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Effectuation – State Of The Art Literature Review And Developing Agent-Based Model Approaches

Introduction - What Effectuation is About

In the field of entrepreneurship, an approach has developed which is known under the term of effectuation. Successful serial entrepreneurs (Sarasvathy, 2001) use it as an independent decision-making logic for the implementation of disruptive technologies.

This approach combines five principles that enable entrepreneurs to drive forward "discontinuous changes" (Schumpeter, 1961, p. 94) of markets and to implement them economically successfully.

In contrast, while causal logic in the context of entrepreneurial activity means setting goals and achieving them in the best possible way by obtaining resources and defining activities, effectuation starts with the existing competencies and existing contact networks of the individual, which serve as the basis of any further action (Wiltbank et al., 2006). This principle is called *bird-in-hand* (Sarasvathy, 2009).

Furthermore, effectuation is oriented towards the *affordable loss*. This represents an investment limit defined by the entrepreneur himself, which can be of financial or time effort nature. (Dew et al., 2009b). Since it is not clear at the beginning of a venture what exactly the object of the venture will be, effectual acting actors avoid predicting expected profits and therefore focus on the downside potential (Wiltbank et al., 2006).

In effectuation, chance and surprises are positive in the entrepreneurial context. Unexpected events are seen as opportunities for the entrepreneur to create and exploit new business opportunities. This *lemonade principle* describes that uncertainty can be used as a lever for innovation (Read and Sarasvathy, 2005).

In addition, other individuals or groups are not excluded from the venture in principle. Rather, partnerships arise through self-selection. Participants from the network of the effectual entrepreneur, who are not willing to bear the risk of the venture, therefore leave the further process of the venture in a self-determined way. Sarasvathy (2009) calls this principle the *crazy-quilt-principle*.

Finally, the *pilot-in-the-plane principle* described by Sarasvathy (2009) illustrates the logic of non-predictive control. The concentration on the skilful use of means makes the prediction of future events obsolete (Dew et al., 2009a).

These principles find their expression in the effectual process illustrated in Figure 1. The iterative process shows how firms and markets can develop over time in an effectual manner (Read and Sarasvathy, 2005).

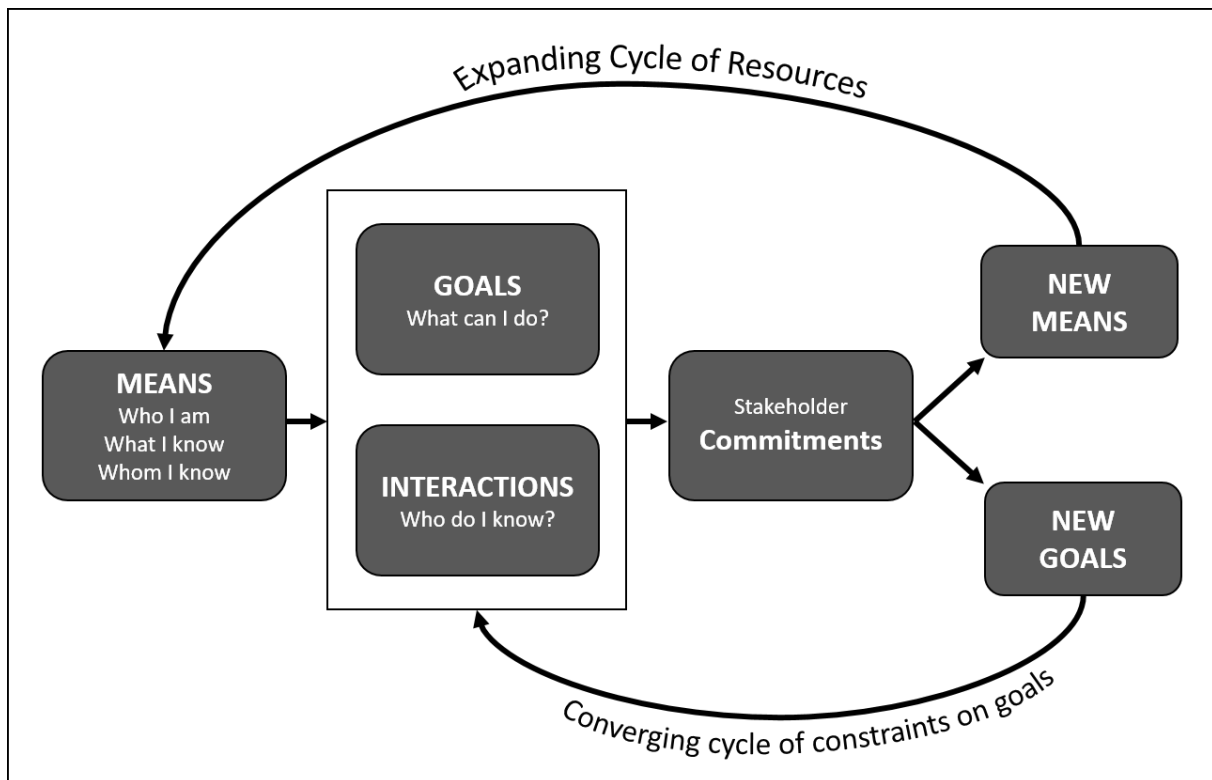


Figure 1 The Effectuation Process (Amended from Sarasvathy, 2009, p. 101)

