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A Methodological Demonstration of Set-Theoretical Approach to Social Media Maturity Models Using Necessary Condition Analysis

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Abstract

Despite being widely accepted and applied across research domains, maturity models have been criticized for lacking academic rigor, especially methodologically rigorous and empirically grounded or tested maturity models are quite rare. A*ttempting to close this gap, we adopt a set-theoretic approach by applying the Necessary Condition Analysis (NCA) technique to derive maturity stages and stage boundaries conditions. The ontology is to view stages (boundaries) in maturity models as a collection of necessary condition. Using social media maturity data, we demonstrate the strength of our approach and evaluate some of arguments presented by previous conceptual focused social media maturity models.*

Keywords: Maturity Models, Social Media, Necessary Condition Analysis, Stage of Growth Models.

1 INTRODUCTION

Maturity models are nested in IS research and in particular, IT practitioner communities. Being normative and prescriptive by nature, lacking theoretical solidity, methodologically rigor and empirical validation maturity models is an ongoing battle field for debate and fierce critique in IS research (King and Kraemer 1984, Lasrado, Vatrapu et al. 2015) and related disciplines (Andersen and Henriksen 2006, Wendler 2012). Maturity models in IS are understood as tools that facilitate internal and/or external benchmarking while also showcasing future improvement and providing guidelines through the evolutionary process of organizational development and growth (Mettler, Rohner et al. 2010, Lasrado, Vatrapu et al. 2015).

Maturity can be defined as "*the state of being complete, perfect or ready*" (Mettler, Rohner et al. 2010). In IS literature, the most common maturity models are termed as stage-growth models and the concept has been employed to develop an understanding of evolution of information systems. While Nolan (1974)'s stage model is considered a landmark reference and the quality grid proposed by Crosby (1980) has influenced researchers in IS domain (Pöppelbuß, Niehaves et al. 2011), maturity models became mainstream with Capability maturity model (CMM) developed by Paulk, Curtis et al. (1993) for software processes in the 1990's.

Despite being widely accepted and applied across domains, maturity models have been criticized for lacking academic rigor (King and Kraemer 1984) as well as practical relevance (Wendler 2012). Another criticism has been the sheer number of the conceptual maturity models that do not use scientific empirical methods during the design process (Lasrado, Vatrapu et al. 2015). The reason for this acceptance and criticism lies in its very nature i.e. it gives a simplistic reductionist view of a complex problem, thus creating awareness on competences and offering a tangible way to assess an organization's practices (Jugdev and Thomas 2002).

However, literature on maturity models design and evaluation in IS till date, baring a few exceptions (King and Kraemer 1984, De Bruin 2005, Becker, Knackstedt et al. 2009, Solli-Sæther 2010, Lahrmann, Marx et al. 2011, Pöppelbuß and Röglinger 2011), have focused solely on criticising the inherent and known nature of maturity models than providing viable solutions to improve their rigor.

Therefore, the aim of this paper is to address some of the criticisms mentioned above in past research. Specifically, this paper addresses the research question of ***how can maturity stages and boundaries conditions be derived by using scientific empirical techniques?*** In order to answer the research question, this paper proposes a set-theoretic approach for designing maturity models based on the method of Necessary Condition Analysis (Dul 2015c). We argue that maturity stages can be conceptualised in terms of necessary conditions (i.e. absence of these causes the entity under maturation to fail) and demonstrate this in the context of social media maturity models.

The rest of the paper is organized as follows. First, we examine the existing literature on maturity models in general, social media maturity in particular and identify key research gaps. Second, we present the method of Necessary Condition Analysis (NCA) drawn from set theoretical approach to social sciences (Ragin 2008, Wagemann and Schneider 2010, Dul 2015c) an approach that can be applied while defining maturity levels or stages. Third, we present the dataset, discuss the data analysis process and rationale and the application of NCA in the domain of social media maturity models. Fourth, we present our research findings and their significance. Fifth we discuss the steps in detail and demonstrate them by identifying stage boundary conditions for social media maturity in customer facing and innovation activities. Sixth and last is the conclusion and future research agenda.

2 PRIOR RESEARCH

2.1 Maturity Models in IS: Characteristics of a Maturity Model

A number of academic disciplines use the term "maturity" in a comparative sense, while developing maturity models as classification schemes (Andersen and Henriksen 2006). The purpose of maturity models has been diverse with many using it as a measure used by organizations to evaluate their capability in a particular domain or problem area (CMMI 2010); with the model providing the construct or structure representing maturity (De Bruin, Freeze et al. 2005) and others to outline the path of entity towards maturation, including defining the stages and relationship between them in the form of stage models (Becker, Knackstedt et al. 2009). This diverse nature of use, positions maturity models in between methods and models (Mettler 2009, Pöppelbuß, Niehaves et al. 2011), with an assessment instrument enabling benchmarking between participants and providing a roadmap for future progress.

A maturity model usually consists of a sequence of maturity stages (Raber, Winter et al. 2012), mostly four or five (Karkkainen, Jussila et al. 2011). Each stage expects the entity (people, process, technology, organisation etc.) under maturation to fulfil certain requirements that constitute that particular stage (Poeppelbuss, Niehaves et al. 2011). Usually, this is determined by defining critical success factors and boundary conditions. The critical success factors as prescribed by the maturity model also mean better outcomes and thus higher business benefits (value) as the organization progresses on the path to increased maturity. In general, maturity assessment is understood as a "*measure to evaluate the capabilities of an organization"*(Raber, Winter et al. 2012), with an underlying assumption of a single linear path to maturity as shown in Figure 1.

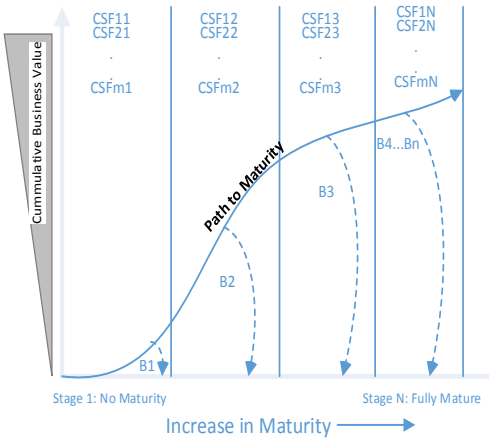


Figure 1: Critical success factors (CSF) and boundary conditions in maturity models.

