

# Social Set Analysis of Corporate Social Media Crises on Facebook

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**Abstract**—Social media crises pose significant challenges for organizations in terms of their rapid propagation and deterioration of brand parameters and can have sustained negative business impacts. This paper reports a multiple case study of four different corporate social media crises. The multiple case study was informed by crisis communication and management theories and employed multiple methods consisting of the novel approach to big social data analytics-social set analysis, nenography, and manual sentiment analysis and topic discovery. Empirical findings show the voluminous but also transient nature of social media crises, reveal the different strategies employed by the organizations to manage the crises and their outcomes, and a diversity of aggregate user behavioural patterns. Based on the findings, we recommend that companies should choose a response strategy that is suitable for the type of crisis they are experiencing as well as the industry sector they belong to. In summary, this paper is the first demonstration of the suitability and effectiveness of Social Set Analysis for conceptualizing, formalizing and analyzing big social data from content-driven social media platforms like Facebook for event studies such as unexpected crises and/or coordinated marketing campaigns.

**Keywords**—Big social data, Social set analysis, Social business, Social media crisis, crisis communication.

## I. INTRODUCTION

Corporate crises are by nature unpredictable but post hoc, crises appear not unexpected. Corporate crisis can trigger negative reactions from stakeholders and thereby affect the overall performance of the company. Therefore, it is important for the companies to respond to the crises in order to limit the damage [1], [2]. This paper addresses the topic of corporate crises on social media channels. Social media crises pose significant challenges for organizations in terms of their rapid propagation and deterioration of brand parameters that can have sustained negative business impacts. This paper addresses the following research questions.

### A. Research Questions

- 1) What were the characteristics of big social data before, during, and after the corporate crisis?
- 2) What strategies and tactics does a companies employ, if at all they do, in order to manage the social media crisis?
- 3) How can a company in general best manage a social media crisis?

### B. Selected Corporate Social Media Crises

In order to address the above research questions, we selected four recent social media crises. The objective was to uncover temporal dynamics and interactional patterns of big

social data and to investigate the strategies and tactics adopted by the companies that have experienced social media crisis in order to manage them. We purposefully limited the selection of social media crises to Denmark and the social media platform to Facebook to hold invariant the technological, linguistic and socio-cultural aspects of interacting with social media [3], [4] invariant : Copenhagen Zoo, Telenor, Jensen's Bøfhus (translation: Jensens Steak House), and Imerco. Next, we briefly describe each corporate social media crisis.

**Copenhagen Zoo** experienced a social media crisis, which started on February 8th 2014, due to an impending euthanizing of a young giraffe they had chosen to call Marius and lasted until February 13th 2014. Also, major international media has also participated in the case of Marius. British BBC and The Guardian newspaper has also referred to the killing, CNN followed the case on both network and TV, and The New York Times has also written about Marius' death [5].

**Telenor** experienced a social media crisis on Facebook, which started on August 3rd 2014 and lasted until August 8, 2014, due to a farewell salute from an unsatisfied customer who wrote in the evening on August 2nd 2014 at Telenor's Facebook page that he had ended his mobile subscription with the telecom company. In his post, the dissatisfied customer described that Telenor could not manage to collect money by Direct Debit and that the company had repeatedly sent reminders before he had received the normal expense. This post brought Telenor into a social media crisis on Facebook <sup>1</sup> and more than 30,000 "liked it" <sup>2</sup>.

**Jensen's Bøfhus** experienced a social media crisis on Facebook, which started on September 19, 2014 and lasted until September 27, 2014, due to a dispute between Jensen's Bøfhus, and a fish restaurant named *Jensens Fiskerestaurant* (ed. Jensen's Seafood Restaurant). The case involved a conviction in the Supreme Court that caused great debate in Denmark, since Jensen's Bøfhus were successful at that the name, Jensen Fiskerestaurant, is too similar to the steakhouse chain restaurant. This meant that the owner of Jensen's Fiskerestaurant, Jacob Jensen, had to change the name of his restaurant. According to Jensen's Bøfhus they were trying to protect their trademark in the catering industry as Jensens Fiskerestaurant were planning to expand with new restaurants in other cities <sup>3</sup>. According to the judgment, the small restaurateur, Jacob Jensen, had to pay 200,000 Danish kroner to Jensen's Bøfhus, 150,000 Danish kroner to the costs that Jensen's Bøfhus have

<sup>1</sup>Telenor on tv2.dk

<sup>2</sup>Telenor on politiken.dk

<sup>3</sup>Jensen's Bøfhus on tv2.dk

had his own lawyer, and the practical arrangements for the defeat <sup>4</sup>.

