 2017; Alcácer & Cruz-Machado, 2019).

While over the IoT, smart objects communicate and cooperate in real time; via the IoS, both internal and cross-organizational services are offered and used by the value chain participants (Hermann, Pentek, & Otto, 2016). Traditional value chains are broken up to a large extent and substituted by loose networks of providers and consumers. Every user may publish the content or functionality on the web, becoming a platform operator and

consuming resources (or reusing them) to compose new applications and make them publicly available (Högg, Martignoni, Meckel, & Stanoevska-Slabeva, 2006).

As illustrated in Figure 1, the IoT establishes communication between "things," like machines or equipment, through the internet. A "thing" requests data from another "thing" that sends the data, and the unique information needed for this communication is the address as the identification of both parts, given by the internet protocol. Most of the time, the data provider "thing" uses sensors to provide real-time data. On the other hand, the data consumer "thing" can use actuators to act in the physical environment. The IoS concept goes beyond simple data communication because when the service consumer requests a provider's service, the request includes input data and parameters that can modify and personalize the response, returning value-added information. Both provider and consumer services can operate automatically or with human users through a human–machine (H-M) interface, so the final user's input data and read responses.

Among several definitions offered for the IoS, the two most common are business related. (1) A collaborative business ecosystem or global market where services from diverse providers (third parties) are offered, discovered and consumed in shared use (Kritikos & Plexousakis, 2014; Bucchiarone, Marconi, Pistore, & Raik, 2017; Givehchi, Landsdorf, Simoens, & Colombo, 2017). (2) A future internet that detects and uses contextual information to seamlessly adapt to an unpredicted scenario, allowing the *ad hoc* configuration of new ICT business models (Papageorgiou, Miede, Schulte, Schuller, & Steinmetz, 2014; Camara, de Lemos, Laranjeiro, Ventura, & Vieira, 2015; Balakrishnan & Sangaiah, 2017). Nevertheless, the scientific literature on IoS focuses on the technological infrastructure and appropriate programming codes to develop applications (Cardoso, Barros, May, & Kylau, 2010; Lara, Lizcano, Martínez, & Pazos, 2013; Chmielewski, 2014; Papageorgiou et al., 2014; Bucchiarone et al., 2017). While IoT emerges in the current business model literature (Sun, Yan, Lu, Bie, & Thomas, 2012; Dijkman, Sprenkels, Peeters, & Janssen, 2015; Ustundag & Cevikcan, 2018), the IoS research is still among the developers' software engineers.

2.2 Business model
The internet is the primary driver of the surge of interest in business models and the emergence of literature around the topic (Zott, Amit, & Massa, 2011). However, there are still important gaps in the research related to business models concerning the new structures for an innovative market.

New business models are likely to provide new opportunities to address customer needs better, generating differentiation from its competitors (Nunes & Russo, 2019). A business model is a conceptual tool containing a set of concepts and relationships to express a specific firm's business logic. It must consider which relationships allow a simplified description and
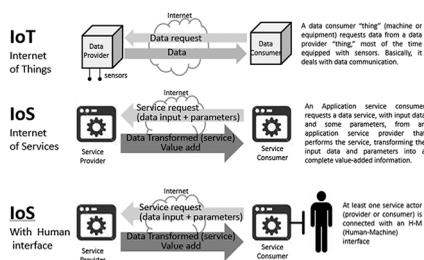

Figure 1.
IoT and IoS concepts

A case study
in the livestock
industry

403

representation of what value is provided to customers, how this is done and the financial consequences (Osterwalder, Pigneur, & Tucci, 2005). An accepted business model approach, both in research and practice, is the business model Canvas (Figure 2A) (Sun et al., 2012; GüNzel & Holm, 2013; Remane, Hanelt, Tesch, & Kolbe, 2017) which was introduced by Osterwalder and Pigneur (2010).

Although it is not always clear the reason for the success of a specific business model, it is generally agreed that a well-functioning business model is essential for the success of any enterprise, whether it is a new venture or a well-established company (Magretta, 2002).

The organization of business structures and emerging technologies for the generation of innovation has become a constant concern of managers in recent years (Bouncken et al., 2019). The business model innovation (BMI) literature reveals interesting fields of applications, such as servitization, open innovation and dynamic capabilities (Foss & Saebi, 2017). Although BMI is predominantly referred to in innovative start-ups, the studies do not shed light on what facilitates entrepreneurial firms' BMI.

The literature suggests the main point would be to assess the value-adding of the service-offering and also the value contributed by the partners since partner value and resources play an essential role in service-offering solutions (Weiner & Weisbecker, 2011). The company needs to set the service level agreements for delivery and operations among the various stakeholders (Schroth & Janner, 2007), considering the customers play an essential role in the service experience (Berman, 2012; Sun et al., 2012), what is being maximized by the pervasive use of social media tools (Muninger, Hammedi, & Mahr, 2019).

The shift from a product-oriented to a service-oriented model leads to new possible revenue opportunities, which brings challenges during the design of new business models (Kastalli & Van Looy, 2013). Enterprises need to focus on getting work with a mix of revenue models (Cristofaro, 2020), such as distribution service charges (pay-per-use), subscriptions or license renewal for a recurrent revenue (Moreno-Vozmediano, Montero, & Llorente, 2013).

In the current scientific research, the correlation between the IoS and the business model is still incipient. One evidence is that the broadly accepted business model canvas (Osterwalder & Pigneur, 2010) is rarely associated with the IoS. Another evidence is that recent research (Grabowska, Gajdzik, & Saniuk, 2020) still brings up challenges related to the adaptation of business models to services scenario, such as the reconfiguration of value chains, the customization and new forms that business models will adopt and the sharing resources in the network of companies operating under flexible supply chains.