Critical Success Factors (CSF_{mn}, m factors and n stages]

"Dimensions", "Factors", "Benchmark Variables" and "Capabilities" are some of the other terms used for critical success factors (Lasrado, Vatrapu et al. 2015). CSF's describe multidimensional factors that decide the entities maturity stage. Each CSF is also further classified into a number of sub-factors with specific characteristics at each stage (Raber, Winter et al. 2012).

Boundary Conditions or Triggers [B1… Bn]

Boundary conditions, also termed Triggers, are very specific conditions (usually a subset of CSF's) that the entity has to satisfy in order to progress from one stage to another. Without satisfying the boundary condition, an entity cannot progress further irrespective of satisfying all other conditions. For example, in the case of intranet maturity models (Damsgaard and Scheepers 1999), active support of a technology champion or a sponsor from the top management team is a boundary condition to progress from stage 1 to stage 2.

Figure 1 briefly summarizes the important characteristics of a maturity model. For the purposes of this paper, we focus our attention on the boundary conditions and conceptualise them as necessary conditions from a set-theoretical approach. In order to do that we have selected the emerging theme of social media maturity as discussed in the next section.

2.2 Social media maturity models

Social media is a collection of applications that include blogs, social networking sites and multimedia sharing sites or as defined by Kaplan and Haenlein (2010) "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content". According to Werder, Helms et al. (2014) most of the organisations have adopted and applied social media applications for branding, marketing, sales,

customer service and support, and other business activities with an objective of increasing brand loyalty, revenue, customer satisfaction and decreasing operational costs. This positive trend has resulted in a number of maturity models being proposed especially by consultancies: Deloitte (Kane, Palmer et al. 2014), Forrester (Li and Bernoff 2011) and many more proposing improvements and providing guidelines towards success media success. However, all the models are mostly conceptual and lack documentation of strong empirical evidence and the design process, with the sole exception of the social business maturity assessment by Deloitte (Kane, Palmer et al. 2014).

Academic IS literature on the other hand too had only four social media maturity models which were rigorously analysed and only one being empirical validated (Table 1). These four models had wide diversity in terms of business processes and employed different conceptualizations of maturity. The focus of Duane and OReilly (2012) was SME's in Ireland using social media for PR & Sales. Lehmkuhl, Baumol et al. (2013) and Karkkainen, Jussila et al. (2011) looked at social media maturity for innovation related processes in organisations. While these three models looked at social media maturity from a strategic perspective, Geyer and Krumay (2015) proposed social media management maturity from an operational perspective. Further, the conceptualisation of maturity was different with Duane and OReilly (2012) taking inspiration from Nolan (1974)'s stages of growth approach, while Lehmkuhl, Baumol et al. (2013), Karkkainen, Jussila et al. (2011) and Geyer and Krumay (2015) adopt a practical matrix approach inspired by Crosby (1980). There was significant overlap of critical success factors between the four maturity models as listed in Table 1: IT security, employee access, strategy, governance, empowered employee and many others.

Table 1: Conceptual Social Media Maturity Models: Empirical Validation, Scope, Intended Users, Characteristics, and CSF

Authors	V	Scope, Intended Users, Characteristics, Critical success factors
Karkkainen, Jussila et al. (2011)	N	• Social media for innovation activities. 5 Stages, 5 CSF's, No boundary conditions. • Level of integration in innovation processes, social media practices are structured, information security and incentives are institutionalised, and skills are recognised & resources employed.
Duane and OReilly (2012)	Y	• Social media business profile primarily for PR, Sales and marketing activities. SME's in Ireland. 5 Stages, 10 CSF's, 24 boundary conditions (dominant problems). • Strategy, empowered employees, dedicated leadership, active new social channels, selected access to staff, dedicated resources, internal social media skills and measuring ROI has a linear positive impact on maturity and business value.
Lehmkuhl, Baumol et al. (2013)	N	• Social media adoption for innovation activities. 5 Stages, 5 CSF's (17 sub-conditions), 12 boundary conditions out of 17 sub-conditions. • Strategy, governance, social data analysis, top management support, employee access, employee usage, and workflows.
Geyer and Krumay (2015)	N	• Social media operations across an organisation. No Stages yet, 3 pre-conditions, 6 CSF's. • Operational social media management process, human resource management, social listening & monitoring, social media & data integration, social media strategy, and policy & operational guidelines.

Note. V- Validated, *Y – Yes, *N- None/No

It is however worth noting that even though all four models acknowledged recent papers on model development (Becker, Knackstedt et al. 2009, Mettler 2009, Solli-Sæther 2010), only one maturity model (Duane and OReilly 2012) provided a theoretical justification for the stage boundaries. However, no empirical evidence was included to justify the theoretical conceptualisation of the boundary conditions in both the original and subsequent papers (Duane and O'Reilly 2015). Situated in this academic context, we propose the adoption of a novel method called Necessary Condition Analysis (NCA) that can be used by maturity model designers to both conceptualise as well as empirically evaluate the critical success factors (CSF's) and boundary conditions.

3 METHODOLOGY - NECESSARY CONDITION ANALYSIS (NCA)

In this section, necessary condition analysis is discussed as a method to empirically evaluate the boundary conditions in a stage-growth maturity model. As described in Figure 1 earlier, an entity under maturation has to satisfy boundary conditions in order to progress to the next stage in the maturity model. Logically, these conditions can be categorised as ‘‘necessary but not sufficient’’ (Ragin 2008). That is, the absence of the necessary conditions guarantees failure in terms of progression to the next stage of the maturity model. Traditional variance based (e.g., correlation or multiple regression) approaches are not appropriate for testing or inductively deriving such conditions (Ragin 2008, Wagemann and Schneider 2010, Dul 2015c). While the fuzzy set theory based qualitative comparative method pioneered by Ragin (2008) is a more established alternative, it mostly focuses on sufficient but not necessary configurations (Dul 2015a). Therefore, given the requirements of this study, we explore a recent method called Necessary Condition Analysis (NCA).

