Open Digital Business Ecosystems: A Pathway for Value Co-creation

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Abstract. Individual businesses enthuse over participating in the4"We Economy" era [1] through a digital business ecosystem (DBE). DBE is seen as a gateway for an individual company to penetrate new markets where new products, services, and highly personalized experiences are delivered to their customers. Despite the benefits of DBE, collaboration uncertainty is the main challenge for a company wanting to participate in a wider ecosystem. This paper presents an open digital business ecosystem model that prepares companies prior to participating in the world of digital business and to secure multi-faceted benefits. This model demonstrates three key functionalities: 1) evaluating a company's current digital and non-digital business capabilities driven by its vision, 2) capturing these capabilities in a value cloud register, and 3) integrating the business capabilities determined by innovative collaborations. A case study of a global non-profit organization is employed to demonstrate how a company connects its partners in an innovation ecosystem.

Keywords: Open Digital Business Ecosystems, Digital Business Capabilities, Value Cloud, Affordance, Open Innovation

1 Introduction

Digital business has become a strategic transformation paradigm for a company to redefine its business model in a business network. Such a business network also redefines its environment as digital business ecosystems (DBE) which connect multiple companies to deliver products and customer experience as well as co-create values in a win-win-win fashion, a Business win, a Customer win, and an Innovation win [modified from 1]. However, new business environments impose collaboration uncertainties between the focal company and its lead partners, such as ineffective collaboration that affects the co-development of products or services and ill-aligned business

capabilities that impact on achieving win-win-win innovation values. Hence, it is vital for the stakeholders to recognize these uncertainties prior to participation in the DBE.

There is active research on evolving from a traditional business model to a networked digital business. This kind of business transformation reveals that the ecosystem approach has been incorporated for sharing vision and integrating other partners in the ecosystem from the business and IT perspective such as incorporating open data and the cloud computing approach [adapted from 2]. There are new challenges in the business and IT alignment research for a modern digital society that incorporates the ecosystem approach and innovation elements [3, 4]. However there is a lack of mechanism for assessing a company's readiness prior to joining a DBE.

This paper hence presents a conceptual model of open digital business ecosystems (ODBE) that comprises a methodology for assisting a company prior to joining the ODBE. The paper is structured as follows: Section 2 reviews the related literature, Section 3 illustrates the conceptual model of ODBE, Section 4 demonstrates the application of ODBE in a global non-profit organization, Section 5 discusses and contributions, limitations and concludes the research with future work.

2 Theoretical Background

2.1 Digital Business and Ecosystems

Digital business research concerns what and how technologies create business value and build a digital economy [5, 6]. Such research discovered that digital businesses compete and collaborate among diverse entities in a self-organized and self-evolved ecosystem which is formally defined as Digital Business Ecosystems (DBE) [7, 8, 4]. This concept enables organizations within the ecosystem to create new connections for offering new services or products, sharing experiences and all these ultimately drive open innovation. A digital business strategy is imperative for forming DBE that maximizes co-created values by leveraging the digital resources [9].

The study of enterprise architecture (EA) is instrumental for modeling a digital business ecosystem [10]. The future of EA research predominantly lies in developing the digital business strategy and capturing the co-created value through an innovation ecosystem [3]. The innovation ecosystem encourages the organizations within the ecosystem to strategically collaborate and develop new digital business capabilities for competitive advantages [11].

2.2 Value co-creation through affordances in innovation contexts

Business participants in a DBE collaborate among each other to achieve mutual business goals and this mechanism promotes innovation that fosters value co-creation. The innovation context of a DBE is described as an affordance that realizes business transformation. The concept of affordance is used to describe the behavior of an organism made available by some combined structure of entity and its environment [12] This concept studies all organized behavior being affected by communications and

interpretation of signs by people [13]. Affordance and norms are often employed for identifying semantic units of a domain of study and hence establishing relationships among these semantic units [14].

The study of affordances and norms clearly contributes to identifying value co-creation in a DBE. The typical values co-created in a DBE are: 1) customer value, which helps to increase customers' satisfaction towards the product or service; 2) information value, where information is shared across the ecosystem and the partners within the DBE; 3) operational value, where a certain level of process interoperability is established; 4) business value, where partners within the ecosystem share their best capability in driving the best product or service; and 5) talent value, where people knowledge or human capital are shared across the DBE [modified from 15].