2.3 Agriculture and livestock 4.0
The current industrial revolution driven by the CPS, IoT and IoS is expected to have a significant impact on the future of food production as well. The robotics and automated
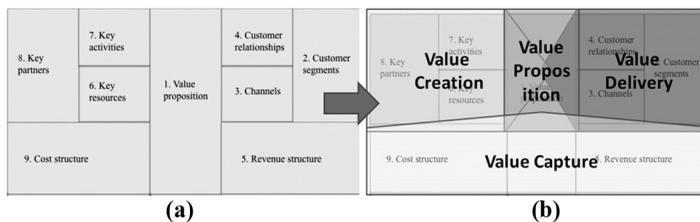
systems will improve farm efficiencies and sustainability (Swisher, Ruiz-Menjivar, & Koenig, 2018; Smith, 2020). Several concepts have emerged in the primary food production sector to express different digitalization forms in agricultural production systems, value chains and food systems. These include smart farming, precision agriculture, precision livestock farming and agriculture 4.0, to name a few (Dutta, Morshed, Aryal, D'Este, & Das, 2014; Klerkx, Jakku, & Labarthe, 2019).

With the IoT's help, the food supplies can become more transparent than before (Tzounis, Katsoulas, Bartzanas, & Kittas, 2017). The CPS or digital twins (which are sensors and actuators that monitor physical processes and create a virtual copy of the physical world; Jazdi, 2014) will emerge as an essential concept to improve how information about farm industries are coordinated to support decision-making (Dumitrache, Sacala, Moisescu, & Caramihai, 2017; Smith, 2020). Therefore, standardization mechanisms at each step of production (from the grower to the consumer – "farm to fork") need to be adopted to assure food safety and quality. Agriculture 4.0 requires fast, reliable, distributed measurements to give farmers a more detailed overview of the ongoing stage of the production, coordinating the automated processes in such a way that optimizes energy consumption, water use and the use of pharmaceuticals and chemicals (Tzounis et al., 2017).

Smart farming includes several areas of interest, for instance, sensor system, traceability, smart logistics and smart food awareness (Banhazi & Black, 2009; Kutter, Tiemann, Siebert, & Fountas, 2011). The solutions more explored are related to IoT, covering remote sensing and traceability with applications for controlled environment and food supply chain tracking (Banhazi & Black, 2009; Kutter et al., 2011; Liu et al., 2016; Tzounis et al., 2017). An attractive activity could be mapping such platforms with the stakeholders' requirements to establish new valuable services (Lezoche, Hernandez, Alemany Díaz, Panetto, & Kacprzyk, 2020). This relation with stakeholders is an essential part of the IoS-based business model proposed in the presented case study when evaluating value creation partnerships in a company from the livestock industry.

The innovative technologies expanded to rural food production, enabling the digitalization in agricultural production systems, value chains and the decision-making process (Smith, 2020). The need to produce more food with less usable land and reduce environmental impact has led to significant precision agriculture advancements (Lindblom, Lundström, Ljung, & Jonsson, 2017; Bahlo, Dahlhaus, Thompson, & Trotter, 2019).

3. Methodology

Initially, a bibliographic research was carried out to understand the role of the IoS on the business model conception and the gaps in current literature, which were evidenced by the few occurrences of the keywords IoS with business model. When searching for the string "internet of service*" AND "business model*" in Web of Science, only 14 papers are found. Furthermore, the papers mention the keywords but explore other subjects like IoT solutions or service-oriented architecture. Owing to the novelty, the study became exploratory with searches of relevant papers about the two subjects, IoS and business model, without a specific inclusion or exclusion criteria for papers selection.

The field research was structured as follows:

- definition of a framework to represent an IoS-based business model;
- case study describing a free-range egg production enterprise; and
- evaluation of the IoS-based business model using the elements of the case.

A case study
in the livestock
industry

405

3.1 Framework for an internet of services-based business model

The business model concept was used as a tool to conceptualize and illustrate a company's business strategy and objectives (Osterwalder et al., 2005). Before starting to work on the drivers for our IoS-based business model, we used the approach introduced by GüNzel and Holm (2013) for the original business model Canvas (Osterwalder & Pigneur, 2010). The business model describes four essential dimensions: value proposition, value creation, value capture and value delivery. The analysis of these core elements is crucial for designing the solution based on the key functions (Figure 2B) (GüNzel & Holm, 2013).

Those functions are described as: (1) value proposition, which is the value-adding of service or product; (2) value creation, which defines the structure of the value chain to create and distribute the offering; (3) value delivery, which covers the segments of clients addressed by the value proposition; the communication and distribution channels used to reach the clients; and (4) value capture, which estimates the cost and revenue structures, given the value proposition and the value chain structure chosen. Such mechanisms for creating, delivering and capturing value reflect the components that are well understood in the business model and BMI literature (Foss & Saebi, 2017).

By exploring the concepts of IoS and a service-offering view when proposing each business model function's value, we have the framework (Table 1).