NCA is a methodology for identifying necessary conditions in data sets (Dul 2015c) be it categorical or continuous in nature. Necessary conditions are:

> “factors that produce desirable outcomes, factors that enable outcomes (i.e., that are necessary for the outcome to occur). A necessary condition is a condition that must be present to enable a certain outcome; without the condition, the outcome will be absent” (Wagemann and Schneider 2010, Dul 2015c).

For example, in a dichotomous situation (figure 2a), “the independent variable (the necessary condition) and the dependent variable (the outcome) are either absent or present” (Dul 2015a). Identifying a necessary condition (i.e., X is necessary for Y) requires no data points in the upper-left corner of the X-Y plot: X (condition) is absent (0) and Y (outcome) is present (1). The combinations X=0, Y=0 and X=1, Y=1 illustrate the presence of a necessary condition; X=1, Y=0 is irrelevant as X is not sufficient for Y (Wagemann and Schneider 2010, Dul 2015c). The same criteria of no data points in the upper-left corner is extended to figure 2b and 2c in case of categorical and continuous data sets respectively.

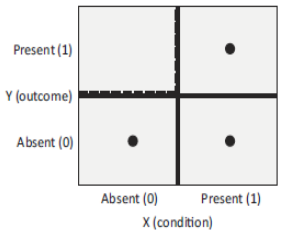


Figure 2a: A dichotomous necessary condition (Dul 2015c)

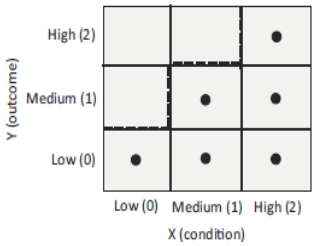


Figure 2b: A necessary condition with 3 levels (Dul 2015c)

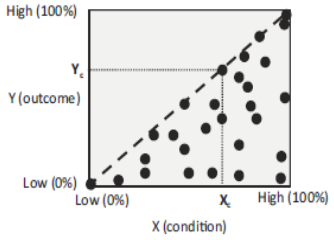
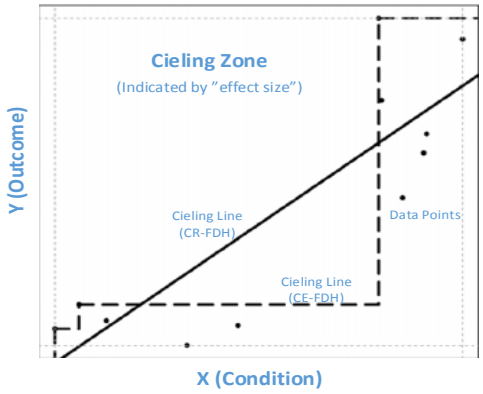


Figure 2c: Continuous necessary condition(Dul 2015c)

In reality however, the distribution of the X-Y plot is not so symmetrically distributed from the centre. The measure of necessary conditions is calculated by drawing a ceiling line wherein the upper-left part of a scatterplot is separated from the lower-right by a line between the area with and without data points. To draw ceiling lines, various techniques are prescribed and in the R package prescribed (Dul 2015b) for NCA, ceiling envelopment is created on the basis of Data Envelopment Analysis (DEA) techniques from the operations management domain (Dul 2015c). Dul (2015c) suggests a piecewise linear ceilings with free disposal hull technique (CE-FDH) or a ceiling regression with free disposal hull (CR-FDH) as “they generally produce stable results with relatively large ceiling zones”. The strength of the necessary condition is evaluated in terms of the effect size, i.e., “the constraint that the ceiling poses on the outcome” (Dul 2015c) and its characteristics have been listed in Figure 3.



- Larger the ceiling zone, lower the ceiling line, larger is the ceiling effect, and therefore larger the effect size of the necessary condition.
- The effect size (d) = C/S, where C is the size of the ceiling zone, and S is the scope. The scope (S) is calculated based on either theoretical or observed minimum and maximum values of X and Y: S = (Xmax – Xmin) / (Ymax – Ymin).
- Effect size (d) can be interpreted similar to R^2 in regression analysis i.e. the necessary condition effect size ranges from 0 to 1.
- Necessary condition is valued as important or not depending on the effect size, context as well as theoretical arguments and practical common sense.

Figure 3: X-Y Plot, Ceiling Zone, Effect Size and Necessary Condition Analysis (Dul 2015c).

Dul (2015c) further suggests a general benchmark for the size of an effect: $0.0 < d < 0.1$ as a ''small effect,'' $0.1 < d < 0.3$ as a ''medium effect,'' $0.3 < d < 0.5$ as a ''large effect,'' and $d > 0.5$ as a ''very large effect''. Furthermore it is suggested to use effect size 0.1 as the threshold as "any necessary condition hypothesis in the continuous case (X is necessary for Y) is rejected if the effect size d is less than 0.1" (Dul 2015c). We adopt the above suggestions in our data analysis as discussed in the next.

4 DATASET COLLECTION, SELECTION AND ANALYSIS

4.1 Data Collection

The NCA method was applied to a subset of the dataset focusing on social media developed by Networked Business Initiative (NBI)[1]. NBI measured digital maturity of organizations in Denmark in terms of five digital technologies and measured 231 organizations. The targeted audiences are managers (top and middle management) in Danish organizations looking towards comparing their digital performance against their peers. Due the limited data availability till date, we limit the scope to customer facing activities (i.e. Sales & marketing and PR) and innovation activities, thus using sample of 86 organizations (Appendix 1 & 2). The data was collected through a cross-sectional survey linked to a live dashboard whose primary purpose was comparative benchmarking of participating organizations in Denmark. Given the page constraints, we do not go into the depth of the dataset, but list out key facts and briefly list the CSF's (Table 2) relevant for this paper.

