IT Enabled Frugal Effectuation

Full Paper

Prem B. Khanal
Victoria University of Wellington
Wellington, New Zealand
prem.khanal@vuw.ac.nz

Jean-Gregoire Bernard
Victoria University of Wellington
Wellington, New Zealand
jean-gregoire.bernard@vuw.ac.nz

Benoit A. Aubert
Victoria University of Wellington
Wellington, New Zealand
benoit.aubert@vuw.ac.nz

ABSTRACT

To succeed, entrepreneurs operating in frugal contexts tend to adopt an effectual logic of action. Such entrepreneurs also increasingly rely on digital technologies to pursue opportunities. Yet, despite a flurry of scholarly attention to effectuation tactics and their outcomes, surprisingly little is known about how digital technologies support effectuation, and with what outcomes. This paper sketches a theoretical model of how IT affordances support effectuation in frugal contexts. The model extends entrepreneurship and information systems theories of frugal entrepreneurship by linking specific IT affordances to dimensions of effectuation. The paper also discusses how the model could be refined by empirical studies and extended across levels of analysis.

CCS CONCEPTS

• **Social and professional topics → Socio-technical systems**;

KEYWORDS

Effectuation, Entrepreneurship, Frugality, Frugal Innovation, IT Affordances, Experimentation

ACM Reference format:
Prem B. Khanal, Jean-Gregoire Bernard, and Benoit A. Aubert. 2017. IT Enabled Frugal Effectuation. In *Proceedings of SIGMIS-CPR '17, June 21-23, 2017, Bangalore, India, ,* 8 pages.
DOI: http://dx.doi.org/10.1145/3084381.3084396

1 INTRODUCTION

Rajesh, an engineering graduate, wanted to help the millions of Nepalese citizens who have no access to conventional banking services. His knowledge of payment systems was limited to what he could learn through Wikipedia, YouTube videos, and other online resources. He used his savings of 14000 Rupees (about $140 USD) to put together a network from commoditized hardware parts sourced from a cousin that runs a local computer store. He relied on open source technologies to setup a development environment and offered a partnership to his friend Asgar Ali in exchange of a spare room at Asgar's home to serve as an office. He often found himself tied up in red tape when dealing with central bank and other government agencies for licenses and other formal approvals, but managed to glean enough information from government websites to get his venture off the ground. After many trials and errors attempting to offer a payment gateway he ended up developing a mobile payment solution when a local telecom vendor began offering a new low-cost mobile data service in the country. Following a successful crowdfunding campaign on Kiva (www.kiva.org), the solution spread quickly across all 75 districts by exploiting existing mobile networks.

This stylized case provides a glimpse of the role of information technology (IT) in an entrepreneurial venture. Rajesh could expand his knowledge corridors through digital repositories. Constrained by limited resources he could rein expenses to minimum by using free open source technology and his immediate contacts. He found partners who could share the risks and aid in experimentation. Finally, IT provided a reach to millions of customers and investors in no time.

The relationship between IT and entrepreneurship is enabling, inspiring, and long standing [22]. Effectuation theory can provide insights to understand this relationship. Effectuation draws attention to the logic of action underlying entrepreneurial behavior when creating new ventures: "When using effectuation processes, entrepreneurs start with a generalized aspiration and then attempt to satisfy that aspiration using the resources they have at their immediate disposal . . . The overall objective is not clearly envisioned at the beginning, and those using effectuation processes remain flexible, take advantage of environmental contingencies as they arise, and learn as they go" [40, p. 837]. Nowadays, entrepreneurs like Rajesh who pursue innovation opportunities in frugal contexts characterized by extreme resource constraints and institutional voids (lack of regulatory/institutional/legal norms or safeguards) can leverage the potential of IT for ideation and launch of products and services in much faster, affordable, scalable ways than ever before.

Entrepreneurs often come up with creative and affordable solutions when impinged by resource scarcity and institutional voids. A separate branch of innovation studies which acknowledges scarcity as both constraint and opportunity has emerged under the label of frugal innovation [21]. Effectuation is at the core of frugal innovation, which consists in the creation of "good-enough, affordable products that meet the needs of resource-constrained consumers" [63, p. 1]. Affordable improvisation to solve grass-root level problems in resource scarce environment distinguishes frugal from traditional innovation, which relies on resource abundance [4]. Typically, western companies used to ignore resource constrained

SIGMIS-CPR '17, June 21-23, 2017, Bangalore, India

ACM ISBN 978-1-4503-5037-2/17/06…$15.00
DOI: http://dx.doi.org/10.1145/3084381.3084396

consumers and targeted minority affluent class in emerging markets [63]. It was only after Prahalad and Hart [42] came up with the concept of fortune at the bottom of the pyramid (BoP) that this bottom segment got more serious attention. Recent data reflects that people earning less than $10 a day (Purchasing Power Parity) represent 71% of world population [11] [1]. Most of these people live in Africa, Asia and South Pacific. This particular market segment has its own peculiar challenges and opportunities. These markets are characterized by harsh development/deployment environments, a semi/un-educated customer base, the need for radical improvement on value/price ratio, and institutional constraints [7, 41]. Providers of products and services in these emerging market segments face unique types of opportunities: provide acceptable (not high) performance at a much lower price point, introduce a solution without worrying about compatibility since there is usually no infrastructure in place, offer sustainability, operate in minimally regulated markets, and adjust to distinct preferences of emerging markets [23]. Frugal innovators find creative workarounds to aforementioned constraints and exploit these opportunities to "reinvent, recycle and reuse ideas, resources, technologies and even people" [28, p. 252]. To succeed in such difficult situations, an effectual orientation toward entrepreneurial action becomes unavoidable [20, 45].