3.2 Case study

The case study relates to a Brazilian free-range virtual egg business ("Easy Egg," a fictitious name), aiming to develop a virtuous circle through high technology, innovation and proper animal management practices and welfare. The laying hens (Emprapa 051 genetic strain) are kept in an outdoor "range" fenced area with access to a house with nests and where they

| Business model function	Internet of services-based model outlook
Value proposition	1. Describe the value-adding of the service-offering and the advantages compared to an on-premise offering (Weiner & Weisbecker, 2011) 2. Share the other stakeholders' experiences in the optimization of the supply chain with close respect to production sustainability (Swisher et al., 2018)
Value creation	1. Use IoS coupled with IoT so that people, machines and goods are interconnected via the network infrastructure (Hermann et al., 2016) 2. Use predictive analytics to gain insights by exploring patterns in demand and consumer behavior (Lezoche et al., 2020) 3. Assess the value contributed by partners and how critical the value is for their customer and own offering (Weiner & Weisbecker, 2011)
Value Delivery	1. Explore new channels with target customers, mainly by designing apps for smartphones and encouraging social media use (Muninger et al., 2019) 2. Measure the quality and create a feedback loop with customers, since the value is created through collaboration and participation (Berman, 2012; Sun et al., 2012) 3. Set the service level agreements for operations and security rules to protect each stakeholder's services and products (Schroth & Janner, 2007)
Value capture	1. Work with a mix of revenue models such as pay-per-use charges, subscriptions, or license renewal for a recurrent revenue (Moreno-Vozmediano et al., 2013) 2. Evaluate if worth collaborates with competitors, break into a new business or outsource functions (Berman, 2012) 3. When part of the digital services is offered free, as the mobile app, the value should be captured by In-App purchase or advertising to increase revenues (Cristofaro, 2020)

Table 1.
Framework for the
IoS-based business
model

stay overnight. Inside the house, there are feed and fresh water *ad libitum*. The laying hens are free to move inside the house and outside to the pasture area during the daytime. The overall management is done as described by Lay et al. (2011) for free-range laying hens.

The selected company has two main activities, the production of free-range eggs and their commercialization. The production involves free-range egg production farms, which strategy consists of certifying farms for free-range egg farmers, and the commercialization of the eggs is done using an egg cart placed in a common area of housing condominiums. The enterprise developed two mobile apps to perform the online business, one app for the farmers of free-range eggs and another app for the final consumers (Figure 3). Initially, the entrepreneur worked with his single farm, but soon the eggs demand increased, new farms have been homologated, and, thanks to the flexibility and scalability of the business model, the enterprise became a network of egg farmers.

Owing to the scarcity of business models exploring the IoS solution, we studied only this real company that started in the digital business proposing a direct sale with a new service offer through the internet. Single-case research typically exploits opportunities to explore a significant phenomenon under rare circumstances scenario (Eisenhardt & Graebner, 2007), which happens to be the case owing to the novelty of the IoS, the scarcity of correlated business models and the absence of studies that investigate Brazilian companies in such innovative field. The company's selection was also focused on the fact that the business is tightly integrated with emerging technologies. We interviewed the entrepreneur, who is also the chief executive officer, to assess our IoS-based business model framework and then validate its adherence.

The case study was carried out by adopting a proposed method (Voss, Tsikriktsis, & Frohlich, 2002), consisting of a semi-structured interview with its manager. We followed the
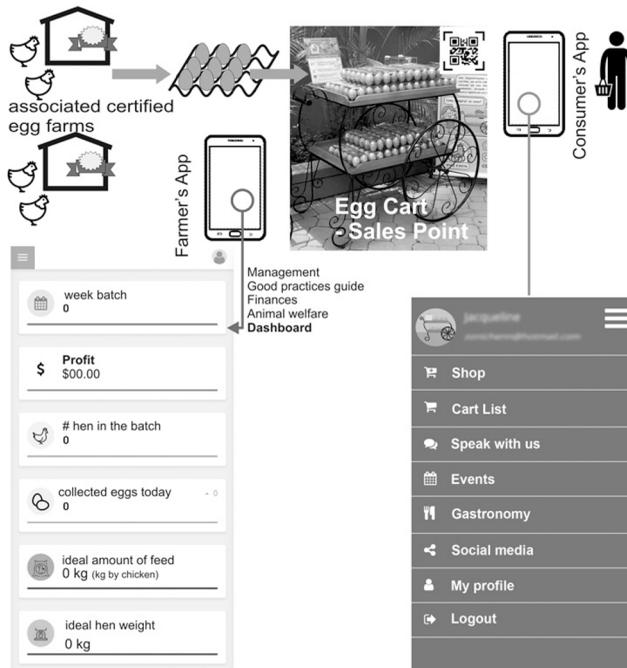
Figure 3.
The enterprise business using two mobile applications, the farmers' app and the consumers' app

A case study
in the livestock
industry

407

deductive or theory-testing process (Voss, Godsell, & Johnson, 2015). The framework (Table 1), the IoS-based model, has been evaluated in a real business. Besides the interview, we performed documental analysis, visited the social media pages and installed the tests' apps.

3.3 Evaluation of the internet of services-based business model with a case study
The evaluation was carried out according to the method developed by Voss et al. (2015). From our IoS-based model framework, we assessed if the IoS was a driver during the business model conception and if the executives are doing the correct questions on this start-up phase.

There are two apps, one for the farmers and another for the final consumers:

The farmers' app aims to give information concerning the management of the free-range laying hens. The farmers that would like to become partners of the company can easily find all the production lifecycle information before joining the business, such as regulations, lighting plans and hens' management. Next, the farmers can follow up on their production numbers as well as the financial results through a dashboard.

The consumers' app, also named Egg Cart App, offers egg trays with the final consumers' products. The egg-cart is accessed by scanning the QR-code through the app. The consumers pick up the products physically from the egg-cart and pay online via the app or in cash in a cash box placed on the egg-cart. Also, other services are available like the tracking of the products, virtual visits to the farms, gastronomic recipes with eggs provided by known cuisine chefs. The apps have been developed in the "Apache Cordova" platform software, enabling programmers to build mobile devices web applications. Both Easy Egg apps – the farmers' app and the consumers' app – are free for users to download on the Apple Store and Google Play Store. We installed both apps for tests and ensured they were working properly.