Outcome(s): Business value delivered in PR as well as Sales and Marketing is calibrated as an outcome in analysis 1 (N=86). Business value is measured using a 5-point Likert scale (0 to 4) for each of the business processes separately. In the case of measuring maturity for customer facing (promote & sell) activities, a simple average is used. For example, if Organization A has realised some business value (2) in PR and no business value (0) in Sales and Marketing, then the outcome is calibrated as Y = (2+0)/2 = 1.

Boundary Conditions: There are 17 CSF's identified for achieving maturity in customer facing (promote & sell) activities. However, for social media maturity in innovation related activities, in addition to the 17 CSF's, both the extent of use of social media in promotion and selling as well as business value realization are two additional necessary conditions. This hypothesis is also supported by existing social media maturity models literature: Duane and OReilly (2012) and Kane, Palmer et al. (2014). Given the page limit of this paper, we do not go into the specific details of every CSF but list the most important examples.

[1] Networked Business Initiative (NBI): Benchmarking maturity of Danish organizations (www.networkedbusiness.org)

Table 2: Critical success factors and outcomes of NBI social media maturity survey.

Condition or CSF (X)		**Abbreviation; Scale; # of items**
Management	Top Management encourages the use of social media throughout the organization, while having digitalisation as priority in the past and future.	TMT; (0-4); 3
	IT investment within the organization as compared to previous years, understanding the intention of management towards digitalization.	INV; Ordinal scale (0=decreased,1=Same, 2=increased) ; 1
	Digital strategy Index[2]	DS; (0 to 4); 1
IT Policy	Allowing access to Own devices (OD) measured on access to number of systems, and/or providing employees with devices (PEWD) measured on number of employees, while having a high IT security index 1(ITS) is considered as an organization with high social media maturity.	ITS; (scaled to 4); 1
		OD; (0-4) ; 1
		PEWD; (0-4) ; 1
Technology	Social media presence, measured as the number of social media channels.	ESC; Count (0 -8) ; 1
	Extent of Use of social media, measured as an average of PR and Sales & Marketing	U; (0-4) ; 2
	Number of resources (FTE) hired specifically for social media activities, measured as none, part time, full time and more than one. Sometimes, a sole manager manages social media. Hence NBI also measured professional skills (S) available inside the organization that can manage social media.	FTE; Ordinal (0,1,2,3) ; 1
		S; (0-4) i.e. Not at all to Very high degree; 1
	Metrics (M) is a measure of formalized social media activities. It is measured through the presence of either KPI's, workflows or both.	M; Ordinal (0,0.5,1) ; 2
Culture	The measures for Culture were based on an organization orientation towards employee empowered style of working and an explorative culture wherein new IT systems are always sought after (EEC), a well-planned and structured style (PSC),. These were based on a factor analysis of seven items measured on 5 point scale i.e. Completely disagree (-2) to Completely agree (2).	EEC; (-2 to 2) ; 5
		PSC; (-2 to 2) ; 2
Y	Business Value from social media in customer facing activities measured as an average of PR and Sales & Marketing	BV; (0-4) ; 2
	Business Value from social media in innovation activities	BV-Innov; (0-4) ; 1

In addition to the above 4 more conditions were measured by NBI as part of the survey of which 3 (# of IT systems, # of internal online communication channels, IT training) all of which is measured as their number count and one i.e. IT Skills within the organisation is measured similar to Digital strategy Index. Now that all the conditions (CSF's) and the outcome (business value) have been explained, we go ahead and apply the method of NCA on our dataset and present our findings in the next section.

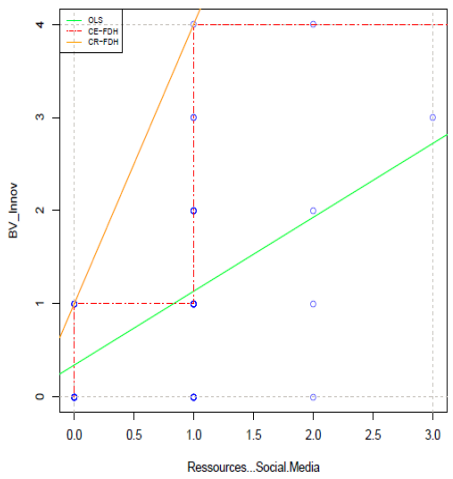
5 RESULTS

To determine if a given CSF was in fact a necessary condition, we employ the bivariate approach and plot the calibrated value to each CSF against the calibrated value assigned to the outcome (business

[2] The criterion for this index is the presence or absence of an overall digital strategy (measured as Yes/No), the extent to which this policy has been aligned with the company strategy, communicated and implemented across the company (measured using a 5-point Likert scale from 0 to 4). For example, if Organization A has no digital strategy (X1=0) then the index is calibrated as 0. Organization B however has digital strategy (X1=1), has been aligned fully (X2=4), has been communicated largely (X3=4) and implemented to a small degree (X4=2). The digital strategy index for organization B is (X1+X2+X3+X4)*4/13 = 3.384, wherein 4 is calibration range and 13 is actual scale range. IT security index is also calculated in the same manner.

value) on an X-Y scatter plot. This is done using the R software package for NCA (Dul 2015b), specially to draw the ceiling lines and calculate effect sizes. As discussed earlier an effect size of 0.1 is considered as threshold and any necessary condition hypothesis below that is rejected. Furthermore, as discussed earlier (section 3.1.2) depending on the CSF measure (i.e. dichotomous or continuous) and the interpretability of the results, the type of ceiling line (i.e. CE-FDH, CR-FDH or any other) is selected. This concept is further explained using figure 5. Using CE-FDH it is logical to interpret that hiring a part time resource to work on social media is found to be a necessary condition for delivering greater than 20% of the business value in innovation related activities. However, while using CR-FDH, it becomes very difficult to interpret the results as shown and explained in figure 5. Therefore, in our analysis (see appendix 1 & 2 for details), we have used CE-FDH when the condition is discrete (e.g. number of systems, channels, resources, etc.).