The academic research on frugal innovation is still at a nascent stage [58]. A number of terminologies have emerged such as jugaad innovation [46], Gandhian innovation [43], inclusive innovation [19], BoP innovation [14], reverse innovation [23], and grass-root innovation [54]. These terms are sometimes used interchangeably and sometimes used to refer to slightly different concepts and contexts. In this particular research frugal context is characterized by four fundamental pillars of frugality namely resource scarcity, uncertainty, affordability, and sustainability.

Ever since Sarasvathy's initial conceptualization of effectuation back in 2001, academic interest in its role in entrepreneurial action has swelled [2]. Attempts have been made to compare and contrast effectuation with other entrepreneurial concepts like causation, bricolage, and frugal engineering [12, 18, 49, 50, 62]. Efforts have been made to understand the role of effectuation in R&D processes and outcomes, as well as its relationship with entrepreneurial orientation and firm performance [9, 35]. In a meta-analytic review Read, Song and Smit [48] not only suggest a measure of effectuation but also conclude that three dimensions of effectuation are positively related to new venture performance, namely means driven action, partnership orientation, and leverage contingency. No significant effect was observed between a fourth dimension, affordable loss, and performance. In another review Perry et al. [40] conclude that the research on effectuation is moving towards an intermediate state of theoretical maturity. Surprisingly, despite this growing volume of research about effectuation, no formal attempt has been made to investigate how and when information technology facilitates effectuation.

In this conceptual paper we examine how entrepreneurs who follow the principles of effectuation can leverage IT to seek opportunities in the context of frugal innovation. Our primary contribution is to extend effectuation theory to acknowledge the role of information technology in frugal contexts. The unit of analysis for our proposed model is the frugal entrepreneur who employs digital technologies to enact the effectuation method as a way to transcend constraints in the design of creative and sustainable solutions.

Moving forward, the core concepts of effectuation and IT affordances are discussed in the next sections, then a set of propositions is developed to explain how IT affordances influence each dimension of effectuation. This is followed by a discussion of the key ideas and conclusion.

2 CONCEPTUAL FRAMEWORK AND PROPOSITIONS

In this section existing literature on effectuation is explored to understand how IT influences the behavior of an effectuator while pursuing an innovation opportunity.

2.1 What is Effectuation?

Two distinct approaches to entrepreneurial action have been proposed in the literature: causation and effectuation. Causation considers a specific effect as given and focuses on selecting the appropriate means to create the effect. Effectuation takes the opposite view: the set of means is given and the innovator is selecting between possible effects that could be created with the means [50]. Causation underlies planned, outcome-driven activities like market analysis and business plan development. Effectuation, on the contrary, involves emergent and adaptive strategies of opportunity creation [12]. Sarasvathy [50] uses the example of a chef to illustrate the difference between causation and effectuation. With causation, the chef thinks about a recipe, purchases the required ingredients, and follows the set of steps to prepare the meal. On the other hand, if effectuation is followed, the chef just opens the refrigerator, looks at the ingredients available, and prepares a dish using the ingredients on hand. The entrepreneurship literature considers effectuation as an intuitive entrepreneurial function and causation as a goal-oriented managerial function [15, 47, 50].The enactment of causation and effectuation is situational: both logics may interlace in entrepreneurial actions and decisions to varying degrees [50].

According to Sarasvathy [50, p. 250] effectual action consists of:

(1) A given set of means (that usually consists of relatively unalterable characteristics/circumstances of the decision maker);
(2) A set of effects or possible operationalization of generalized aspirations (mostly generated through the decision process);
(3) Constraints on (and opportunities for) possible effects (usually imposed by the limited means as well as by the environment and its contingencies);
(4) Criteria for selecting between the effects (usually a predetermined level of affordable loss or acceptable risk related to the given means);
and
(5) The creation of new markets together with customers, suppliers, and even prospective competitors [51, p. 390].

[1] Prahalad & Hart [42] categorize the people earning less than $4 a day (PPP) as bottom of the economic pyramid (BOP).
[2] reflected by 2859 citations that appear in Google Scholar as of 26-12-2016 to [50].

Table 1: Effectuation Dimensions and Descriptions used in the literature

Effectuation Dimensions	Unit of Analysis	Description	Authors
Affordable loss, Experimentation, Flexibility, Pre-commitments	High-technology Firms	Effectuation have been linked with entrepreneurial outcomes and firm performance under dynamic and hostile environments	Mthanti & Urban [35]
Resource focus, Affordable loss, Strategic Alliance, Exploit Contingencies, Control Logic	Entrepreneur or Emerging Firm	Effectuation should be measured as a reflective construct when research centers around effectuation and as a formative construct when effectuation is part of a complex research model.	Perry et al. [40]
Means-driven, Affordable loss, Partnership, Acknowledge unexpected	R&D Project	Effectuation and causation dimensions have been linked with R&D process efficiency and output.	Brettel et al. [9]
Experimentation, Affordable Loss, Flexibility, Pre-Commitments	Startup Phase of Venture	Initial empirical validation of effectuation as a formative construct.	Chandler et al. [12]
Means: What I know, Who I am and Whom I know, Partnership, Affordable loss, Leverage contingency	New Venture	Meta-analysis relationships with entrepreneurial outcomes. All sub-dimensions except affordable loss influence new venture performance positively.	Read et al. [48]

Figure 1: Effectuation (Sub) Dimensions

Significant efforts have been made by researchers to articulate the construct of effectuation as a multidimensional latent variable based on aforementioned theoretical principles [9, 12, 35, 40, 48]. Table 1 lists some of those research works along with unit of analysis and a short description. The following paragraphs discuss the key points in the effectuation construct as shown in Figure 1.