**Imerco** experienced a social media crisis, which started on August 25th, 2014 and lasted until August 26th 2014, due to a fast sold out anniversary vase from the brand Khler. 16,000 customers wanted to buy a special anniversary vase from the company Khler on offer at Imerco's website. However, this tumbled the website, after which angry customers vented their displeasure on Imerco's Facebook page <sup>5</sup>.

The remainder of the paper is organized as follows. Section II presents and discusses the relevant concepts and theories on social business, crisis communication and management, and social set analysis. Section III presents theory of social data along with formal model for social set analysis (sec. III-A). Section IV provides a formal description of methodology adopted for empirical analysis. Section V presents the key findings from the multiple case studies, where as section VI discusses the findings, implications for research and practice of big social data analytics and outlines future work.

## II. THEORETICAL FRAMEWORK

### A. Social Media and Social Business

Social media can be defined as *fundamentally scalable communications technologies that turn internet based communications into an interactive dialogue platform* [6]. Social business refers to the "utilization of online social channels to conduct business" [7]. Within social business there are three critical aspects, namely; Social Media Engagement, Social Media Analytics, and Social Media Management. Social media engagement addresses the strategic use of social media channels to interact with stakeholders - both external and internal. Social media analytics covers the collection, storage, analysis, and reporting of the social data gained from the engagement and social media conversations about the organization. Social media management concerns managerial challenges and operational issues of the organizations, both internally and externally, and comparative advantages the organization may have. The first two critical aspects - social media engagement and social media analytics - were employed in relation to the first research question stated earlier as The third critical aspect - social media management - was employed in relation to the second research question when looking at the managerial challenges of the organizations - in this case the challenges of managing a crisis.

### B. Crisis and Social Media Crisis

There is no universally accepted definition of a crisis and many definitions exist in the literature. We use the definition of a crisis as *"the perception of an unpredictable event that threatens important expectancies of stakeholders and can seriously impact an organizations performance and generate negative outcomes"* [6]. Social media crises is focusing more on reputational concerns and are defined as *"events that can harm an organization and arise in or are amplified by social media"* [2].

A crisis needs not to be seen as something entirely negative as crises can be viewed as an opportunity for the organization to learn and achieve improvement. A crisis is a *dangerous opportunity* with the potential to leave the organization stronger than before the crisis. The opportunity of a positive outcome caused by a crisis is depending on the crisis being managed effectively [8].

1) *Types of Crises*: In literature numerous descriptions of different crisis types can be found. According to the Situational Crisis Communication Theory (SCCT), crises can be organized into three types of crisis, namely; victim, accidental, and preventable [9]. It is impossible for organizations to prepare a crisis management plan for every unpredictable event that can cause a crisis. However, they can prepare for these major types of crises due to the similarities of many of the crises within these major types [9].

2) *Types of Social Media Crises*: A way of differentiating social media crises is by the origin of the crisis. Social media crises can be divided into three types of crises, namely organizational misuse of social media, dissatisfied customer, and challenges [2]. The organizational misuse of social media crisis is when the organization violates the norms of behavior in a specific social media channel - e.g. misuse of a hashtag. These types of crises can escalate when the mistake is considered intentional. Dissatisfied customer social media crises are actually a customer relations problem rather than a crisis and can be seen as an early warning of a product harm situation if customers are reporting the same problems. However, since a social media crisis is defined as "events that can harm an organization", since a dissatisfied customer can express the dissatisfaction via social media. The third type of social media crises - challenges - are when stakeholders perceive that an organization's behaviors and/or policies are inappropriate or irresponsible. In this type of crisis the organization risk the stakeholders' negative perception of the organization can harm the reputation of the organization. Since the reputation is valuable, managers seeks to build and protect it.