3 Open Digital Business Ecosystem (ODBE)

DBE is seen as a disruptive business infrastructure at the business strategy and policy level but still it is a lack of a methodology in facilitating the participation of multiple companies. Therefore, the ODBE model introduced in this paper aims to facilitate open innovation that enables an alignment between open innovation and value co-creation in a manner of self-evolving and self-managing towards co-development of products [16]. Fig. 1 depicts a conceptual architecture of ODBE that consists of four key functional components: 1) the business participants and their digital business capabilities, 2) the Digital business competency valuation, 3) DBE value cloud, and 4) an Innovation ecosystem.

Fig. 1. A conceptual model of ODBE

Business participant component
A focal company specifies its collaboration requirements which are used to qualify the participation of other partners based on their business capabilities. Such collaboration relationship is defined as a set of firms $F=\{f_1, f_2, \ldots, f_m\}$. These firms may serve as a focal company in their own ecosystems. Each firm possesses a set of capabilities $C=\{c_1, c_2, \ldots, c_n\}$ which could potentially contribute to the ODBE. C is a proper subset of F, denoted by $C \subset F$, $\forall x\{x \in C, x \notin F\}$. $f \in F$ is a candidate firm to enter digital business competency valuation where $c \in C$ will be evaluated.

Digital business competency valuation component
The digital business competency valuation components provides a set of assessment techniques that examine by the readiness of a company prior to participating to the ODBE adopting the capability-resource analysis [17, 18] (Fig. 2). The capability-resource analysis requires input from the organizational aspects which are represented

by digital business strategy, objectives and the critical success factors (CSFs). The objectives set the business goals which are part of the digital business strategy and the performance of the core competency is measured by CSFs.
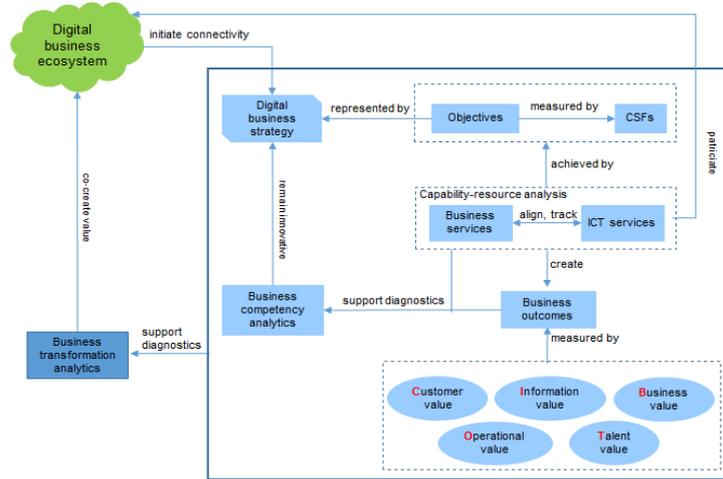

Fig. 2. Assessment of the digital business competencies

C is represented through a unique pair of {*business service, ICT service*}, at the business operational level [19]. *Business services* provide the business functionality of business roles that serves business needs for the customer. This is achieved through internal behavior, i.e., business processes, which require resources, competencies, knowledge and skills in order to produce products and values [20]. The *business services* profile captures the description about the stakeholders and their roles, operational capabilities, business processes, and business norms. The social perception of the stakeholders while consuming the resource to produce the outcome is also captured in the *business services*. The *ICT services* profile captures the enterprise ICT resources, such as hardware, applications, infrastructure, and contracted ICT components and the cost of each ICT element is associated with its total cost ownership (TOC).

Both profiles are used to determine digital business capabilities which resulted from mapping the specific *business service* and *ICT service* [21]. A group of digital business capabilities form the basis of an assessment by using a cost-benefit analysis model in conjunction with a SWOT model. The insights can be generated from large volumes of corporate datasets and external social media repositories. The assessment produces *Business outcomes* which can be used to identify the candidate digital business capabilities for DBE value cloud. *Business outcomes* are specified by a set of measures based on {C, I, B, O, T} [adapted from 15], where C is consumer experience value; I is relevant and quality information value [22]; B is B-B market share value, O is internal process and productivity value, and T is level of employees' knowledge, skill, and experience value [23]. These measures reveal the quality of business performance and how the firm engages with customers, employees and partners. For those business capabilities with {C, I, B, O, T} that are scored High or a

high end of Medium, they are likely able to enable co-creation of value when they are connected through *Innovation ecosystem*.

The business competency analytics technique diagnoses a current internal stage of a firm f in moving towards a sustainability-led innovation. This diagnostic analysis adopts the prescriptive and predictive analytical methods, e.g., business performance and margin predictive analytics [24], customer relationship analytics [25], marketing analytics [26], cost-benefit analysis, and talent analytics [27]. A key purpose of this analysis is for f to predict its business by recognizing its SWOT dynamics, being aware of influential issues, and evaluating the implementation of the Digital business strategy. $F=\{f_1, f_2, \ldots, f_m\}$ can internally carry out such diagnostic analysis when appropriate so that each f remains innovative.