Means Driven: Entrepreneurs start with aspirations and limited means: who they are (traits, identity, preferences, resource endowments), what they know (abilities, knowledge corridors), and whom they know (social networks) [50]. Entrepreneurs rely on these means, are aware of their own strengths and limitations, and utilize their social network to kickoff innovation.

Affordable Loss: Entrepreneurs assess an innovation opportunity based on the loss they could absorb in case of failure rather than the potential returns [15]. In other words effectuators look for frugal ways of doing things to minimize downside risk first and foremost [18].

Exploit Contingencies: Effectuators seek to turn unexpected events into profitable outcomes [18] by exploiting environmental contingencies through flexibility and experimentation [40].

Flexibility: Effectuators tend to remain flexible to choose and adapt contingent opportunities.

Experimentation: "A series of trial and error changes pursued along various dimensions of strategy, over a relatively short period of time, in an effort to identify and establish a viable basis for competing [37, p. 496]."

Partnerships: The last dimension is concerned with establishing pre-commitments and alliances with customers, suppliers, and other strategic partners which help reduce the uncertainty associated with the venture. Diversifying risk among multiple stakeholders minimize potential loss for each one [35, 50].

2.2 Information Technology: Artifact, Relationship or Property

Our goal is to identify how IT influences the behavior of frugal effectuator. These influences will be complex and hence a multifaceted construct to represent the various ways information technology is likely to influence effectuation is needed.

IS researchers have adapted different terminologies to understand human technology interactions. These terminologies include (but are not limited to) artifact, artifact properties, artifact capabilities, artifact functionalities, perceived functionalities, emergent functionalities, and properties of relationship between artifact and end user etc. Ever since Gibson's inception of affordance to understand animal environment interactions, IS researchers have adapted the analogy to study human technology interactions. Slightly varied definitions of IT affordances could be found in IS literature. For example: according to Markus & Silver [34, p. 622] functional affordance is offered by technical objects; "the possibilities for goal-oriented action offered to specified user groups by technical objects". Similarly Volkoff & Strong [59, p. 823] define affordance as a function of relationship as "The potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an object (e.g., an IT artifact) and a goal-oriented actor or actress." The concept of IT affordances have been adapted

in various contexts; for example Schultze [53] explains that IT affordances provide a sense of presence in virtual world and Leonardi [29] explores the implication of IT affordances in collective action of a group (individualized, collective and shared affordances).

In order to illustrate the notion of affordances a few examples are provided. Social media offers to shape the identity of someone who is trying to create/change an impression to others. Also, social media offers entertainment to someone who is looking for some pastime. Interestingly, we can see that, the same technology can exhibit different affordances depending on the goal of end user(s). Therefore affordances not only change with the technology or artifact but also with the goal of the end user. Hence influence of technology on actions and on decisions of frugal effectuators could be studied using the concept of affordances.

In this particular research both aforementioned definitions have been considered where appropriate.

2.3 Information Technology and Effectuation

We now turn our attention to how IT affordances can influence each of the sub-dimensions of effectuation.

Modern day entrepreneurs have access to ubiquitous and cheap technology. By drawing on past literature that has examined how IT affordances are enacted, it is possible to assess which dimensions of effectuation are possibly affected by IT affordances. The list of affordances considered is not comprehensive nor is it applicable in all cases. Affordances were chosen according to their relevance with each dimension. Our objective is to open up an initial line of inquiry about how IT affordances can enable various aspects of effectual action. Table 2 maps effectuation dimensions with IT affordances in frugal context.

2.3.1 *How IT Affordances Enable Means Driven Action.*

Digital-Self. Effectuation starts with the limited means/resources of the entrepreneur where s/he knows her own traits, preferences, and resource endowments [50]. In other words: effectuators draw on their identity as a resource to recognize and exploit opportunities. Frugal effectuators are driven by the aspiration to do more with less resources for more people [7]. Also, entrepreneurial identity plays a major role in securing resources and acquiring trust and investment [36]. We propose that effectuators' identity involves an IT component too: a cyber-extension of oneself. IT identity is a novel identity created when one associates IT as an integral part of his/her sense of self [10]. IT in this context means a unit of technology (hardware, software, platform) accessible to a conscious end user over time and space to produce, store and communicate information [10]. Stein, Galliers and Markus [56] identify five different ways of how IT shapes professional identity: creation, translation, management, illustration, and utilization of IT artifacts. These so called cyber extensions of the self can help sharpen the skills or abilities, convey the thought process in graphical ways, and create an image of the person (entrepreneur). For example effectuators might project their entrepreneurial identity through their personal or professional websites, blogs, and presence in social media. In short digital projection of the identity of the effectuator creates an extended self which in turn extends entrepreneurial resources. This leads to our first proposition:

Proposition 1. *In frugal contexts, IT affordances can extend self-identities of effectuators by creating digital persona.*

Digital-Knowledge. Effectuators are aware of the knowledge corridor they are in [50]. Said differently they masterfully utilize what they know to create something new (contingent effects). Frugal innovators also exploit the deep knowledge of contextual problems and the local workarounds to those problems [32]. The knowledge corridors the entrepreneurs are in could be extended, influenced and/or established through digital repositories of information. Combination of computing resources and existing knowledge if properly utilized increases the chances of entrepreneurial endeavors [22]. Multimedia repositories like Youtube and Wikipedia are useful to extend explicit knowledge. Online communities and blogs help extending/spreading tacit knowledge. Self-paced, customized online courses like MOOC (Massive Open Online Course) can be source of both tacit and explicit knowledge. In short publicly/proprietary available digital repositories deepen the breadth of effectuator's knowledge. Which leads us to our second proposition:

Proposition 2. *In frugal contexts, IT affordances can extend (positively) the limited entrepreneurial knowledge by enabling contextual knowledge seeking.*