3) *Crisis Management*: The overall purpose of crisis management is *"to prevent or lessen the negative outcomes of a crisis"* [2]. In order to have effective crisis management it is important to see it as an ongoing process that must be integrated into the normal operations of an organization. Additionally, a crisis is said to have a life cycle in which different actions is required - the three-stage model of crisis management, which is an established approach of handling a crisis. The model is divided into three interdependent macro stages; pre-crisis, crisis event, and post-crisis, in which there are different sub-stages at a micro level [2].

4) *Crisis Communication*: Crisis communication can be defined as *"the communication between the organization and its publics prior to, during, and after the negative outcome occurrence"* [10]. Thus, crisis communication can be described as communication that companies use before, during, and after a crisis, and can be of great strategic importance to a company. Crisis communication takes part in all stages of crisis management and is therefore an important tool in reaching the goals that crisis management aims for. When it comes to crisis communication, in relation to the three-stage model, it is recommended to respond quickly, consistently, and with openness. A quick response is active because it fills the gap

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<sup>4</sup>Jensen's Bøfhus on politiken.dk

<sup>5</sup>Imerco on politiken.dk

of information that the crisis has created with real facts. A consistent response makes people to perceive the response as it is more reliable without any contradictions. In relation to openness, it implies that members of the organization are available and willing to disclose information to the media and other publics. It is argued that these three response types are necessary for reducing a crisis in the organization [11].

5) *Response Strategy*: After identifying the type of crisis, the organization should ideally select a response strategy. SCCT divides response strategies into four categories; deny, diminish, rebuild, and reinforce [9]. These four options of response include other types of response as explained below, which we have gathered and presented in the table below:

Deny	Attack accuser	Denial	Scapegoat
Diminish	Excuse	Justification	-
Rebuild	Compensation	Apology	-
Reinforce	Bolstering	Ingratiation	Victimize

Table I. CRISIS RESPONSE STRATEGIES ACCORDING TO SCCT

In terms of overall "deny" strategy, organizations can adopt one of the three strategies: confront the one who claims that a crisis exists - **attack accuser**, or state that the crisis does not exist - **denial**, or state that someone else is responsible for the crisis - **scapegoat**. According to SCCT, **denial** is recommended as a respond to rumors and unwanted challenges.

When it comes to "diminish" as a response option, it includes two strategies: organizations excuse in providing an explanation for the crisis that limits the responsibility of the organization - **excuse** or they explain why the crisis occurred - **justification**. Similarly **Rebuild** includes two strategies for an organization. The organization can support the crisis victims financially - **compensation** - or they can express regret for the crisis - **apology**. According to SCCT, organizations should use rebuilding as their response strategy in any preventable crisis. In terms of the response strategy **reinforce** it includes three options. The first one occurs when organizations past good deeds - **bolstering**. The second option is used when organizations praise stakeholders - **ingratiation**. The third option occurs when organizations state they are a victim of the crisis - **victimize**. However, reinforce response is supplemental and must therefore be used with at least one of the other response options. The next section presents brief description of the methodology.

### C. Big Data and Social Set Analysis

Table II below shows the philosophical comparison between the traditional approach of **Social Network Analysis** (SNA) and our proposed new approach of **Social Set Analysis** (SSA) [12]–[15]. Our main criticism on the limitations of the relational sociology assumptions of SNA is that it is primarily focussed on exploring structural relationships of social actors, where as large-scale social media platforms are increasingly social content driven. Such large-scale and content driven social media platforms are of extreme importance to organizations in terms of marketing communications, corporate social responsibility, democratic deliberation, public dissemination etc. Social media analytics in practice [4], [7], [16], [17] has been based on an implicit, inherent and latent understanding of social associations as expressed by metrics

	Social Network Analysis	Social Set Analysis
Basic Premise	There exists a <b>relation</b> between social actor A and social actor B	There exists an <b>association</b> by actor A with some entity E which can be an actor or an artifact
Social Action	Molecular Relations	Atomic Actions
Unit of Analysis	Dyadic	Monadic, Dyadic & Polyadic
Social Configuration	Networks	Sets
Social Explanation	Structural	Agentic
Mathematics	Graph Theory	Set Theory

Table II. TWO PHILOSOPHIES OF COMPUTATIONAL SOCIAL SCIENCES

and key performance indicators such as brand sentiment, brand associations, conversation keywords, reach etc.