State of the Art – Methods of Literature Review

In order to obtain an overview of the current literature on effectuation research, the procedure proposed by Wolfswinkel et al. (2013) was applied. The following framework conditions are to be defined, which have to be taken into account when selecting literature:

1. Definition of requirements for the consideration or exclusion of articles
2. Identification of relevant research areas
3. Identification of appropriate sources
4. Definition of concrete search terms

Based on condition 1, only journals with a rating of A+, A or B according to VHB-JOURQUAL3 (as of 2015) were selected. Journals that do not appear in the VHB-JOURQUAL3 ranking were also rated according to the Scimago Journal & Country Rank. Only journals that are in the first quantile in 2017 were selected.

Effectuation has to be integrated into entrepreneurship research (Sarasvathy and Dew, 2003) and was not further limited according to framework condition 2.

In order to achieve the highest possible hit rate in literature search, *Web-of-Science* was chosen as the meta-database (framework condition 3).

In order to obtain relevant literature, the search term *effectua*^{*1} was used on the basis of framework condition 4.

Based on these criteria, 150 scientific papers were identified. Some articles came from scientific journals in chemistry, biology, renewable energies, materials science and law. After an examination of the abstracts, these were not in the context of entrepreneurship and consequently were not considered any further.

¹ The symbol * serves as a placeholder, because besides *effectuation* also terms like *effectual* can appear.

Perspectives of Effectuation – A Structural Review

In her dissertation, Sarasvathy (1999) examined the strategy of serial entrepreneurs in the start-up context. With the help of think-aloud protocols, she captured the actions of entrepreneurs. The 27 chosen entrepreneurs had at least 15 years of experience at the time of the study and had set up several companies (including failed companies). They were established on the market with at least one company. These companies owned a market capitalization of between \$250 million and \$6.6 billion. (Sarasvathy, 2009)

In 2001, Sarasvathy first presented the results of her dissertation, in the form of effectuation, in the *Academy of Management Review*. Sarasvathy (2004) further delimited her developed theory to existing theories, since up to then start-up-related success was only equated with business success or entrepreneurs were described by means of collections of behaviour and character traits. Effectuation was further compared with other theories of entrepreneurship research, such as Bricolage, Causation, Opportunity Creation and Lean Startup (Fisher, 2012) (Selden and Fletcher, 2015) (Mauer and Wuebker, 2016) (Ries, 2011). Causation, in particular, was understood as dominant and a competing theory to effectual logic (Gustafsson, 2006). Reymen et al. (2015) have shown by means of a longitudinal study that effectuation and causation are not mutually exclusive, but that effectuation is mainly applied by entrepreneurs at the beginning of a business formation. Smolka et al. (2018) underlined this insight and highlighted the synergy effects of effectual and causal logic in setting up a company.

In the further course effectuation was examined under several other aspects. In the field of personality-related research, there are studies that discuss the relationship between the personality trait of over-trust and entrepreneurs acting effectual (Goel and Karri, 2006). Alsos et al. (2016) also highlight the relationship between an entrepreneurs social identity and his entrepreneurial behaviour (causation vs. effectuation). At company level, Randerson (2016) deals with effectuation as part of entrepreneurial orientation and provides information on the classification of theories.

With the establishment of effectuation in entrepreneurship research, the theory and its relevance as well as scientificness were discussed. Dew and Sarasvathy (2008) deal with the connection between the personality trait over-trust and effectuation. As a result Karri and Goel (2008) criticise the behavioural assumptions Dew and Sarasvathy insinuated to effectuation. Baron also sees methodical mistakes within effectuation theory. Consequently, the reason why serial entrepreneurs are more likely to act effectual than novices is problematic. Sarasvathy attributes this to the entrepreneur's experience, while Baron (2009) believes that the groups considered are unequal and that other characteristics are crucial to the difference in entrepreneurial expertise. Baron thus responded to the article by Dew et al. (2009).

Dew et al. (2009), however, again substantiate the relevance of effectuation, particularly with regard to the non-predictive approach, by means of quantitative analysis of the investment behaviour of angel investors. With the help of a meta-analysis, Smit, Song and Stuart (2009) were also able to connect three principles of effectuation with the success of start-ups.