From the results in appendix 1, it could be concluded that only three CSF's (# of external social media channels, extent of use, and an employee empowered culture) are termed as necessary conditions for delivering business value using social media in customer facing activities. In addition, we also found one condition of sufficiency as illustrated in figure 6. When one inverts a necessary condition, a sufficient condition is obtained (Poon, Young et al. 2011). By definition, a sufficient condition "ensures the existence of the outcome (i.e., if X=1 then Y=1). But the outcome can also exist without the sufficient condition (i.e., if X=0, Y can still be 1)" unlike a necessary condition (Ragin 2008). In our case, as shown in figure 6, we can interpret that if an organization has hired a dedicated resource (i.e. even part time) to handle social media operations, then the organization has already realised some level of business value (benefits) from its use of social media for promotion and selling activities.



Y (BV-Innov) (%)	FTE's (%)	FTE's	(FTE's) (%)	FTE's
0	NN	NN	NN	NN
10	NN	NN	NN	NN
20	NN	NN	NN	NN
30	33.3	**Part Time**	2.2	
40	33.3	**Part Time**	6.7	
50	33.3	**Part Time**	11.1	Unsure
60	33.3	**Part Time**	15.6	Zone
70	33.3	**Part Time**	20.0	
80	33.3	**Part Time**	24.4	
90	33.3	**Part Time**	28.9	
100	33.3	**Part Time**	33.3	**Part Time**
Effect Size	**0.250**		**0.125**	
	Medium Effect		Medium Effect	
Ceiling Line	**CE-FDH**		**CR-FDH**	

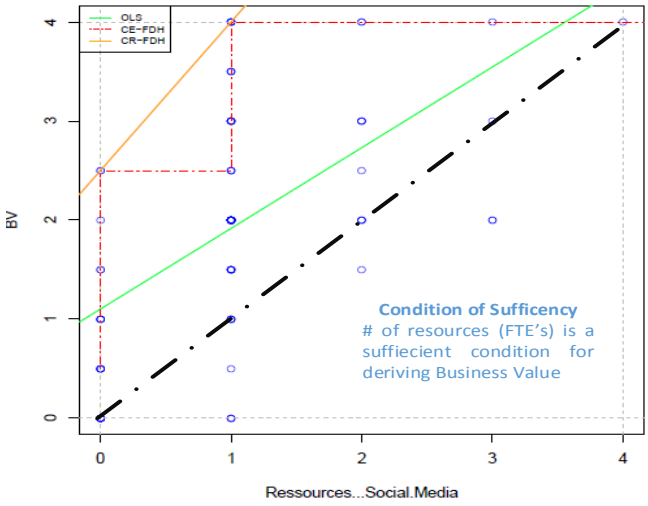
Unsure Zone: In some situations, it is difficult to interpret results using the ordinary linear regression ceiling line (CR-FDH). For instance, consider a situation in which to realise 30% Business value at least 2.2% of maximum (3-5 resources) is necessary. In such situations CE-FDH makes more sense as one part time resource (33.33% of maximum) is necessary to achieve 30% or more business value from using social media for innovation related activities.

Figure 5: Rationale for type of ceiling lines based on the variables (continuous vs. discrete).

On the contrary, our results for social media maturity for innovation related activities (appendix 2) has nine out of the seventeen CSF's termed as necessary conditions for delivering business value. In fact, two of these CSF's (top management support and # of external social media channels) are considered to have a large effect on the outcome which supports the conceptual arguments presented by both Karkkainen, Jussila et al. (2011) and Lehmkuhl, Baumol et al. (2013) in their respective social media maturity models for innovation processes. Furthermore, we found that extent of use and the business value realised in customer facing activities are also necessary conditions for realising business value in innovation related activities. These results provide empirical evidence to the conceptual arguments by Duane and OReilly (2012) and Li and Bernoff (2011) in their respective social media maturity models at the organizational level in general.

In this section, we found that there are 3 and 11 necessary conditions for realising business value by using social media in promotion & selling activities and innovation related activities respectively. In

the next section, we discuss these findings and present an approach to derive "stage boundaries" of a maturity model using the bottleneck table from NCA (see Appendices 2 & 3 for details).



Not Necessary: Using the CE-FDH ceiling approach, an effect size of 0.094 is calculated showing that number of dedicated resources hired to be a non-necessary condition for deriving business value.

Not Fully Sufficient: The bottom right of the X-Y scatter plot is almost empty indicating that # of resources hired is a sufficient condition for achieving business value. It is not a fully sufficient condition as there are 3 exceptional cases wherein presence of a part time resource has failed to produce the outcome (i.e. at least some business value)

Y (Business Value)				
	Very High (Y > 80%)	0	8	4
	High (50% ≤ Y ≤ 80%)	3	9	5
	Low (20% < Y < 50%)	11	29	6
	No Value (Y≤ 20%)	8	**3**	0
	N= 86	None	Part time	One/ More
		X (# of resources or FTE's)		

Figure 6: Condition of Sufficiency - Presence of part time resource indicates that at least some business value w.r.t promoting & selling activities.

6 DISCUSSION

6.1 Towards an empirical approach to stage boundary conditions for maturity models

We have demonstrated that boundary conditions in a maturity model can be conceptualised and empirically evaluated as "necessary conditions" and that all conditions need to be satisfied to progress further to the next stage. Moreover, these boundary conditions are in many cases a subset the of critical success factors (CSF's). We have applied Necessary Condition Analysis (NCA) to single antecedents (bivariate approach) separately. However, there are multiple antecedents to maturity and therefore we interpret these necessary conditions using the bottleneck table.[3] We propose the following steps for deriving the stage boundary conditions and demonstrate their application:

Step 1: Define the basic characteristics of the maturity model (i.e. focus, audience, CSF's, assessment tool and the unit of analysis). In our case (NBI dataset), the characteristics are: focus is social media maturity, the audience is organisations in Denmark, 17 CSF's, self-assessment via online survey and the unit of analysis is business process.

Step 2: Clearly and explicitly state the underlying assumptions to maturity. Moreover, if one is using a proxy for measuring maturity is should be stated. In our case, we listed our assumptions clearly in section 4.1 and use business value (Y) as a proxy for maturity.