4. Results
The initiatives from the company Easy Egg have matched most of the points addressed in our framework. It has been checked the company's corresponding compliance for each attribute placed in the framework previously presented in Table 1.

From the results, it was concluded that the business is aligned with the IoS adoption, and the framework presents adherence to the business. The company could better explore some opportunities, but it depends on the venture's sizing and strategy.

4.1 Internet of services-based business model aspects in the case
4.1.1 Value proposition. The main value proposition of the company Easy Egg is the availability of high-quality free-range eggs directly from the farmer to the consumer in a trust-based sale using the traceability process to increase consumer reliability. The process allows the product path to be tracked from the farm until it reaches the consumer. It matches what enterprises have been doing to reshape their customer value propositions and transform operations using digital technologies for more significant customer interaction and collaboration (Berman, 2012; Parviainen & Tihinen, 2017).

In Table 2, there are the results for value proposition evaluation, showing both the attributes from the framework comply with the business.

4.1.2 Value creation. The Easy Egg concept includes egg production in a free-range system (Lay et al., 2011) and delivered from the farm to the consumer. Farmers seek a direct relationship with the consumers, eliminating the intermediaries.

Such internet-based solutions guarantee a positive impact on production and have been implemented using cutting-edge technology developed by a software company. The system has become the Easy Egg farmer app (Figure 3).

The value creation evaluation results are presented in Table 3, showing what complies and what does not comply with the framework.

4.1.3 Value delivery. Customers who want to request a cart's placement in their condominium might access the website to request the Easy Egg consumers' app (Figure 3). All Easy Egg carts consumers, with the mobile application installed and using the previously described QR code, aim to focus the camera on the code that the cart is recognized. It is possible to see the number of free-range eggs available in the cart and the amount needed for replacement on the screen. The management of the Easy Egg cart can be done by both the building manager and the residents.

Business model function	IoS-based model outlook	Results Comply	Does not comply
Value proposition	1	The main value-adding from Easy Egg is the availability of high-quality free-range eggs directly from the farmers to the consumers in a trust-based sale	–
	2	With direct selling from farmer to consumer, Easy Egg eliminates intermediaries and creates a more optimized service delivery, closely related to sustainability	–

Table 2.
Value proposition evaluation from the framework for the IoS-based business model

Business model function	IoS-based model outlook	Results Comply	Does not comply
Value creation	1	The Easy Egg farms are connected and monitored with IoT technologies to keep the quality in production and to provide information concerning the management of the free-range laying hens. The farmers feed the App and keep the business running with the latest technological advances	–
	2	The farmers can follow up their production numbers as well as the financial results through a dashboard in the farmers' app. The dashboard brings the weather forecast for helping the farmers in decision-making	Easy Egg is a small business still not exploring predictive analytics in all its potential since the managers understand there is no need to apply this yet
	3	Homologating and certifying farms, keep the service level for free-range egg farmers according to the protocol developed. This way, the eggs have the same quality, and the hens' management meets the agreed conditions	–

Table 3.
Value creation evaluation from the framework for the IoS-based business model

A case study
in the livestock
industry

409

The application was designed to meet Easy Egg consumers' needs: manage the carts placed in condominiums with 20 dozen free-range eggs. Through the app, the consumers can check when the time has come to replenish the eggs. Usually, they are replenished once a week (Table 4).

4.1.4 Value capture. Revenue from the eggs' selling is straightforward from the buyer to the farmer associated with the process. The condominium resident goes to the cart and removes the eggs tray from the egg cart and closes the purchase doing the payment via the app using a debit or credit card. The online transaction runs without intermediaries or cashier operators, and the service hired, delivered and paid online matches the IoS-based business model (Table 5).

The revenue and production per month are shown in Figure 4. During the period, the price/egg remained unchanged, and a considerable revenue increase has been observed. This is explained by the great response from the market, with more condominiums ordering the egg carts. The convenience of buying online and the good service delivery received a positive return from consumers.

As the offer of organic products through other companies, complementary services have also been added in the same mobile app. This way, the revenues may originate from the egg selling and the partnerships by sharing the same applications platform. The IoS application can be easily scalable because a partner network is already established through the Easy Egg farmers app.

Business model function	IoS-based model outlook	Results	
		Comply	Does not comply
Value delivery	1	The Egg-cart App offers customers services as tracking the products, virtual visits to the farms, and gastronomic recipes. The egg-carts are replenished once a week. Through the app, the consumers can check when the time has come to replenish the eggs. Easy Egg maintains an active presence in the most popular social media sites	–
	2	Every new service launched is shared with the customers, and the feedback is followed up on social media. The sites on Facebook and Instagram are regularly updated and used as an open channel for customer complaints and suggestions. If there is some damaged egg, the consumer can report directly through the WhatsApp corporative number that reaches anyone from Easy Egg staff	–
	3	Regarding security, each farmer or consumer has a login and password for the app, which protects each stakeholder's information	There is a best effort in returning promptly anything reported by customers, but there is no service level agreement because they are still a small business

Table 4.
Value delivery evaluation from the framework for the IoS-based business model