Digital-Connections. Effectuators lean on their immediate contacts to create/exploit opportunities. In other words they rely on people they know, personally or professionally, to kick off their venture. Being embedded in local networks has been identified as one of the major driving forces for frugal innovations [16]. Digital connections can expand the effectuator's network not only by linking people with people but also by linking people with objects and objects with objects. Ever expanding digital network known as "Internet of things (IoT)" encompasses the interconnectivity of things, data and people [6]. Pilot IoT projects like 'physical-web'at the slums of Dharavi (Mumbai, India) are being developed to help entrepreneurs and customers in BoP markets [24]. Platforms like social media help entrepreneurs to coordinate and collaborate not only with people to whom that are in their immediate network vicinity, but also with the people that are remotely located - socially, physically, and culturally. For example effectuators develop personal contacts over social media like Facebook and professional contacts over LinkedIn. In short digital networks and platforms extend effectuator's social capital. Which leads to our third proposition.

Proposition 3. *In frugal contexts, IT affordances can extend the reach and breadth of effectuators' social network by enabling local embeddedness.*

2.3.2 *How IT Affordances Limit Affordable Losses.*

Seasoned entrepreneurs start by estimating the loss they could afford rather than thinking about possible returns from an opportunity [50]. In the same vein, affordability is the defining feature of almost any innovations in frugal contexts [5, 52, 55, 57] where success can only be achieved by failing cheap [46]. With modern day technologies like cloud computing, entrepreneurs can get an affordable and scalable world class IT infrastructure "on demand". It is not long ago that investing in a fully operational datacenter and sophisticated software was a mandatory requirement for entrepreneurs seeking to exploit IT. Economic, scalable and customizable solutions are

Table 2: Mapping Effectuation Dimensions, IT Affordances, and Frugal Innovation Context

Effectuation Dimensions	Dimension Description	IT (Affordances and *Artifacts)*	Description of IT (Artifact and Affordances)	Explanation	Frugal Innovation Context
Means-who am I	Their own traits, tastes, and resource endowments	Shaping Identity - *Digital Persona Systems*	"IT identity is the extent to which an individual views use of an IT as integral to his or her sense of self - as a new form of identity" [10, p. 931].	Presence in social media, blogs, websites as an extension to who they are or how do they project themselves in the digital world	Aspiration to create product/ service/process/ system that is profitable, sustainable and affordable for more people
Means-what do I know	Abilities and knowledge corridors	Seeking Knowledge - *Digital Repositories, Online Communities*	Organizational knowledge repositories, academic knowledge repositories, big data repositories, online communities	The knowledge corridors are expanded by digital repositories	Aspects of domestic marketplace [5]
Means-whom do I know	Social network they are part of	Seeking Connections - *Social Media/Platforms*	" Web-based services that allow individuals to (1) construct a … profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site" [8, p. 211].	Social networking platforms generate social capital by expanding the reach and breadth of an entrepreneur's network	Non-traditional partnering, localizing value creation, positive social action, local business unit [17]
Affordable Loss	Loss that could be absorbed in case of failure	Seeking Solutions on Demand - *Cloud Technology /Open Source Technology*	" 'On demand'refers to the fact that users of IT resources access them when they need them, for how long they need them, and only pay for this actual usage" [31, p. 163].	Economic IT solution for budding entrepreneurs which might help to keep expenses low	Fail cheap, fail fast, fail often [46]
Exploit Contingencies - Flexibility	Flexible to choose and adapt contingent opportunities	Seeking Flexibility - *Real Time Communication/ Simulation/Modeling*	" Modeling is the process of producing a model; … One purpose of a model is to enable the analyst to predict the effect of changes to the system" [33, p. 7].	Simulation and modeling of the system provides flexibility to choose among contingent opportunities	Flex your assets, MacGyver Spirit [45]
Exploit Contingencies - Experimenta-tion	Trial and error	Evaluating Alternatives - *Simulation/Modeling/3D Printing*	" A simulation … can be reconfigured and experimented with; usually, this is impossible, too expensive or impractical to do in the system it represents. The operation of the model can be studied, and hence, properties concerning the behavior of the actual system or its subsystem can be inferred" [33, p. 7].	Simulation/modeling and/or 3D printing could be an economic way of experimentation of complex systems.	Engage and Iterate [45]
Partnership - Pre commitments	Risk sharing	Finding Supporters - *Social Media/Platforms/Crowd Funding*	"Crowd-funding is an initiative undertaken to raise money for a new project proposed by someone, by collecting small to medium-size investments from several other people (i.e. a crowd)" [38, p. 444].	Funding could be obtained in the form of pre commitments from crowd (Partnership redefined)	Make innovative friends [45]
Partnership - Alliances	Reduce uncertainty	Seeking Alliances - *Social Media/Platforms/Crowd Sourcing*	"The fundamental idea of crowdsourcing is that a crowdsourcer …proposes to an undefined group of contributors …the voluntary undertaking of a task presented in an open call. The ensuing interaction process unfolds over IT-based crowdsourcing platforms. The power of crowdsourcing lies in aggregating knowledge from a multitude of diverse and independent contributors. Crowdsourcing enables crowdsourcers to obtain solutions that are beyond the boundaries of their established mindset" [39, p. 200].	Transient alliances could be created using crowd sourcing or a long lasting one could be created using platforms or social connections on world wide web.	Co-create value with prosumers [45], collaborative efforts with local market partners [3]

nowadays available through internet connections. Entrepreneurs do not need to put at risk excessive amount of resources upfront while facing an uncertain future payoff: if the innovation succeeds then costs rise as the innovation is scaled, and if the innovation fails then the loss is limited to the cost of the on-demand services consumed. Also, social media platforms provide a cheap (and sometimes free) reach to the millions of potential customers and/or partners. A plethora of open source technologies is available for free, which further limit the magnitude of investments required. Hence frugal information systems using minimal of resources [61] help reducing losses in case of venture failure, an observation which leads to our fourth proposition:

Proposition 4. *In frugal contexts, IT affordances can lower the potential losses associated with entrepreneurial action by providing on-demand solutions.*

2.3.3 How IT Affordances Enable Experimentation and Flexibility. Effectuators perform trial and error with multiple business model variations [18]. Moreover they are flexible enough to choose one or more among those variations based on their aspirations. Frugal innovators engage customers in experimentation with products or services; they are flexible enough to choose one among many contingencies as they come along [45]. Nowadays, the entrepreneurs' ability to simulate reality using sophisticated software systems facilitates both experimentation and flexibility to choose among contingencies. For example, India was able to launch a satellite to Mars "Mangalyan" within 15 months and $74 million USD whereas the budget for the NASA's satellite to the Mars "Maven" was $670 million USD [13] [3]. One of the secrets to achieving this for a 10 times lower cost and 3 times less time was the experimentation using sophisticated simulation and modeling software instead of physical prototypes [44]. Ideas could be evaluated in no time on world wide web using control experiments like A/B testing [where users are randomly exposed to a single factor with two values control(A) and treatment(B)] or MultiVariable testing (where users are exposed to multiple factors at the same time) [27]. In short, digital effectuators perform virtual experiments to generate contingencies (often referred as effects) and to evaluate those, which increases flexibility. This potential leads to our fifth proposition:

Proposition 5. *In frugal contexts, IT affordances can facilitate flexibility and experimentation by allowing virtual experiments.*

2.3.4 How IT Affordances Help Building Partnerships. Rather than focusing on competitors and/or competitive analysis, effectuators focus on a) building strategic alliances to reduce uncertainty and b) obtaining pre-commitments to share risks. Frugal innovators rely on non-traditional partnerships, local business units [17], local networks [16], strong local presence [63], and collaboration with prosumers [45]. Platforms like AirBnb and Uber help forming a partnership among millions of users and reach out to billions of customers. In addition to traditional forms of partnership using social media, websites, emails, and mobile technologies, significant growth has been observed in alternative finance markets like crowdfunding or peer-to-peer lending [60, 64]. In short digital partnerships and alliances, often done through social media and platforms, extend the reach to partners and potential users. This leads us to our sixth proposition:

Proposition 6. *In frugal contexts, IT affordances can facilitate partnerships by connecting with local allies.*

In sum, we sketched a preliminary theoretical model of how effectuators can leverage IT affordances while pursuing an innovation opportunity in frugal contexts. We have selected only a few of the trending IT artifacts and affordances nowadays, and we acknowledge that there may be unforeseen affordances that could affect entrepreneurial behavior as new IT artifacts become available over time. There may also be IT affordances that influence entrepreneurial effectuation negatively (or do not affect it at all) such as traditional reporting and analyzing tools which effectuators do not seem to bother about because those tools are aligned with a goal-based causation logic.

3 DISCUSSION

Technology has infiltrated every aspect of human life, be it self-identity, be it aspirations, be it relations, be it the way we see and evaluate opportunities or be it the way we conduct businesses. Traditional usage of information technology to automate and operate treats it as a logical intellectual tool. So does the traditional view of entrepreneurship where a predefined goal is pursued in a logical way keeping return on investments in mind. Effectuation challenges the traditional view point of entrepreneurship by arguing that entrepreneurs are driven by intuition. They can switch and adopt new goals. In this paper we have investigated the potential use of IT to support emergent strategies of effectuation in frugal contexts. The growth of global income inequality [11]; the reduction of purchasing power in the developed world [23]; and the increasingly pervasive role of IT to reduce the cost of experimentation, improvisation and innovation [2] make the study of digital effectuation in frugal contexts particularly relevant and timely.

As explained earlier effectuation and causation are intermingled in entrepreneurial decisions and actions. Hence it is difficult to observe the effect of IT on effectuation in isolation. This examination of digital frugal effectuation as an archetype contributes to effectuation theory by acknowledging the role of IT affordances in frugal innovation approaches of entrepreneurial actions.

To the best of our knowledge this is the only conceptual work that explores the influence of digital affordances on effectuation principles. It is opening up new possibilities to study digital effectuation.

From our explanations and propositions we identify four key characteristics of digital effectuators as shown in Figure 2. Digital effectuators are equipped with digital means (Digital Identity, Digital Knowledge, and Digital Connections). They utilize digital (on-demand/open source) solutions to curb losses. Digital experiments facilitate trial and error to create new effects and provide flexibility to choose among the contingent effects. Partnerships on digital platforms facilitate risk sharing and strategic alliances.

Sarasvathy [50] has explained that effectuation principles are applicable at individual, organization, and macroeconomic levels. In this conceptual research we have explored the technologies and traits at the individual level but it is possible to imagine that IT-enabled effectuation follows the same pattern and thus could

[3] Authors acknowledge that Mavan was highly advanced science mission and Mangalyaan was a technology demonstration mission.

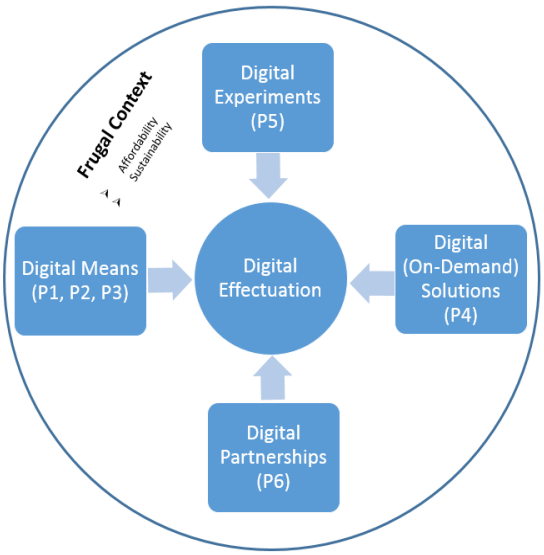

Figure 2: Key Characteristics of Digital Effectuators

also be applied at different level of analysis. Macroeconomic level effectuation principles have not yet been a research focus at all, but it would be interesting to study how national and international economies are influenced by digital effectuation principles.