Step 3: Communicate all the CSF's and outcomes (section 4.2). In our case, we had 17 CSF's and 2 outcomes[4].

Step 4: Run NCA and identify all the necessary conditions (section 4.3). Use effect size (d) of 0.1 as minimum threshold. In our case, we identified 3 and 11 necessary conditions.

Step 5: Present all necessary conditions results (i.e. descriptive statistics, ceiling lines, effect size, and significance of the effect) and the bottleneck table[5] as shown in appendix 1 & 2.

[3] NCA's "bottleneck table is a representation of the ceiling multiple antecedents (multivariate approach). In the multivariate approach, all conditions need to be put in place to prevent failure" (Dul 2015).
[4] Given that our unit of analysis was at a "business process" level, we analysed the 2 outcomes separately.

Step 6: Define the maturity stage boundaries using bottleneck table as reference. Find meaningful theoretical or practical reasoning to support the stage boundaries. In our case we derive 4 maturity stages [i.e. Very High ($Y > 80\%$), High ($50\% \leq Y \leq 80\%$), Low ($20\% < Y < 50\%$), No Value ($Y \leq 20\%$)]. We use the calibration logic used by Fiss (2011), Ragin (2008) and others in configurational techniques wherein the minimum threshold is marked at 50% and the outcomes above that are divided as high and very high respectively. In addition, we further split the lower half into two stages as we find a significant difference among the necessary conditions at $Y \leq 20\%$ and $Y > 20\%$.

Step 7: Populate the boundary conditions (necessary conditions) to their respective stages as illustrated in table 3 and table 4. For example, while presence of one social media channel (X=12.5%) in considered necessary to realise anywhere between none to high business value (i.e. $10\% \leq Y \leq 80\%$) in customer facing activities, the organisation has to increase its presence to two channels (X=25.5%) in order to realise very high ($Y > 80\%$) business value.

Table 3: Stage Boundary Conditions in Customer Facing (Promote & sell) Activities

CSF (Boundary Conditions)		Social Media Maturity (PR, Sales & Marketing Activities)			
		No	**Low**	**High**	**Very high**
Extent of use	Promotion & Selling Activities		Small degree of use.	Some to high degree of use.	Very high degree of use is necessary
Social Media Presence	Facebook, twitter, YouTube, etc.	Presence on one of the social media channels is necessary.			Presence on two channels is necessary.
Culture	Employee Empowered			Necessary for high business value.	

Step 8: Finally, explicitly list the managerial implications of not satisfying these necessary conditions. For example, as shown in table 3, for an organisation to realise high business value (maturity stage 3) through use of social media in innovation related activities, 8 stage boundary conditions (table 4) have to be met. Failure to satisfy even one of those necessary conditions would keep the organisation at stage 2 (low maturity). For example, an organisation at stage 3 is expected to provide its relevant employees with a device (i.e. laptop, mobile), while allowing employees to access some of company IT systems through personal devices and at the same time having an IT security policy in place.

Table 4: Stage boundary conditions in Innovation (R&D) related activities

CSF (Boundary Conditions)		Social media maturity w.r.t Innovation activity →			
		No	**Low**	**High**	**Very high**
Top Management support		Social media use to be initiated with regards to innovation related activities in an organisation.			
Number of resources (FTE's)			An organisation is required to hire a part-time resource so as to realise low to very high business value. Hiring one or more FTE is considered a non-necessary to realise higher level of business value.		
Extent of use	Innovation related activities			Small degree of use in necessary.	High degree of use is necessary.
	Promotion & Selling activities		Small degree of use is necessary.	Some degree of use is necessary.	Very high degree of use is necessary
Social Media Presence	Facebook, twitter, etc.	One channel is necessary.	Three channels are necessary.	At least three channels are necessary.	Five channels are necessary.
Culture	Employee Empowered			A necessary condition to realise high business value.	
IT Governance	IT security policy			A necessary condition to realise high business value.	
	Access to own systems(BYOD)		Access given to very few systems	Personal access given - some of the systems	Personal access given to most of the IT systems.
	Providing employees with devices			At least some people receive a device (mobile, laptop, etc.)	Most people receive a device from the company.
# of IT systems			Use of 1 IT system	Use of 2 IT systems is a necessary condition	
Business Value realised in Promotion and Selling activity			Realisation of low business value in PR, Sales & Marketing activities is a necessary condition		High Business value is a necessary condition.

6.2 Other Implications

Social media platforms create new forms of online public spheres (Robertson and Vatrapu 2010) and have greatly impacted the media and entertainment industry; especially traditional media organisations such as newspapers, television and radio (Lugmayr, Risse et al. 2009). Lugmayr (2013) calls for media organisations to be regarded as holistic digital firms from an information systems (IS) perspective. Social media maturity models have an important role to play in that regard. Ideally, a social media maturity model should cover the diverse business functions of an organization such as operations, HR, sales and marketing, product development and innovation, IT, finance etc., and not be limited to customer facing activities. Further, it is important that social media maturity models encompass not only business-to-customer (B2C) companies but also public broadcasters, non-profit organisations, business-to-business (B2B), and business-to-government(B2G) organisations.

7 CONCLUSION AND FUTURE WORK

This paper applied NCA (Dul 2015c), to a social media maturity dataset. In the process of demonstrating the NCA method in the context of maturity models, the paper provides empirical evidence for some of conceptual arguments made in previous social media maturity models research. For example, we successfully validated the claim that only when business value is realized by using social media in customer facing activities (i.e. PR, marketing) can there be business value realisation in internal operations (i.e. innovation related activities) and that without top management support one cannot realise any business value in innovation related activities. The primary contribution of this paper is to conceptualize stage boundaries as necessary conditions and provide a systematic approach to empirically design and/or validate the stage boundary conditions. Furthermore, we believe that NCA in particular and set-theoretical approaches in general can successfully address most of the strong criticisms levelled at maturity models research in terms of academic rigor.