Business model function	IoS-based model outlook	Results	
		Comply	Does not comply
Value capture	1	–	Pay-per-use charges or subscriptions would suit better a cloud-based service that demands licenses or subscriptions to run, which is not the Easy Egg business case
	2	New egg farmers that would like to become partners of the company can easily find all the production lifecycle information before joining the business, such as regulations, lighting plans, and hen's management. The Egg-cart App has offers egg trays with the products to the consumers and offers organic products through partners	–
	3	The Apps are offered free, and the eggs' selling is the leading business, but some complementary services start to bring some revenue. Virtual visits to the farms live with gastronomic chefs presenting recipes containing eggs and consulting on free-range laying hen's production for new potential farmers	–

Table 5.
Value capture evaluation from the framework for the IoS-based business model
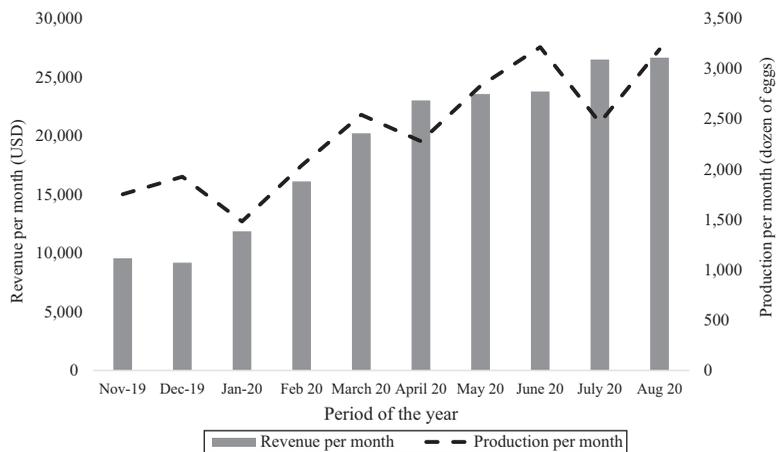
Figure 4.
Revenue per month (in USD) and production per month (in dozen of eggs)

5. Discussion

The case study takes its starting point in describing the business model and IoS as central actors. By using the main dimensions of the business model introduced by GüNzel and Holm (2013) for the original business model Canvas (Osterwalder & Pigneur, 2010), we proposed and evaluated a framework that describes how the enterprise can propose, create, deliver and capture value through the adoption of the IoS. The study also fills the gap raised by

Matt et al. (2015) that research should seek to identify additional elements attributed to the following dimensions of digital transformation: use of technologies, changes in value creation, structural changes and financial aspects.

Considering the IoS main target is to present everything as a service on the internet, including software applications and the platform to deliver these mobile applications (Moreno-Vozmediano et al., 2013), the enterprise Easy Egg has succeeded in doing so. When thinking about IoS to build a network of partners to create a cooperative service-offering, it is essential to think about all the contributing roles potential values. The business model developed by the company Easy Egg explored this idea very well. The mobile app is available on the Apple Store and Google Play Store and is distributed free of charge to free-range egg farmers who want to become partners. The idea was to use the IoS application to connect the egg's production to consumers. A farmer can become a partner using the Easy Egg farmers app. The entrants can start producing and use all the benefits of this cross-enterprise network. The convenience saves time and effort during purchase, and the service receives a positive assessment from consumers. The concept of online collective purchases (Chang, Dong, & Sun, 2014) is directly related to social networks, a structure formed by users and their interpersonal relationships.

With the direct selling from farmer to consumer, Easy Egg eliminates intermediaries and creates a more optimized service delivery. The IoS-based business model, evaluated from our case study, shows how adopting a collaborative mobile platform has created revenue opportunities. Although several ideas have been emerging to different digitalization forms in agricultural production systems and value chains (Klerkx et al., 2019), our case study explores the IoS in depth.

The presented case study brings a framework for a business model construct and the strategies for a revamp of the business in a specific application field, considering the new digital market. IoS adheres to the business model that becomes digital, mainly by using online and social collaboration platforms. This is the primary business value, the viral adoption by users, and the increased customer engagement level, also seen in the Easy Egg enterprise.

While ICT strategies focus on managing the infrastructure with a limited impact on driving innovation and business development (Matt et al., 2015), the IoS covers the ICT aspects but jointly with a business-centric perspective. It has been confirmed from the case study that the IoS-based business model works as a collaborative business ecosystem or global market where services from diverse providers are offered, discovered and consumed in combined use (Kritikos & Plexousakis, 2014; Bucchiarone et al., 2017; Givehchi et al., 2017).

Chao (2016) shows that the reciprocal is also true when affirming that businesses are no longer only interested in the design of economic models and mechanisms but also have a great interest in information and communication technology. This is a guideline that is shaping the e-business landscape and strategic decisions.

The Easy Egg's business model answered most of the points addressed in our framework, showing that business is aligned with the IoS adoption. The framework has adherence to the business and can be replicated in other fields. Whenever a business is considering the service model through a digital solution, the proposed framework may serve as the initial approach, both for a new venture designing its business model or an established company changing its business model.

The business model improves the integration between the business and IoS domain and leads to mutual reinforcement because it creates a shared understanding by the different stakeholders in the value chain. It has been assessed how the IoS could support the key partners, key activities and critical resources value through the proposed framework, forming a business model construct.

6. Conclusion

Among the several digital transformation paradigms, the IoS takes a vital role in business through an innovative way of service offering. The presented case study covered an IoS-based business model through a framework that correlates two concepts, IoS and business models, into a digitally transformed market for service offer.

To keep pace with the swiftly changing digital ecosystem, organizations cannot afford to stand still. A company needs to assess its business model continually, and the consequences of not having a comprehensive business model can be severe. Thus, it is essential having tools that support the entrepreneurs and managers during the business model deployment. Due to the IoS's novelty and the lack of correlated business models in the literature, it is not evident how the IoS and business model interact. The case study aimed to fill this literature gap by defining a framework that indicates the IoS adoption attributes, describing how the enterprise can create, deliver and capture value.