In the context of social entrepreneurship, effectuation was identified as a catalyst for social and environmental improvements (VanSandt, Sud and Marmé, 2010) (Doyle Corner and Ho, 2010). Servantie & Rispal (2018) show by means of a longitudinal study that the approaches bricolage, effectuation and causation are differently pronounced in the field of social entrepreneurship during certain periods of the entrepreneurial process. In addition, Dwivedia & Weerawardena (2018) present a behavioural measure for social entrepreneurship orientation that describes effectuation as one of five influential dimensions.

Effectuation was also investigated within the framework of R&D projects. A positive correlation with weak significance between project success in highly innovative markets and the effectual approach was confirmed. This study was the first quantitative study on effectuation until then (Brettel et al., 2012).

However, Arend, Burkemper, and Sarooghi (2015, 2016) criticized the empirical evidence and lack of test criteria for effectuation, which led to a new discussion on the relevance of the theory. The authors refer to the 3E Framework (Enhance, Extend, Empower). Gupta, Chiles and McMullen (2016) contradict the criticism by making it clear that the 3E Framework for evaluating theories neglects the properties of process theories where effectuation has to be classified. Reuber, Fischer & Coviello (2016) give hints on how Effectuation can be advanced as theory and emphasize that theory formation happens evolutionarily.

Miller, Steier and Breton-Miller (2016) and Jones and Li (2017) discuss effectuation in the context of family-owned enterprises. In addition, Sharma and Salvato (2011) make clear that a combination of effectuation and causation makes sense in such enterprises in order to exploit the structures of the existing company and discover new opportunities for corporate development.

The extent to which effectual thinking can be promoted among students and pupils is the subject of entrepreneurship education research and is discussed in (Vorley and Williams, 2016), (Lahn and Erikson, 2016), (Lackéus, Lundqvist and Williams Middleton, 2016), (Maritz, 2017), (Günzel-Jensen and Robinson, 2017) and (Shirokova et al., 2017).

In the area of marketing, Deligianni, Voudouris and Lioukas (2015) recorded positive effects from the application of effectuation (excluding the affordable loss principle) on the relationship between product diversification and business success. Furthermore, Yang and Gabrielson (2017) found that entrepreneurs alternate between causal and effectual forms of marketing, depending on the degree of uncertainty. In 2017, Galkina and Lundgren-Henrikson investigated the role of effectuation and causation in cooperative interactions. They found that both logics are used differently at different stages of the cooperative process.

While Engel et al. (2017) investigate how the course of a career affects the preference for either effectual or causal decision logic, further studies show that the decision-making behaviour of entrepreneurs is also dependent on cultural circumstances. Laskovaia, Shirokova and Morris (2017) found that entrepreneurs in socially supportive cultures prefer an effectual approach, while entrepreneurs from performance based cultures tend to use causal logic. According to Frigotto and Valle (2018), the use of effectuation also depends on gender. Men therefore make more use of effectuation than women.

How to go on - Research Question

Sarasvathy (2009) proposes to look at effectuation from further perspectives. Among others, she recommends to examine effectuation from a mathematical point of view. In order to narrow down the research field and to take Sarasvathy's suggestion into account, additional keywords were added to the original search term in *Web-of-Science*. This corresponds to the procedure proposed by Wolfswinkel et al. (2013) in order to achieve a further delimitation of the study area. By supplementing the terms *simulat**, *algorithm** or *probabil**, 7 scientific articles were identified.

In the work of Kim & Welter (2018) and Chandra & Sunny Yang (2013), a new methodological perspective for the study of effectuation is proposed. While Yang and Chandra (2013) explain the reference framework for the use of an agent-based model approach, Kim & Welter (2018) also provide insights into concrete implementation. Eberz (2017) presents FSim, a simulation approach for effectuation and causation, which has been user-led and provides empirical findings for effectuation research.

On the other hand, the approach of Kim & Welter (2018) provides a framework for an agent acting autonomously according to simple rules (control-based and prediction-based) and gives some indication of the agents' performance in the entrepreneurial problem space (isotropy, goal ambiguity and uncertainty). The decision-making behaviour of the agent is modelled

deterministically and also neglects the learning behaviour of the entrepreneur agent. Kim & Welter propose for further research to investigate the strategy in the process.

This need for research can be met by evaluating mathematical models that map decision-making and learning behaviour. In the field of multi-agent systems, there are a number of methods that can map different behaviour forms (Luke and Panait, 2005). By operationalizing entrepreneurship theories such as effectuation and causation, the success of the applied models is made measurable (Chandler et al., 2011) (Jiang & Ruling, 2019).

In addition, the mathematical-decision-theoretical assumptions in effectuation require a precise examination and verification of correctness. In particular, the comparison between Bayesian inference and effectuation and the presentation of the affordable loss principle in the context of the plunge decision as semi-lattice indicate theoretical weaknesses of effectuation (Sarasvathy, 2009).

Based on the current state of effectuation research, especially with regard to simulation-based models, and finding a way to simulate learning behaviour in effectuation, the following research question arises for further work:

How can effectual decision-making and learning behaviour be modelled to enable an algorithmic interpretation?

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