The theoretical aim of this paper is to make a positive contribution in terms of an associational sociological approach to big social data analytics in order to address the twin problems of (a) largely absent academic research, and (b) mostly latent industry practice on social media analytics from a sociology of associations in general and social set analysis in particular. As such, the primary scientific objective of our work is to theoretically formulate, mathematical model and empirically investigate an alternate holistic approach based on associational sociology [18], set and fuzzy set theory [19], and social set analysis [12]. To achieve these objectives, the theory of social data is developed and discussed next.

Social Set Analysis (SSA) as employed in this paper is concerned with the mobility of social actors across time. To be specific, we conduct SSA of big social data from the Facebook walls of the four companies with an analytics focus on the set of actors that interacted with the company before, during and after the social media crises and set theoretical intersections of the three time periods. This will allow us to uncover not only the interactional dynamics over time but also identify user/actor sets that correspond to marketing segmentations such as brand loyalists, brand advocates and brand critics.

## III. THEORY OF SOCIAL DATA

Our theory of social data is drawn from the theory of socio-technical interactions by Vatrappu [3] and for a more detailed explication of the theoretical framework in terms of its ontological and epistemological assumptions, please refer to [3], [12]–[14]. Social data consists of two types: *Social Graph* and *Social Text*. Social Graph maps on to the first aspect of socio-technical interactions that involve perception and appropriation of affordances (which users/actors act up on which technological features to interact with what other social actors in the systems). Social Text maps on to the second aspect of socio-technical interactions that constitute the structures and functions and technological intersubjectivity (what the users/actors are trying to communicate to each other and how they are trying to influence each other through language). In our model, we use actor and user interchangeably and with respect to action/activity, an action (post, comment, like etc.) is atomic event done by an actor on an artifact, where

an activity (e.g. promotion, campaign etc.) can spread across many actions, artifacts and actors.

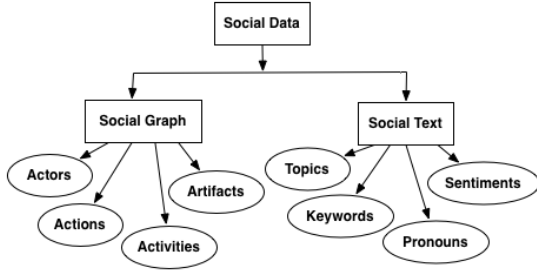


Figure 1. Social Data Model

### A. Formal Model

In this section, we will recall concise formal semantics for social data model from [12]–[14]. First, we define type of artifacts and actions in a socio-technical system (Def. 3.1).

*Definition 3.1:* We define  $\mathbb{R}$  as a set of all artifact types as  $\mathbb{R} = \{ \text{status, comment, link, photo, video} \}$  and  $\mathbb{A}_{CT}$  as a set of actions that can be performed as  $\mathbb{A}_{CT} = \{ \text{post, comment, share, like, tagging} \}$ .

The social data model contains Social Graph and Social Text, which is formally defined in Def. 3.2 as follows,

*Definition 3.2:* Formally, Social Data is defined as a tuple  $S = (G, T)$  where

- (i)  $G$  is the social graph representing the structural aspects of social data as defined further in Def. 3.3
- (ii)  $T$  is the social text representing the content of social data and is further defined in Def. 3.5

The following definition describes the social graph formally,

*Definition 3.3:* The Social Graph is defined as a tuple  $G = (U, R, Ac, r_{\text{type}}, \triangleright, \rightarrow_{\text{post}}, \rightarrow_{\text{share}}, \rightarrow_{\text{like}}, \rightarrow_{\text{tag}}, \rightarrow_{\text{act}})$  where

- (i)  $U, R, Ac$  are finite sets of actors, artifacts and activities respectively,
- (ii)  $r_{\text{type}} : R \rightarrow \mathbb{R}$  is artifact type function and  $\triangleright : R \rightarrow R$  is parent artifact function,
- (iii)  $\rightarrow_{\text{post}} : U \rightarrow \mathcal{P}_{\text{disj}}(R)$  is a partial function mapping actors to mutually disjoint subsets of artifacts,
- (iv)  $\rightarrow_{\text{share}}, \rightarrow_{\text{like}} \subseteq U \times R$  are relations mapping actors to artifacts indicating the
- (v)  $\rightarrow_{\text{tag}} \subseteq U \times R \times (\mathcal{P}(U \cup Ke))$  is tag relation mapping artifacts to power sets of actors and keywords
- (vi)  $\rightarrow_{\text{act}} \subseteq R \times Ac$  is a relation mapping artifacts to activities.