Entrepreneurial and frugal practices within established organizations are gaining popularity among both academicians and practitioners (e.g., intrapreneurship, amoeba management techniques [1], increasing number of R&D centers in emerging markets [25, 26]). Study of digital effectuation principles/dimensions in the context of frugal intrapreneurship is another potential research area for exploration.

One aspect that was not considered in this paper is the negative influence of IT affordances on effectuation. Our primary interest was in identifying the nature of the affordances that can support specific dimensions of effectuation as a first step, rather than examine the directionality of the influences. The examination of IT affordances that negatively influence effectuation principles have been left for future research. Conceptually, it is conceivable that such negative influences exist. It is unclear if the effectuators would be able to avoid such influences.

Further understanding of the effect of IT affordances on effectuation will be derived from empirical work. Case studies to establish conceptual foundation of digital effectuation could further unpack how frugal entrepreneurs rely on IT affordances for effectuation. Studies examining the moderating or mediating effects of IT affordances on new venture performance is another potential research area. Our model complements comparative case studies of 'born-digital' versus 'grown-digital' ventures [30], and help further the IS field's collective understanding of digital effectuation.

It becomes increasingly important to understand the influence of digital technologies on effectuation principles given the centrality of IT in today's emerging business models that aim to provide sustainable solutions to some of the world's most complex problems. More broadly, the spread of agile and lean approaches to innovation suggests that ignoring IT-enabled effectuation in theories of frugal innovation could become a crucial error of exclusion.

4 CONCLUSION

Nature has sustained the exponential growth of human population from 5 million (8000 BC) to 7 billion (2016 AD). This growth has brought an unprecedented use of scarce and finite resources. Yet about 71% of world population is bound to live in despair conditions [11]. Hence entrepreneurs who could do more with less resources for more people in sustainable way are desperately needed. That is the reason why we have developed a conceptual framework to study the influence of IT affordances on effectuators in frugal context. Frugal context stimulates the industrious effort for sustainable and affordable solutions for more people in entrepreneurial endeavors.

In this theoretical paper we set out to explore if intuition based effectuation principles could be supported by emerging information technologies. By mapping relevant IT affordances to the corresponding dimensions of effectuation we conclude that specific IT affordances have positive influence on each effectuation sub-dimension. Effectuation is basically trying to control the future based on today's contingent choices. It follows the principle of you don't need to predict the future if you can control it from your choices [50]. IT affordances facilitate creating and evaluating contingent effects from digitally extended means to fulfill entrepreneurial aspirations.

Frugal digital effectuation viewpoint helps understanding the actions and decisions of new generation tech-savvy entrepreneurs and prosumers who not only care about value for money but also care about value for many.

REFERENCES

[1] Ralph W. Adler and Toshiro Hiromoto. 2012. Amoeba Management: Lessons From Japan's Kyocera. *MIT Sloan Management Review* 54, 1 (2012), 83–89.
[2] Suchit Ahuja and Yolande E. Chan. 2014. The Enabling Role of IT in Frugal Innovation. In *Thirty Fifth International Conference on Information Systems*. 1–20.
[3] Peter Altmann and Robert Engberg. 2016. Frugal Innovation and Knowledge Transferability: Innovation for Emerging Markets Using Home-Based R&D. *Research-Technology Management* January-Februrary (2016), 48–55.
[4] Preeta M. Banerjee. 2013. The "Frugal" in Frugal Innovation. In *Evolution of Innovation Management*, Alexander Brem and Eric Viardot (Eds.). Palgrave Macmillan UK, 290–310.
[5] Radha R. Basu, Preeta M. Banerjee, and Elizabeth G. Sweeny. 2013. Frugal Innovation: Core Competencies to Address Global Sustainability. *Journal of Management for Global Sustainability* 2 (2013), 63–82.
[6] Anandhi Bharadwaj, Omar A. El Sawy, Paul A. Pavlou, and N. Venkatraman. 2013. Digital Business Strategy: Toward a Next Generation of Insights. *MIS Quarterly* 37, 2 (2013), 471–482.
[7] Yasser Ahmad Bhatti and Marc Ventresca. 2013. How Can "Frugal Innovation" Be Conceptualized? *SSRN* (2013), 1–26. DOI:http://dx.doi.org/10.2139/ssrn.2203552
[8] Danah m. Boyd and Nicole B. Ellison. 2007. Social Network Sites: Definition, History, and Scholarship. *Journal of Computer-Mediated Communication* 13, 1 (oct 2007), 210–230.
[9] Malte Brettel, René Mauer, Andreas Engelen, and Daniel Küpper. 2012. Corporate Effectuation: Entrepreneurial Action and Its Impact on R&D Project Performance. *Journal of Business Venturing* 27, 2 (2012), 167–184.
[10] Michelle Carter and Varun Grover. 2015. Me, Myself, and I(T): Conceptualizing Information Technology Identity and Its Implications. *MIS Quarterly* 39, 4 (2015), 931–957.
[11] Pew Research Center. 2015. World Population by Income: How Many Live on How Much, and Where. (2015). http://www.pewglobal.org/interactives/global-population-by-income/
[12] Gaylen N. Chandler, Dawn R. DeTienne, Alexander McKelvie, and Troy V. Mumford. 2011. Causation and effectuation processes: A validation study. *Journal of Business Venturing* 26, 3 (2011), 375–390.
[13] National Geographic Channel. 2015. India's Mission To Mars Video By National Geography. (2015). https://www.youtube.com/watch?v=FPQkasiqVkw

[14] Carl Dahlman and Yevgeny Kuznetsov. 2014. Chapter 4- Innovation for the " Base of the Pyramid": Developing a Framework for Policy Experimentation. In *Making Innovation Policy Work: Learning From Experimentation*. OECD/World Bank, Chapter 4, 71–123.