One major limitation of the NCA method employed is that it only identifies the level of CSF's that are required to progress to the next stage in the maturity model (i.e. necessary but not sufficient). However, our analytical approach in this paper ignores the CSF's (sufficient but not necessary) that also contribute to progress as absence of these CSF's are not a hindrance to progress to the next stage of maturity. We plan to address this limitation in our future work where a well-established analytical approach, fuzzy set QCA (Ragin 2008, Fiss 2011), would be applied in tandem with NCA. This would also allow us to conceptualize multiple paths to maturity, equifinality. Moreover, in future studies we would combine our findings for social media maturity in customer facing and innovation related activities, collect data for other business activities (i.e. HR, service & support, leadership) and propose a holistic social media maturity model with the entire organisation as the unit of analysis.

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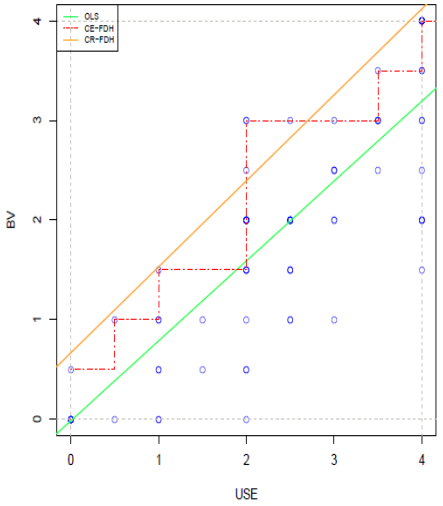
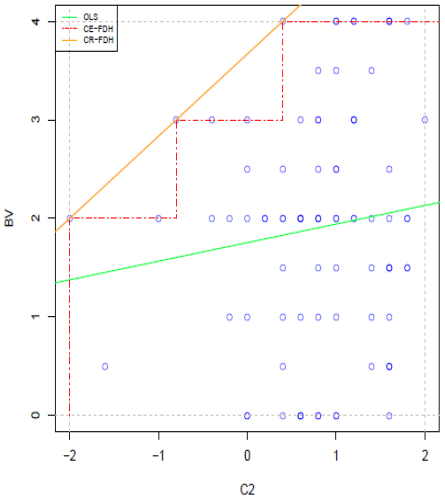
Appendix-1: NCA and Bottleneck table for customer facing activities i.e. Promote and Sell (PR & Communications, Sales & Marketing).

Descriptive Statistics	
Sample Size	86
Unit of Analysis	Organisations in Denmark
Business Process (Activity)	PR & Communication Sales & Marketing
Company Size:	
1-2	15 (17%)
3-14	29 (34%)
15-49	13 (25%)
50-249	23 (27%)
Above 250	6 (7%)
Market Orientation:	
B2C	13 (15%)
B2B	43 (50%)
B2B & B2C equally	28 (33%)
Other	2 (2%)
Founded Year:	
Before 2000	46 (53%)
2001-2010	24 (28%)
2011 onwards	16 (19%)

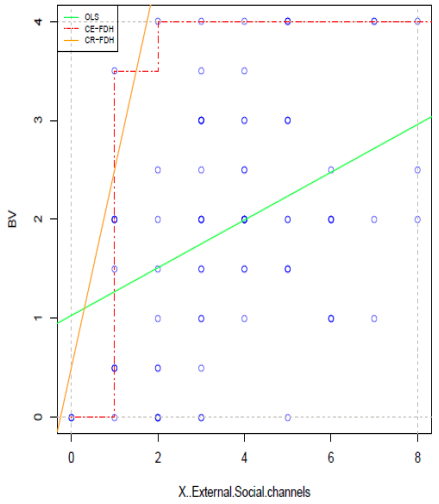
Extent of Use Vs. Business Value



Employee empowered Culture Vs. Business Value



# of SM channels Presence Vs. Business Value



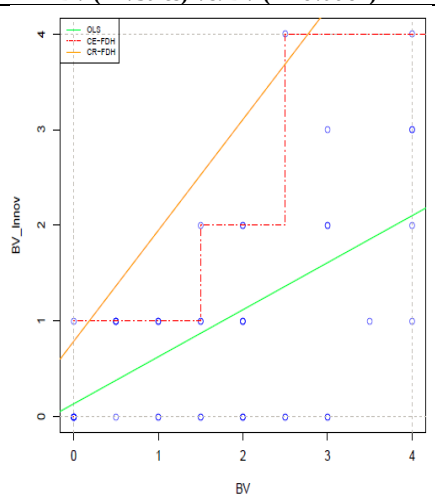
Y Business Value (%)	Top Management support (%)	# Of dedicated resources (%)	Skills of the resources (%)	Extent of Use (%)	# of IT systems (%)	# of SM channels – Presence (%)	Planning Culture (%)	Employee empowered Culture (%)
0	NN	NN	NN	NN	NN	NN	NN	NN
10	NN	NN	NN	NN	NN	12.5	NN	NN
20	NN	NN	NN	3.8	NN	12.5	NN	NN
30	NN	NN	NN	15.4	NN	12.5	NN	NN
40	NN	NN	NN	27.0	NN	12.5	NN	NN
50	NN	NN	NN	38.6	NN	12.5	0	0
60	NN	NN	NN	50.2	NN	12.5	5.7	12.0
70	NN	25.0	5.0	61.8	NN	12.5	11.4	24.0
80	11.1	25.0	11.7	73.4	NN	12.5	17.1	36.0
90	33.3	25.0	18.3	85.0	14.3	25.0	22.9	48.0
100	55.6	25.0	25.0	96.6	14.3	25.0	28.6	60.0
Effect Size	0.069	0.094	0.047	0.402**	0.018	0.141*	0.071	0.150*
	Small Effect	Small Effect	Small Effect	Large effect	Small Effect	Medium effect	Small Effect	Medium effect
Ceiling Line	CR-FDH	CE-FDH	CR-FDH	CR-FDH	CE-FDH	CE-FDH	CR-FDH	CR-FDH

The dashed line is a piecewise linear ceilings with free disposal hull technique (CE-FDH). The ceiling line technique i.e. CR-FDH (ceiling regression with free disposal hull) allows some data points above the ceiling line. The solid line is ordinary least squares regression line. Ceiling lines for 8 of the 17 necessary conditions of which only three have significant effect. The rest 9 conditions failed the condition of necessity.