Each artifact is posted or created by a single actor, which is defined as a partial function ( $\rightarrow_{\text{post}}$ ) mapping actors to mutually disjoint sub sets of artifacts. On contrary,  $\rightarrow_{\text{share}}$  and  $\rightarrow_{\text{like}}$  allows many-to-many relationship, indicating that

an artifact can be shared/liked by many actors and each actor can share/like many artifacts. The  $\rightarrow_{\text{tag}}$  relation is a bit different mapping actors, artifacts and power set of actors and keywords to allows an actor to tag other actors or keywords in an artifact. The definition of the Social Text is as follows,

*Definition 3.4:* In Social Data  $S = (G, T)$ , we define Social Text as  $T = (To, Ke, Pr, Se, \rightarrow_{\text{topic}}, \rightarrow_{\text{key}}, \rightarrow_{\text{pro}}, \rightarrow_{\text{sen}})$  where

- (i)  $To, Ke, Pr, Se$  are finite sets of topics, keywords, pronouns and sentiments respectively,
- (ii)  $\rightarrow_{\text{topic}}, \rightarrow_{\text{key}}, \rightarrow_{\text{pro}}, \rightarrow_{\text{sen}} \subseteq R \times To$  are relations defining mapping between artifacts to topics, keywords, pronouns and sentiments respectively.

*Definition 3.5:* In Social Data, let  $\mathbf{T} : (u, r, ac) \mapsto \mathbb{N}$  be time function that keeps tracks of timestamp ( $t \in \mathbb{N}$ ) of an action ( $ac \in \mathbb{A}_{CT}$ ) performed by an actor ( $u \in U$ ) on an artifact ( $r \in R$ ).

## IV. METHODOLOGY

In this section, we will outline the methodology adopted to conduct big social data analytics on the Facebook walls of the companies. In the analysis, we also distinguish between admin-actor (denoted by  $u_a$ ), who manages the Facebook wall of an enterprise from non-admin actors (denoted by  $u \in U \setminus u_a$ ), who are the social media users. To simply the matters, we have excluded *share* action from our analysis as we did not noticed any share actions in the datasets. Moreover, the terms *user* and *actor* are used interchangeably throughout the paper without any difference in semantics.

### A. Artifact Analysis (Crisis Detection)

Social media crises are characterized by marked increase in interaction levels on the social media channels. Further, based on traditional crisis communication and management theories and frameworks discussed earlier, we conducted temporal analysis of interactions in terms of two kinds of actions (like and comment) with respect to two kinds of artifacts (posts and comments) made by two different kinds of actors (admins/companies and non-admins) over temporal dimension of daily, weekly and yearly as further explained below.

artifact (post) by	actions	by actor
admin actor	comment or like	admin actor
non-admin actor		non-admin actor

Table III. ACTIONS OF ADMIN/NON-ADMIN ACTORS ON POST ARTIFACT

1) *Post artifact Analysis:* As shown in Table III, kind of actions that can be performed on a post artifact are comment and like. As one of the possible interactions in Table III, comment and like actions made by non-admin actors over the post artifact created by the admin-actor can be defined as,

- 1) Comments by non-admin actors on admin-actor posts:  $R_c^{u|u_a} = \{ r_c \mid (u_a, r_p) \wedge (u, r_c) \in \rightarrow_{\text{post}} \}$
- 2) Likes by non-admin actors on admin-actor posts:  $L^{u|u_a} = \{ (u, r_p) \mid (u_a, r_p) \in \rightarrow_{\text{post}} \wedge (u, r_p) \in \rightarrow_{\text{like}} \}$ .