Besides the theoretical contribution, the present study may help companies construct the business model based on their future IoS applications. The framework works as a guide to the entrepreneur verifies if the main questions are considered in the startup phase. By evaluating the framework in a direct sale of free-range eggs direct from farmer to consumers, it is concluded the IoS is adhered in the business model mainly by using online and social collaboration platforms. The research revealed to the entrepreneur how the stakeholder's relations establish new valuable services through the IoS applications, leading the business to new possible revenue opportunities.

The digital marketplace does not reward organizations simply for going digital. It rewards them to leverage business practices to enhance the customer's experience and encourage innovation in the organization. The IoS-based business model's contribution is the collaboration among the customers and the enterprises that are inherently competitors. It explores the IoS adoption in each of the key functions: the value proposition, through the shift to a service-offer; the value creation, by employing a network of partners; the value delivery, by adopting a collaborative mobile platform; and the value capture, through the mix of revenue models.

For entrepreneurs and researchers in this field, the paper brings an important contribution by evaluating the business model's convergence key functions with the IoS adoption. The IoS-based business model serves as a tool for a new venture designing the business model or an established company changing its business model when deciding to apply the IoS into a specific proposition.

Owing to the scarcity of business models exploring the IoS, a single company has been considered in our case study and analyzed in great depth. Although there is a limitation of taking only the field of agriculture 4.0 for the case study, the proposed framework may contribute broadly to an IoS-based business model deployment. Future studies may explore the IoS-based business model in different business sectors other than the livestock industry.

References

Alcácer, V., & Cruz-Machado, V. (2019). Scanning the industry 4.0: A literature review on technologies for manufacturing systems. *Engineering Science and Technology, an International Journal*, *22*(3), 899–919. doi: https://doi.org/10.1016/j.jestch.2019.01.006.

Asadnezhad, M., Hejazi, R., Akbari, M., & Hadizadeh, E. (2017). Designing the business model of herbal pharmaceutical knowledge based companies. *Journal of Entrepreneurship, Business and Economics*, *5*(2), 47–63.

A case study
in the livestock
industry

413

Bahlo, C., Dahlhaus, P., Thompson, H., & Trotter, M. (2019). The role of interoperable data standards in precision livestock farming in extensive livestock systems: A review. *Computers and Electronics in Agriculture*, *156*, 459–466. doi: https://doi.org/10.1016/j.compag.2018.12.007.

Balakrishnan, S. M., & Sangaiah, A. K. (2017). MIFIM – Middleware solution for service centric anomaly in future internet models. *Future Generation Computer Systems*, *74*, 349–365. doi: https://doi.org/10.1016/j.future.2016.08.006.

Banhazi, T. M., & Black, J. L. (2009). Precision livestock farming: A suite of electronic systems to ensure the application of best practice management on livestock farms. *Australian Journal of Multi-Disciplinary Engineering*, *7*(1), 1–14. doi: https://doi.org/10.1080/14488388.2009.11464794.

Berman, S. J. (2012). Digital transformation: Opportunities to create new business models. *Strategy & Leadership*, *40*(2), 16–24. doi: https://doi.org/10.1108/10878571211209314.

Bouncken, R. B., Kraus, S., & Roig-Tierno, N. (2019). Knowledge- and innovation-based business models for future growth: Digitalized business models and portfolio considerations. *Review of Managerial Science*. doi: https://doi.org/10.1007/s11846-019-00366-z.

Bucchiarone, A., Marconi, A., Pistore, M., & Raik, H. (2017). A context-aware framework for dynamic composition of process fragments in the internet of services. *Journal of Internet Services and Applications*, *8*(1). doi: https://doi.org/10.1186/s13174-017-0057-0.

Camara, J., de Lemos, R., Laranjeiro, N., Ventura, R., & Vieira, M. (2015). Robustness-driven resilience evaluation of self-adaptive software systems. *IEEE Transactions on Dependable and Secure Computing*, 1–1. doi: https://doi.org/10.1109/TDSC.2015.2429128.

Cardoso, J., Barros, A., May, N., & Kylau, U. (2010). *Towards a Unified Service Description Language for the Internet of Services: Requirements and First Developments*. 2010 IEEE International Conference on Services Computing, 602–609. doi: https://doi.org/10.1109/SCC.2010.93.

Chang, Y., Dong, X., & Sun, W. (2014). Influence of characteristics of the internet of things on consumer purchase intention. *Social Behavior and Personality: An International Journal*, *42*(2), 321–330. doi: https://doi.org/10.2224/sbp.2014.42.2.321.

Chao, K.-M. (2016). E-services in e-business engineering. *Electronic Commerce Research and Applications*, *16*, 77–81. doi: https://doi.org/10.1016/j.elerap.2015.10.004.

Chmielewski, J. (2014). Device-Independent architecture for ubiquitous applications. *Personal and Ubiquitous Computing*, *18*(2), 481–488. doi: https://doi.org/10.1007/s00779-013-0666-y.

Cristofaro, M. (2020). E-business evolution: An analysis of mobile applications' business models. *Technology Analysis & Strategic Management*, *32*(1), 88–103. doi: https://doi.org/10.1080/09537325.2019.1634804.

Dijkman, R. M., Sprenkels, B., Peeters, T., & Janssen, A. (2015). Business models for the internet of things. *International Journal of Information Management*, *35*(6), 672–678. doi: https://doi.org/10.1016/j.ijinfomgt.2015.07.008.