Business transformation analytics diagnoses the current stage of f in its external environment and it puts the emphasis on how f should respond to the pressures from the marketplace as well as the impact for change required by the Innovation ecosystem. Any changes for optimizing the business performance may be revolutionary or evolutionary and require strategic decisions from the stakeholders. The decision making process is then influenced by the SWOT analysis [28], competitor analysis [29], risk analysis [30] and change impact analysis [31]. The result may reform the existing Digital business strategy where each f can maintain its co-created value in an Innovation ecosystem and stay competitive.

DBE value cloud component

The *DBE value cloud* is a repository of sharable digital capabilities owned by the *business participants*. A digital business capability is seen as-a-service [8] that is featured as automated business processes, IT-enabled capabilities, data analytics models, technology infrastructures and data host services. Fig. 3 depicts an information model that registers business capabilities in the value cloud. The value cloud interfaces with the *Innovation ecosystem (IE)* via a connector. The connector: 1) registers and publishes the capability, 2) discovers the capability based on a query (i.e., a set of criteria) from the *IE*, 3) selects the appropriate capabilities, and 4) transfers the resultant capabilities (e.g., URIs) to the connector at the *IE* end.

Firm	Capability	Value Cloud Register Scale ={High, Medium, Low, Not Applicable}									
		Customer		Information		Operational		Business		Talent	
		Scale	Description	Scale	Description	Scale	Description	Scale	Description	Scale	Description

Fig. 3. Information model of the *DBE value cloud*

Innovation ecosystem component

An *Innovation ecosystem (IE)* is an affordance of the business transformation from the connected individual companies where these companies co-create values. A connection is driven by the qualitative requirements of an *IE* based upon which the "fit for purpose" digital business capabilities contained in the *DBE value cloud*. An affordance function of discovering and deploying digital capabilities is executed through connectors and it deploys the participating digital business capabilities (e.g.,

API-led connectivity), manages the service level agreement (SLA), and communicates the feedback of impact for change with the concerned firm (f). The SLA related function deals with the shared responsibilities for the collaboration quality and outcomes of the F and the C, and relevant cost and profit models.

Co-creation of value is the strategic goal of *IE*. All the alliance of C must aim at this common goal. The performance of each c is monitored and their joint business outcomes are assessed. As a result, the impact of change is fed back to those concerned F. The feedback suggest changes to 1) the existing c∈C for improving its quality of offering due to the evolutional change in the *IE*, 2) the existing F for investing further in their own C or developing new c to meeting the revolutionary change in the *IE*, and 3) the *IE* affordance to deploy different alliances with more appropriate quality and performance to satisfy customers' new needs.

4   ODBE Application in a Global Non-Profit Organization

ODBE is employed in the United Bible Societies (UBS) which is a case study of a global non-profit organization (NPO). UBS is one of the largest Christian fellowships in the world and it consists of approximately 146 Bible Societies (BS) operating in more than 200 countries and territories [32]. The key ministry services provided by UBS are bible translation, publication and distribution, literacy training, bible engagement and advocacy. These services often involve collaboration with other bible societies within the fellowship, partners such as the local churches and other faith-based NPOs. In this case study, BS5, a focal bible society, intends to run a mission project teaching *women's literacy* on a large scale. BS5 is then seeking collaboration with other fellowship partners who have registered business services in the *value cloud* (Fig. 4). BS5 looks for service providers who could offer the capabilities in *women's literacy*: 1) producing literary training materials, 2) providing funding opportunities, 3) experience in training the tutors. These services in the *DBE value cloud* were selected by conducting *capability-resource analysis*. Fig. 5 shows the *business outcomes* of various literacy services available in the *DBE value cloud*.

By following the affordance of business transformation process, BS5 decided to collaborate with BS4 and BS2 as: 1) BS4 has delivered high customer value in the experience of engaging with local churches to reach 5000 women, and possesses high operational and talent value in the experience of setting up a literacy center and talent pool of trainers, and 2) BS2 possess medium *information* value in terms of producing literacy materials, high *operational* value as they have own printing facilities, and high *business* value as they have good relationships with the funding bible societies. BS2 and BS4 also perceive certain mutual benefits yielded from this collaboration.