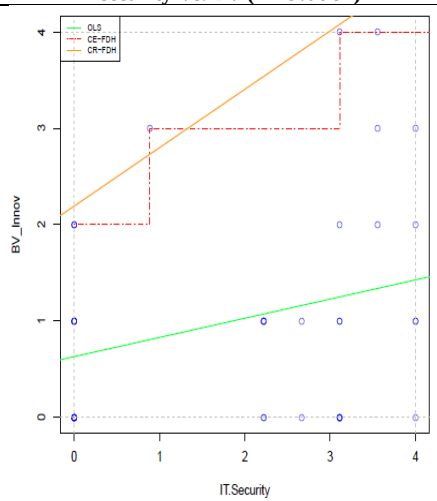
Appendix-2: NCA and Bottleneck table for internal operations i.e. Co-create and Innovate (Innovation related activities).

Descriptive Statistics	
Sub-set size (sample)	45 (86)
Business Process (Activity)	Innovation (R&D)
Company Size:	
1-2	10 (22%)
3-14	16 (36%)
15-49	5 (11%)
50-249	12 (27%)
Above 250	2 (4%)
Market Orientation:	
B2C	23 (51%)
B2B	7 (16%)
B2B & B2C equally	13 (29%)
Other	2 (4%)
Founded Year:	
Before 2000	22 (49%)
2001-2010	12 (27%)
2011 onwards	11 (24%)

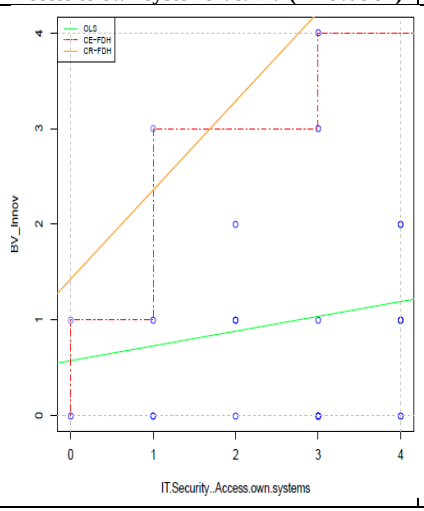
BV (PR/Sales) Vs. BV (Innovation)



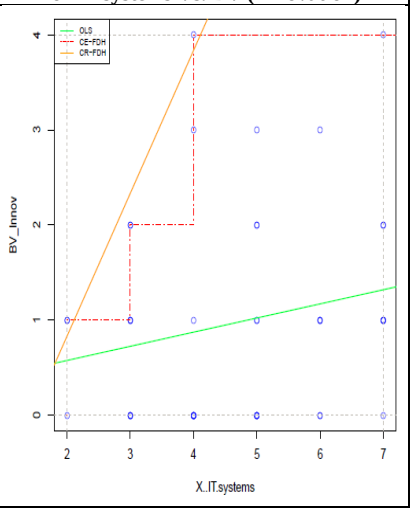
IT security Vs. BV (Innovation)



Access to own systems Vs. BV (Innovation)



# of IT systems Vs. BV (Innovation)



Y Business Value (%)	Top Management support (%)	# Of dedicated resources (%)	Skills of the resources (%)	Extent of Use in PR & SM (%)	# of IT systems (%)	# of SM channels Presence (%)	Planning Culture (%)	Employee empowered Culture (%)	# internal social media (%)	IT-Security (%)	Access to own devices (%)	IT investment increase (%)	Providing employees devices (%)	Extent of Use in Innovation (%)	Business Value in PR & SM (%)
0	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
10	5.6	NN	NN	NN	NN	12.5	NN	NN	NN	NN	NN	NN	NN	NN	NN
20	12.2	NN	NN	NN	NN	12.5	NN	NN	NN	NN	NN	NN	NN	NN	0.2
30	18.7	33.3	1.7	3.4	20.0	37.5	NN	NN	NN	NN	NN	NN	NN	NN	8.9
40	25.3	33.3	5.0	15.0	20.0	37.5	NN	NN	NN	NN	4.6	NN	NN	NN	17.5
50	31.9	33.3	8.3	26.6	20.0	37.5	0	NN	NN	NN	15.4	NN	4.2	2.8	26.1
60	38.5	33.3	11.7	38.1	40.0	37.5	5.7	12.0	NN	8.6	26.2	NN	25.8	18.3	34.8
70	45.0	33.3	15.0	49.7	40.0	37.5	11.4	24.0	NN	25.1	36.9	NN	47.5	33.9	43.4
80	51.6	33.3	18.3	61.3	40.0	62.5	17.1	36.0	14.3	41.6	47.7	50.0	69.2	49.4	52.0
90	58.2	33.3	21.7	72.8	40.0	62.5	22.9	48.0	14.3	58.1	58.5	50.0	90.8	65.0	60.7
100	64.7	33.3	25.0	84.4	40.0	62.5	28.6	60.0	14.3	74.6	69.2	50.0	94.2	80.6	69.3
Effect Size	0.319**	0.250*	0.094	0.308**	0.250*	0.375**	0.071	0.150*	0.036	0.169*	0.223*	0.063	0.288*	0.209*	0.278*
	Large effect	Medium effect	Small Effect	Large effect	Medium effect	Large effect	Small Effect	Medium effect	Small Effect	Medium effect	Medium effect	Small Effect	Medium effect	Medium effect	Medium effect
Ceiling Line	CR-FDH	CE-FDH	CR-FDH	CR-FDH	CE-FDH	CE-FDH	CR-FDH	CR-FDH	CE-FDH	CR-FDH	CR-FDH	CE-FDH	CR-FDH	CR-FDH	CR-FDH

Ceiling lines for 13 of the 17 necessary conditions of which 9 have a significant effect. In addition to this, use of social media for promotion and selling leading to business benefits are two additional necessary conditions.