Dumitrache, I., Sacala, I. S., Moisescu, M. A., & Caramihai, S. I. (2017). A conceptual framework for modeling and design of cyber-physical systems. *Studies in Informatics and Control*, *26*(3). doi: https://doi.org/10.24846/v26i3y201708.

Dutta, R., Morshed, A., Aryal, J., D'Este, C., & Das, A. (2014). Development of an intelligent environmental knowledge system for sustainable agricultural decision support. *Environmental Modelling & Software*, *52*, 264–272. doi: https://doi.org/10.1016/j.envsoft.2013.10.004.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, *50*(1), 25–32. doi: https://doi.org/10.5465/amj.2007.24160888.

Foss, N. J., & Saebi, T. (2017). Fifteen years of research on business model innovation: How far have We come, and where should We go?. *Journal of Management*, *43*(1), 200–227. doi: https://doi.org/10.1177/0149206316675927.

Givehchi, O., Landsdorf, K., Simoens, P., & Colombo, A. W. (2017). Interoperability for industrial cyber-physical systems: An approach for legacy systems. *IEEE Transactions on Industrial Informatics*, *13*(6), 3370–3378. doi: https://doi.org/10.1109/TII.2017.2740434.

Grabowska, S., Gajdzik, B., & Saniuk, S. (2020). The role and impact of industry 4.0 on business models. In K. Grzybowska, A. Awasthi, & R. Sawhney, (Eds.), *Sustainable logistics and production in industry 4.0* (pp. 31–49). Springer International Publishing. doi: https://doi.org/10.1007/978-3-030-33369-0_3.

GüNzel, F., & Holm, A. B. (2013). One size does not fit all – Understanding the front-end and back-end of business model innovation. *International Journal of Innovation Management*, *17*(01), 1340002. doi: https://doi.org/10.1142/S1363919613400021.

Hermann, M., Pentek, T., & Otto, B. (2016). Design Principles for Industrie 4.0 Scenarios. *2016 49th HI International Conference on System Sciences (HICSS)*, 3928–3937. https://doi.org/10.1109/HICSS.2016.488.

Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. *Computers in Industry*, *89*, 23–34. doi: https://doi.org/10.1016/j.compind.2017.04.002.

Hõgg, R., Martignoni, R., Meckel, M., & Stanoevska-Slabeva, K. (2006). *Overview of business models for web 2.0 communities*, TUDpress.

Jazdi, N. (2014). Cyber physical systems in the context of Industry 4.0. *2014 IEEE International Conference on Automation, Quality and Testing, Robotics*, 1–4. doi: https://doi.org/10.1109/AQTR.2014.6857843.

Kagermann, H. Wahlster, W., & Helbig, J. (2013). Securing the future of german manufacturing industry: Recommendations for implementing the strategic initiative INDUSTRIE 4.0 – Final report of the industrie 4.0 working group. Acatech – National academy of science and engineering.

Kastalli, I. V., & Van Looy, B. (2013). Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance. *Journal of Operations Management*, *31*(4), 169–180. doi: https://doi.org/10.1016/j.jom.2013.02.001.

Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS – Wageningen Journal of Life Sciences*, *90-91*, 100315. doi: https://doi.org/10.1016/j.njas.2019.100315.

Kritikos, K., & Plexousakis, D. (2014). Novel optimal and scalable nonfunctional service matchmaking techniques. *IEEE Transactions on Services Computing*, *7*(4), 614–627. doi: https://doi.org/10.1109/TSC.2013.11.

Kutter, T., Tiemann, S., Siebert, R., & Fountas, S. (2011). The role of communication and co-operation in the adoption of precision farming. *Precision Agriculture*, *12*(1), 2–17. doi: https://doi.org/10.1007/s11119-009-9150-0.

Lara, J. A., Lizcano, D., Martínez, M. A., & Pazos, J. (2013). Developing front-end web 2.0 technologies to access services, content and things in the future internet. *Future Generation Computer Systems*, *29*(5), 1184–1195. doi: https://doi.org/10.1016/j.future.2013.01.006.

Lay, D. C., Fulton, R. M., Hester, P. Y., Karcher, D. M., Kjaer, J. B., Mench, J. A., . . . Porter, R. E. (2011). Hen welfare in different housing systems. *Poultry Science*, *90*(1), 278–294. doi: https://doi.org/10.3382/ps.2010-00962.

Lezoche, M., Hernandez, J. E., Alemany Díaz, M. D M. E., Panetto, H., & Kacprzyk, J. (2020). Agri-food 4.0: A survey of the supply chains and technologies for the future agriculture. *Computers in Industry*, *117*, 103187. doi: https://doi.org/10.1016/j.compind.2020.103187.

Lindblom, J., Lundström, C., Ljung, M., & Jonsson, A. (2017). Promoting sustainable intensification in precision agriculture: Review of decision support systems development and strategies. *Precision Agriculture*, *18*(3), 309–331. doi: https://doi.org/10.1007/s11119-016-9491-4.

Liu, Y., Han, W., Zhang, Y., Li, L., Wang, J., & Zheng, L. (2016). An internet-of-things solution for food safety and quality control: A pilot project in China. *Journal of Industrial Information Integration*, *3*, 1–7. doi: https://doi.org/10.1016/j.jii.2016.06.001.

Magretta, J. (2002). Why business models matter. *Harvard Business Review*, *80*(5), 86–92.

A case study
in the livestock
industry

415

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & Information Systems Engineering*, *57*(5), 339–343. doi: https://doi.org/10.1007/s12599-015-0401-5.