BS2 and BS4 adopted the UBS standard literacy framework for project execution and management. Hence, there are no conflicts in terms of the *business process* and *business norms*. As a result of the affordance process, $F_{BS5}=\{f_{BS2}, f_{BS4}\}$, the *innovation ecosystem* of *women's literacy* is formed. This collaboration has co-created five values which are qualitatively defined based on the actual outcomes achieved (Fig. 6). These values are beneficial to the partnership $F_{BS5}=\{f_{BS2}, f_{BS4}\}$ as whole. However,

these values also impacted f_{BS2} and f_{BS4} so that they improved their c_{BS2} and c_{BS4} (Fig. 7). For example, the information value of BS2 has changed from M to H, impacted by VC_3 and VC_5, where they are now capable of conducting *women's literacy* in different demographic. Similarly, the business value of BS4 has changed from L to M, impacted by VC_4, as they have grown in reputation by helping other BS.

Bible Societies	Capability in the Literacy	Customer (e.g. scale of benefiting the audience)		Information (e.g. what sort of information the firm can offer)		Operational (B-B from the process perspective)		Business (B-B from the market share perspective)		Talent (e.g. knowledge sharing, sharing skills and expertise)	
		Scale	Description	Scale	Description	Scale	Description	Scale	Description	Scale	Description
BS1	Women's Literacy	L	Engage with church and local partners, service delivered to 100 women	L	Produce literacy brochures and materials	L	Establish literacy centres	L	Establish relationship with the funding BS	L	Recruit and train literacy tutors
BS1	Distribution of Holy Scriptures	M	Engage with church and local partners, service delivered to 1500 target audiences in rural areas	L	Basic literacy brochures	M	Organise trauma healing workshop	L	Weak relationship with funding BS	M	Recruit and train distributors
						M	Organise distribution campaign				
BS2	Women's Literacy	M	Engage with church and local partners, service delivered to 1000 women	M	Produce literacy brochures and materials	M	Start literacy classes in church	H	Establish relationship with the funding BS	M	Recruit and train literacy tutors
						H	Equip with printing facilities				
BS2	Community based literacy	H	Engage with local government	H	Produce literacy brochures and materials	H	Establish literacy centres	L	No partnership	H	Recruit and train literacy tutors
		H	Engage with partners, service delivered to 3000 target audiences			H	Distribute bibles				
BS2	Prison related literacy	H	Engage with partners, service delivered to 3500 prisoners	H	Produce literacy brochures and materials	H	Conduct theological education	L	No partnership	H	Recruit and train literacy tutors
BS2	Listening based literacy (Faith Comes by Hearing)	H	Engage with partners, service delivered to 6500 people in the local community	L	Basic literacy brochures	H	Identify the existing listening groups	H	Extend the listening related literacy to other rural areas	H	Recruit and train listening-literacy tutors
						H	Distribute Proclaimers (the listening device)				
BS3	Women's Literacy	L	Engage with church and local partners, service delivered to 50 young women in church	L	Basic literacy brochures	L	Establish literacy classes in schools	L	Extend the literacy classes to other regions	L	Recruit and train literacy tutors
BS4	Women's Literacy	H	Engage with church and local partners, service delivered to 5000 women	L	Basic literacy brochures	H	Establish literacy centre	L	Rely on limited local funding	H	Recruit and train literacy tutors
						H	Test the learners			H	Set up training workshops

Fig. 4. Value Cloud Register of C owned by F

Business Service Description			
Bible Society ID:	BS4		
Business service name: *Women's literacy*		Date: *21-December-2015*	Version no:
Business service goal: *Help illiterate women attain basic literacy (read, write, count), scripture engagement and transformation of individuals and society*		Business process: *Standard literacy framework*	
		Business norms: *Standard literacy framework*	
Business capability	Business service strategic value (0-5):	*4*	
	Perceived business service performance		
	Stakeholder	Actor	Responsibility
		GMT Literacy Facilitator	*Support the operational activities*
		GMT Grant Manager	*Manage the grant funded by the resourcing bible societies and ensure sufficient resource is supplied to the member bible societies that are running projects*
		Resourcing Bible Society Faciliator	*Oversee the progress of the mission project*
		Church Facilitator	*Support the implementation of the project*
Business outcomes:	{H, L, H, L, H}		

Fig. 5. Business service description for the *women's literacy* provided by BS4

BS5

BS2.*Women_Literacy*

BS4.*Women_Literacy*

Value co-created (VC)

VC_1: Number of women reached: 5000

VC_2: Efficient use of funding

VC_3: Knowledge sharing and drive innovation

VC_4: Reputation

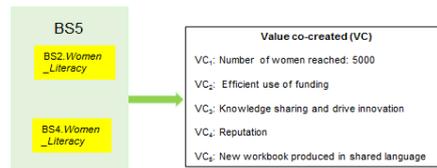VC_5: New workbook produced in shared language

Fig. 6. The *innovation ecosystem* of *women's literacy*

BS5, who originally did not possess any capability in *women's literacy*, now is specialized in the *women's literacy* service provision with connected strengths from

BS2 and BS4. BS5 can expend its *women's literacy* service to other areas by utilizing its local resources of $\{f_{BS2}, f_{BS4}\}$. Furthermore, F_{BS5} can become a fellow partner in other innovation ecosystems.