The set  $(R_c^{u|u_a})$  contains comment artifacts ( $r_c$ ) made by non-admin actors ( $u$ ) on the post artifact ( $r_p$ ) created by admin-actor ( $u_a$ ). Similarly, the set  $L^{u|u_a}$  contains pairs of non-admin actors ( $u$ ) with their liked post artifacts ( $r_p$ ), that were created by the admin-actor ( $u_a$ ). Finally, total number of actions made by the non-admin actors on admin-actor posts can be calculated by taking sum of set cardinalities ( $|R_c^{u|u_a}| + |L^{u|u_a}|$ ). Using this method, we have calculated weekly distribution of actions made by non-admin actors over the admin posts for the case study companies. As an example, such a distribution for Copenhagen Zoo crisis is plotted as shown in Figure 2(a). The other interactions from Table III can be defined similarly.

2) *Comment Artifact Analysis: Like* is the only type of interaction that can be performed on a comment artifact. Therefore, we have conducted temporal analysis of like action (by admin vs non-admin actors) on comments made (by admin vs non-admin actors) over the posts (made by admin vs non-admin actors) on a temporal dimension of daily, weekly and yearly as are shown in Table IV.

artifact (post) by	artifact (comment) by	action
admin actor	admin	like by admin/non-admin actor
	non-admin	
non-admin actor	admin	
	non-admin	

Table IV. LIKES ON COMMENTS BY ADMIN/NON-ADMIN ACTORS OVER POSTS BY ADMIN/NON-ADMIN ACTORS

As one of the possible interactions from Table IV, we define likes by non-admin actors on comments made by non-admin actors over posts by admin-actor as follows.

Let  $u_1, u_2 \in U \setminus u_a$  be the non-admin actors,  $r_p, r_c \in R$  be the post and comment artifacts such that the comment is made on post ( $r_p \triangleright r_c$ ), then

$$L^{u|u|u_a} = \{(u_2, r_c) \in \rightarrow_{like} \mid (u_a, r_p), (u_1, r_c) \in \rightarrow_{post}\}.$$

The set  $L^{u|u|u_a}$  indicates likes by non-admin actors ( $u$ ) on the comments ( $r_c$ ) made by non-admin actors ( $u$ ) over the posts ( $r_p$ ) made by admin actor ( $u_a$ ).

Similarly, the likes by non-admin actors on the comments made by the admin-actor over the admin posts can be defined as,  $L^{u|u_a|u_a} = \{(u_1, r_c) \in \rightarrow_{like} \mid (u_a, r_p), (u_a, r_c) \in \rightarrow_{post}\}.$

Using the above methodology, comparison of likes on comments made by admin actor verses non-admin actors over the admin posts for the Jensen Bøfhus company is computed and plotted as shown in Figure 2(c).

### B. Actor Analysis (Social Set Analysis)

As part of social set analysis, sets containing unique actors who performed interactions *during* ( $U_d$ ), *before* ( $U_b$ ) and *after* ( $U_a$ ) the crisis period are computed. Let  $ts_d$ ,  $ts_b$  and  $ts_a$  be time spans for *during*, *before* and *after* the crisis respectively containing respective sets of time stamps for those periods. In the social set analysis conducted on the four companies presented in this paper, we observed that the crisis period spans around two weeks on the social media platforms, therefore timespan  $ts_d$  contains time stamps belonging two weeks of the crisis period, where as  $ts_b$ ,  $ts_a$  contains timestamps belonging to two weeks before the start of the crisis and two weeks after the end of the crisis respectively.

1) *Actors analysis for crisis period:* The *during* ( $U_d$ ) actors set contains the actors who have either posted or commented

or liked an artifact during the crisis period ( $ts_d$ ), as defined below. Let  $ac \in \{post, comment\}$ , then

$$U_d = \{u \mid \exists r \in R. (u, r) \in \rightarrow_{post} \wedge \mathbf{T}(u, r, ac) \in ts_d\} \cup \{u \mid \exists r \in R. (u, r) \in \rightarrow_{like} \wedge \mathbf{T}(u, r, like) \in ts_d\}$$

where  $\mathbf{T}(u, r, ac)$  and  $\mathbf{T}(u, r, like)$  are timestamps of the respective actions. As indicated above the set  $U_d$  contains all the unique actors that have performed either a *post*, or a *comment* or a *like* on an artifact during the crisis period. Similarly, the unique actor sets  $U_b$  and  $U_a$  can be computed where the time stamp of the actions belongs to time spans: before ( $ts_b$ ) and after ( $ts_a$ ) the crisis period respectively. Finally intersections between actor sets ( $U_d, U_b, U_a$ ) have been computed to represent actor Venn diagrams as shown in Fig. 4. As an example, the set of unique actors who have performed actions only during crisis (neither before nor after) can be computed using the principle of Venn diagram as:  $U_d \cup (U_d \cap U_b \cap U_a) \setminus ((U_d \cap U_b) \cup (U_d \cap U_a))$ .