[15] Nicholas Dew, Stuart Read, Saras D. Sarasvathy, and Robert Wiltbank. 2009. Effectual Versus Predictive Logics in Entrepreneurial Decision-Making: Differences Between Experts and Novices. *Journal of Business Venturing* 24, 4 (2009), 287–309.

[16] Holger Ernst, Hanna Nari Kahle, Anna Dubiel, Jaideep Prabhu, and Mohan Subramaniam. 2015. The Antecedents and Consequences of Affordable Value Innovations for Emerging Markets. *Journal of Product Innovation Management* 32, 1 (2015), 65–79.

[17] Siim Esko, Mindaugas Zeromskis, and Juliana Hsuan. 2013. Value chain and innovation at the base of the pyramid. *South Asian Journal of Global Business Research* 2, 2 (2013), 230–250.

[18] Greg Fisher. 2012. Effectuation, Causation, and Bricolage: A Behavioral Comparison of Emerging Theories in Entrepreneurship Research. *Entrepreneurship: Theory and Practice* 36, 5 (2012), 1019–1051.

[19] Christopher Foster and Richard Heeks. 2013. Conceptualising Inclusive Innovation: Modifying Systems of Innovation Frameworks to Understand Diffusion of New Technology to Low-Income Consumers. *European Journal of Development Research* 25, 3 (2013), 333–355.

[20] Michael Gibbert, Martin Hoegl, and Liisa Välikangas. 2007. In Praise of Resource Constraints. *MIT Sloan Management Review* Spring, 48308 (2007), 1–5.

[21] Michael Gibbert, Martin Hoegl, and Liisa Valikangas. 2014. Introduction to the Special Issue: Financial Resource Constraints and Innovation. *Journal of Product Innovation Management* 31, 2 (mar 2014), 197–201.

[22] Manlio Del Giudice and Detmar Straub. 2011. IT and Entrepreneurism: An On-Again, Off-Again Love Affair or a Marriage? *MIS Quarterly* 35, 4 (2011), III–VII.

[23] Vijay Govindarajan and Chris Trimble. 2012. Reverse Innovation: a Global Growth Strategy That Could Pre-empt Disruption at Home. *Strategy & Leadership* 40, 5 (2012), 5–11.

[24] HindustanTimes. 2017. Internet of Things: Dharavi Market Taps into Virtual World for Gains. (2017). http://www.hindustantimes.com/mumbai-news/internet-of-things-dharavi-market-taps-into-virtual-world-for-gains/story-S2KDFsgRJ8MFk0QBp9gJ3O.html

[25] Jeffrey R Immelt, Vijay Govindarajan, and Chris Trimble. 2009. How GE Is Disrupting Itself. *Harvard Business Review* October (2009), 56–65.

[26] Barry Jaruzelski, Kevin Schwartz, and Volker Staack. 2015. The Innovation's New World Order. *Strategy + Business* 27, 81 (2015).

[27] Ron Kohavi, Roger Longbotham, Dan Sommerfield, and Randal M Henne. 2009. Controlled Experiments on the Web : Survey and Practical Guide. *Data Minining and Knowledge Discovery* 18 (2009), 140–181.

[28] Charles Leadbeater. 2014. *The Frugal Innovator: Creating Change on a Shoestring Budget* (1st ed.). Plgrave Macmillan UK.

[29] Paul M Leonardi. 2013. When Does Technology Use Enable Network Change in Organizations? A Comparative Study of Feature Use and Shared Affordances. *MIS Quarterly* 37, 3 (2013), 749–775.

[30] Carmen Leong, Shan L Pan, and Jie Liu. 2016. Digital Entrepreneurship of Born Digital and Grown Digital Firms: Comparing the Effectuation Process of Yihaodian and Suning. In *Thirty Seventh International Conference on Information Systems*. Dublin, 1–11.

[31] Frank Leymann. 2011. Cloud Computing. *it - Information Technology* 53 (2011), 163–164. arXiv:1003.4074

[32] Ted London and Stuart L Hart. 2004. Reinventing Strategies for Emerging Markets: Beyond the Transnational Model. *Journal of International Business Studies* 35, 5 (2004), 350–370.

[33] Anu Maria. 1997. Introduction to Modeling and Simulation. *Proceedings of the 29th conference on Winter simulation - WSC '97* (1997), 7–13.

[34] M Lynne Markus and Mark S. Silver. 2008. A Foundation for the Study of IT Effects: A New Look at DeSanctis and Poole's Concepts of Structural Features and Spirit. *Journal of the Association for Information Systems* 9, 10 (2008), 609–632.

[35] Thanti Sibonelo Mthanti and Boris Urban. 2014. Effectuation and Entrepreneurial Orientation in High-Technology Firms. *Technology Analysis & Strategic Management* 26, 2 (2014), 121–133.

[36] Chad Navis and Mary Glynn. 2011. Legitimate Distinctiveness and the Entrepreneurial Identity: Influence on Investor Judgments of New Venture Plausibility. *Academy of Management Review* 36, 3 (2011), 479–499.

[37] Charlene L Nicholls-Nixona, Arnold C Cooper, and Carolyn Y Woo. 2000. Strategic Experimentation: Understanding Change and Performance in New Ventures. *Journal of Business Venturing* 15, 6-6 (2000), 493–521.