		Increased from M to H	Increased to L	Increased from L to M	Increased from L to M	Impacted by the value co-created (VC)

Bible Societies	Capability in the Literacy	Impact for Change				Scale = {High, Medium, Low}								
		Customer (e.g. scale of benefiting the audience)			Information (e.g. what sort of information the firm can offer)			Operational (B-B from the process perspective)			Business (B-B from the market share perspective)			Talent (e.g. knowledge sharing, sharing skills and expertise)		
		Scale	VC	Description	Scale	VC	Description	Scale	VC	Description	Scale	VC	Description	Scale	VC	Description
BS2	Women's Literacy	H		Engage with church and local partners, service delivered to 1000 women	H		Produce literacy brochures and materials	H	VC3	Start literacy classes in church (enhance the learning experience of the audience)	H	VC4	Establish relationship with the funding BS (the gained reputation helps attracting more funding BS)	H	VC3	Recruit and train literacy tutors (better knowledge in recruiting the trainers)
			VC4	Gained good reputation from helping an inexperienced BS		VC3	Learned new knowledge of how to conduct women's literacy in different demographics	H		Equip with printing facilities						
						VC5	Gained the new workbook produced	L	VC5	Learned how the new workshop is produced and capable in producing the same in						
BS4	Women's Literacy	H		Engage with church and local partners, service delivered to 5000 women	M	VC3	Learned new knowledge of how to conduct women's literacy in different demographics	H	VC3	Establish literacy centre (enhance the learning experience of the audience)	M	VC4	The reputation gained from helping other BS helps attracting more funding	H	VC3	Recruit and train literacy tutors (better knowledge in recruiting the trainers)
			VC4	Gained good reputation from helping an inexperienced BS				H		Test the learners				H		Set up training workshops
								L	VC5	Learned how the new workshop is produced and capable in producing the same in						
BS5	Women's Literacy	L	VC1	Delivered a literacy project that reaches 5000 women	L	VC3	Shared knowledge on women's literacy of a particular demographics	L	VC3	Learned how to establish literacy centre	L	VC2	Learned how to efficiently use the project funds	L	VC3	Gained knowledge of how to recruit and train the tutors
								M	VC5	Gained the new workbook produced in shared language hence capable in providing similar consultation in future						

Fig. 7. The *innovation ecosystem* of *women's literacy* impacted on the fellowship partners

5 Discussions and Conclusion

The ODBE model has implications for the modern business environment in areas such as the digital oriented business network, business-ICT alignment, innovation and management. From the theoretical perspective, ODBE brings new ideas to the field of business and IT alignment by applying its principles to the existing digital business landscape and by introducing the ODBE, which enables companies to respond to the market changes driven by business and disruptive technologies. From the methodological perspective, ODBE enables companies to identify their digital business capabilities and assess their readiness for value co-creation in collaboration with multiple organizations. The assessment techniques are robust and can be iteratively carried out whenever appropriate. From the practical perspective, ODBE addresses the uncertainty inherent in new collaborations by indicating the values that could be gained by individual companies in a partnership through the *DBE value cloud*.

There are a few limitations in the ODBE. Each *business participant* has to be formally profiled. This profile provides useful inputs (structured and unstructured data) for the *digital business competency valuation* to instantiate the business analytics. External data sources need to be appropriately discovered and integrated to support the valuation analysis. The *DBE value cloud* requires technical mechanisms to register, store, manage, and discover business capabilities. An affordance query can then configure the innovation alliance collaboratively. The innovation ecosystem needs to

be robust in co-creating values and can also generate feedback to aid the participants to maintain their service sustainability.

As for the future work, a number of structural methods will be developed for the ODBE such as the formal representations for *DBE value cloud* and *innovation ecosystem* and the interfaces for information exchange between the components. The technique of *digital business competency valuation* needs an integration of those analytical methods and executes the various analyses in a robust methodology. Furthermore, the technical functions of two types of *connectors* should be developed so that the ODBE model can be simulated scientifically. In addition, ODBE will be applied to multiple case studies in order to prove that it works in the real world.

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