### C. Actor Analysis for likes on admin posts

The *like* action on a post is an indication of definitive support over the opinion expressed by the post. The sets of unique actors who performed like actions on the posts made by admin actor ( $u_a$ ) during the crisis period ( $U_d^l$ ) is computed as follows.

$$U_d^l = \{u \mid \exists r \in R. (u_a, r) \in \rightarrow_{post} \wedge (u, r) \in \rightarrow_{like} \text{ and } \mathbf{T}(u, r, like), \mathbf{T}(u_a, r, post) \in ts_d\}$$

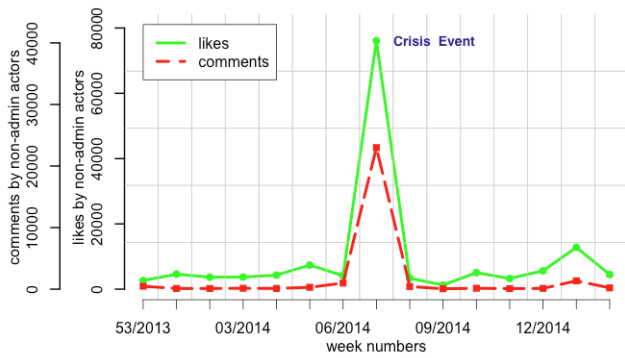
As defined above the set  $U_d^l$  contains the unique actors who have performed like action on the posts made by the admin actor on the Facebook wall of the enterprise. In the similar lines, the set of unique actors who liked the admin posts before ( $U_b^l$ ) and after ( $U_a^l$ ) the crisis period can be computed by considering the timestamps belonging to  $ts_b$  and  $ts_a$  time periods respectively. The Venn diagrams representing the sets of unique actors who liked admin posts are computed for four companies and shown in Fig. 5.

### D. Actor Analysis for comments on admin posts

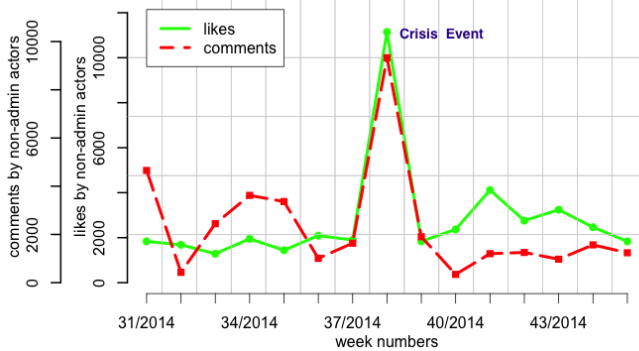
Unlike the *like*, the *comment* action is not a definitive action in support of the opinion expressed by a post. Therefore, we have computed the sets of unique actors who commented on the posts made by admin actor ( $u_a$ ) during the crisis period ( $U_d^c$ ) as follows.

$$U_d^c = \{u \mid \exists r_p, r_c \in R. r_p \triangleright r_c \wedge (u_a, r_p), (u, r_c) \in \rightarrow_{post} \wedge \mathbf{T}(u_a, r_p, post), \mathbf{T}(u, r_c, comment) \in ts_d\}$$