[38] A. Ordanini, A., Miceli, L., Pizzetti, M., & Parasuraman. 2011. Crowd-Funding: Transforming Customers into Investors Through Innovative Service Platforms. *Journal of Service Management* 22, 4 (2011), 443–470.

[39] Joe Peppard, Chris Edwards, and Rob Lambert. 2011. Crowdsourcing: How to Benefit From (Too) Many Great Ideas. *MIS Quarterly* 10, 2 (2011), 115–117.

[40] John T. Perry, Gaylen N. Chandler, and Gergana Markova. 2012. Entrepreneurial Effectuation: A Review and Suggestions for Future Research. *Entrepreneurship: Theory and Practice* 36, 4 (2012), 837–861.

[41] C. K. Prahalad. 2006. *The Fortune at The Bottom of the Pyramid: Eradicating Poverty Through Profits*. Wharton School Pub.

[42] C. K. Prahalad and Stuart L Hart. 2002. The Fortune at the Bottom of the Pyramid. *Strategy+Business Magazine* 26 (2002), 1–16.

[43] C. K. Prahalad and R. A. Mashelkar. 2010. Innovation's Holy Grail. *Harvard Business Review* 88, 7-8 (2010), 1–10.

[44] Navi Radjou. 2015. Navi Radjou: "Frugal Innovation: How To Do More With Less" | Authors at Google. (2015). https://www.youtube.com/watch?v=fI-KPJKrfRY

[45] Navi Radjou and Jaideep Prabhu. 2015. *Frugal Innovation: How to do more with less*. The Economist.

[46] Navi Radjou, Jaideep Prabhu, and Simone Ahuja. 2012. *Jugaad Innovation*. Jossey-Bass.

[47] Stuart Read and Saras D. Sarasvathy. 2015. Knowing What to Do and Doing What You Know: Effectuation as a Form of Entrepreneurial Expertise. *Journal of Private Equity* Winter (2015), 45–62.

[48] Stuart Read, Michael Song, and Willem Smit. 2009. A Meta-Analytic Review of Effectuation and Venture Performance. *Journal of Business Venturing* 24, 6 (2009), 573–587.

[49] Eugenia Rosca and Julia Bendul. 2015. Combining Frugal Engineering and Effectuation Theory : Insights for Frugal Product Development in Entrepreneurial Context. *R&D Management - (Fast?) Connecting R&D* (2015), 1–10.

[50] Saras D Sarasvathy. 2001. Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. *Academy of Management Review* 26, 2 (2001), 243–263.

[51] Saras D. Sarasvathy and Nicholas Dew. 2005. Entrepreneurial logics for a technology of foolishness. *Scandinavian Journal of Management* 21, 4 SPEC. ISS. (2005), 385–406.

[52] A Sarin, L Annala, and JL Green. 2016. Co-production of Frugal Innovation: Case of Low Cost Household Reverse Osmosis Filters in India. *Journal of Cleaner Production* (2016). http://www.sciencedirect.com/science/article/pii/S0959652616309532

[53] Ulrike Schultze. 2010. Embodiment and Presence in Virtual Worlds: A Review. *Journal of Information Technology* 25, 4 (2010), 434–449.

[54] G Seyfang and A Smith. 2007. Grassroots Innovations for Sustainable Development: Towards a New Research and Policy Agenda. *Environmental Politics* 4016, 4 (2007), 37–41.

[55] Pavan Soni and Rishikesha T. Krishnan. 2014. Frugal Innovation: Aligning Theory, Practice, and Public Policy. *Journal of Indian Business Research* 6, 1 (2014), 29–47.

[56] Mari Klara Stein, Robert D. Galliers, and M. Lynne Markus. 2013. Towards an Understanding of Identity and Technology in the Workplace. *Journal of Information Technology* 28, 3 (2013), 167–182.

[57] Rajnish Tiwari and Cornelius Herstatt. 2012. Frugal Innovation : A Global Networks ' Perspective. *Die Unternehmung* 66, 3 (2012), 245–274.

[58] Rajnish Tiwari, Katharina Kalogerakis, and Cornelius Herstatt. 2014. Frugal Innovation and Analogies: Some Propositions for Product Development in Emerging Economies. (2014). http://tubdok.tub.tuhh.de/handle/11420/1175

[59] Olga Volkoff and Diane M. Strong. 2013. Critical Realism and Affordances: Theorizing IT-Associated Organizational Change Processes. *MIS Quarterly* 37, 3 (2013), 819–834.

[60] Robert Wardrop, Bryan Zhang, Raghavendra Rau, and Mia Gray. 2015. *The European Alternative Finance Benchmarking Report*. Technical Report February. 44 pages. http://www.jbs.cam.ac.uk/index.php?id=6481

[61] Richard T. Watson, K. Niki Kunene, and M. Sirajul Islam. 2012. Frugal information systems (IS). *Information Technology for Development* 19, 2 (2012), 1–12.

[62] Chris Welter, René Mauer, and Robert J Wuebker. 2016. Bridging Behavioral Models and Theoretical Concepts: Effectuation and Bricolage in the Opportunity Creation Framework. *Strategic Entrepreneurship Journal* 10 (2016), 5–20.

[63] Marco B Zeschky, Bastian Widenmayer, and Oliver Gassmann. 2011. Frugal Innovation in Emerging Markets: the Case of Mettler Toledo. *Research Technology Management* 54, 4 (2011), 38–45.

[64] Bryan Zhang, Robert Wardrop, Tania Ziegler, Alexis Lui, John Burton, Alexander James, and Kieran Garvey. 2016. *Sustaining Momentum: The 2nd European Alternative Finance Industry Report*. Technical Report September.