Moreno-Vozmediano, R., Montero, R. S., & Llorente, I. M. (2013). Key challenges in cloud computing: Enabling the future internet of services. *IEEE Internet Computing*, *17*(4), 18–25. doi: https://doi.org/10.1109/MIC.2012.69.

Muninger, M.-I., Hammedi, W., & Mahr, D. (2019). The value of social media for innovation: A capability perspective. *Journal of Business Research*, *95*, 116–127. doi: https://doi.org/10.1016/j.jbusres.2018.10.012.

Nunes, M. P., & Russo, A. P. (2019). Analysis of business models innovation – A multiple case study. *Innovation & Management Review*, *16*(1), 17–35. doi: https://doi.org/10.1108/INMR-11-2018-0085.

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers (Nachdr)*, Flash Reproductions.

Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. *Communications of the Association for Information Systems*, *16*. doi: https://doi.org/10.17705/1CAIS.01601.

Papageorgiou, A., Miede, A., Schulte, S., Schuller, D., & Steinmetz, R. (2014). Decision support for web service adaptation. *Pervasive and Mobile Computing*, *12*, 197–213. doi: https://doi.org/10.1016/j.pmcj.2013.10.004.

Parviainen, P., & Tihinen, M. (2017). Tackling the digitalization challenge: How to benefit from digitalization in practice. *IJISPM – International Journal of Information Systems and Project Management*, *5*(1), 63–77. doi: https://doi.org/10.12821/ijispm050104.

Pradhan, R. P., Mallik, G., & Bagchi, T. P. (2018). Information communication technology (ICT) infrastructure and economic growth: A causality evinced by cross-country panel data. *IIMB Management Review*, *30*(1), 91–103. doi: https://doi.org/10.1016/j.iimb.2018.01.001.

Remane, G., Hanelt, A., Tesch, J. F., & Kolbe, L. M. (2017). The business model pattern database – A tool for systematic business model innovation. *International Journal of Innovation Management*, *21*(01), 1750004. doi: https://doi.org/10.1142/S1363919617500049.

Satyro, W. C., Sacomano, J. B., da Silva, M. T., Gonçalves, R. F., Contador, J. C., & von Cieminski, G. (2017). Industry 4.0: Evolution of the research at the APMS conference. In H. Lödding, R. Riedel, K. D. Thoben, G. Von Cieminski, & D. Kiritsis, (Eds.), *Advances in production management systems. The path to intelligent, collaborative and sustainable manufacturing* (Vol. 513, pp. 39–47). Springer International Publishing. doi: https://doi.org/10.1007/978-3-319-66923-6_5.

Schiavi, G. S., & Behr, A. (2018). Emerging technologies and new business models: A review on disruptive business models. *Innovation & Management Review*, *15*(4), 338–355. doi: https://doi.org/10.1108/INMR-03-2018-0013.

Schroth, C., & Janner, T. (2007). Web 2.0 and SOA: Converging concepts enabling the internet of services. *IT Professional*, *9*(3), 36–41. doi: https://doi.org/10.1109/MITP.2007.60.

Smith, M. J. (2020). Getting value from artificial intelligence in agriculture. *Animal Production Science*, *60*(1), 46. doi: https://doi.org/10.1071/AN18522.

Sun, Y., Yan, H., Lu, C., Bie, R., & Thomas, P. (2012). A holistic approach to visualizing business models for the internet of things. *Communications in Mobile Computing*, *1*(1), 4. doi: https://doi.org/10.1186/2192-1121-1-4.

Swisher, M. E., Ruiz-Menjivar, J., & Koenig, R. (2018). Value chains in renewable and sustainable food systems. *Renewable Agriculture and Food Systems*, *33*(1), 1–5. doi: https://doi.org/10.1017/S1742170517000667.

Tzounis, A., Katsoulas, N., Bartzanas, T., & Kittas, C. (2017). Internet of things in agriculture, recent advances and future challenges. *Biosystems Engineering*, *164*, 31–48. doi: https://doi.org/10.1016/j.biosystemseng.2017.09.007.

Ustundag, A., & Cevikcan, E. (2018). *Industry 4.0: Managing the digital transformation*, Springer International Publishing. doi: https://doi.org/10.1007/978-3-319-57870-5.

Voss, C., Godsell, J., & Johnson, M. (2015). *Revisiting case research in operations management. 22nd International Annual EurOMA Conference*.

Voss, C., Tsikriktsis, N., & Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management*, 22(2), 195–219. doi: https://doi.org/10.1108/01443570210414329.

W. Wahlster, H. J. Grallert, S. Wess, H. Friedrich, & T. Widenka, (Eds.) (2014). *Towards the internet of services: The THESEUS research program*, Springer International Publishing. doi: https://doi.org/10.1007/978-3-319-06755-1.

Weiner, N., & Weisbecker, A. (2011). *A Business Model Framework for the Design and Evaluation of Business Models in the Internet of Services. 2011 Annual SRII Global Conference*, 21–33. https://doi.org/10.1109/SRII.2011.13.

Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research. *Journal of Management*, 37(4), 1019–1042. doi: https://doi.org/10.1177/0149206311406265.

Appendix

We used the following questions to interview the entrepreneur, who is also the Chief Executive Officer (CEO), to assess our IoS-based business model framework and then validate its adherence:

1. How does the IoS bring advantages to your business when compared to a traditional service offering?
2. Do you have a partner's network using the same application and technology standards?
3. Do customers participate in the service delivery process through the IoS solutions?
4. Do you accept online payment for the service?
5. Do you have complimentary cross-selling offerings through your IoS-based partnership network?

Corresponding author
Jacqueline Zonichenn Reis can be contacted at: zonichenn@hotmail.com