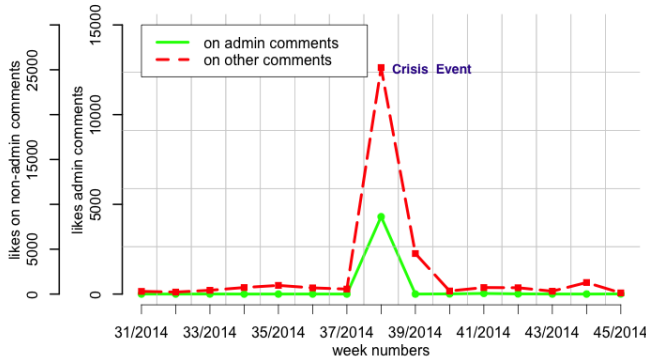
As shown above, the set  $U_d^c$  contains all the unique actors who have commented on the posts made by the admin actor ( $u_a$ ) during the crisis period. The other two sets:  $U_b^c$ ,  $U_a^c$  containing the unique actors who have commented on the posts made by admin actor ( $u_a$ ) before and after the crisis can be computed in the similar lines. The Venn diagrams containing the intersections of the actors who have commented on admin posts before, during and after the crisis period can be computed as shown in Fig. 6.



(a) Zoo - comments, likes by non-admin actors on admin posts



(b) Jensen Bøfhus - comments, likes by non-admin actors on admin posts



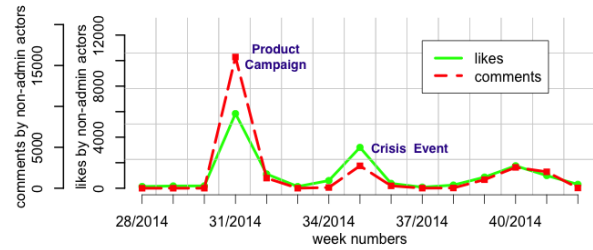
(c) Jensen Bøfhus - comparison of likes on comments made by admin vs non-admin actors

Figure 2. Artifact Analysis of Copenhagen Zoo and Jensen Bøfhus Crises [20]

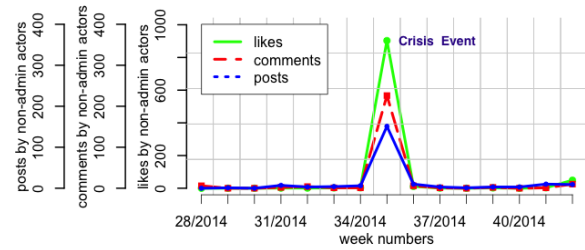
### E. Netnographic analysis of Facebook walls

Netnographic analysis [21] was conducted on the Facebook pages of the four case companies. The aim of netnographic analysis is to explore what the companies are posting, what users are saying, how the companies are responding. The purpose is to deduce the characteristics of social media before, during, and after the crisis and thereby answering the first research question. In addition, a semi-structured interview was conducted with one of the case companies. Even though the interview was conducted in Danish, it is translated into English with out the influence of interviewee bias.

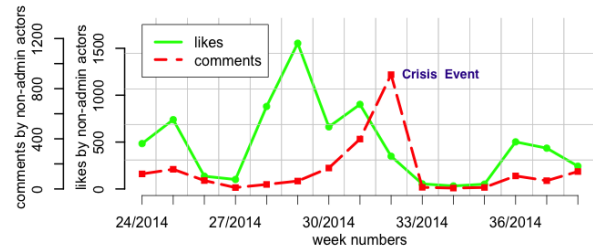
Facebook data from all four companies are collected and analyzed using a new purpose-built software application Social Data Analytics Tool, SODATO [4], [16]. SODATO allows to examine public interactions on the Facebook walls by



(a) Imerco - comments, likes by non-admin actors on admin posts



(b) Imerco - posts, comments, likes by non-admin actors on non-admin posts



(c) Telenor - comments, likes made by non-admin actors on admin posts

Figure 3. Artifact Analysis of Imerco and telenor Crises [20]

extracting several core pieces of information. Furthermore, allows to analyse the sentiment of the comments that people have made on the companies posts - positive, negative, and neutral sentiment. Social media analytics can be undertaken in two main ways - "Social Graph Analytics" and "Social Text Analytics" [4], [7]. Social graph analytics is concerned with the structure of the relationships emerging from social media use whereas social text analytics is more concerned with the substantive nature of the interactions and focuses on the topics discussed and how they are discussed. The aim of our social graph analysis of the four case companies was to define patterns of engagement on the Facebook pages of the companies before, during, and after the crisis in terms of Like Distribution, Post Data Distribution etcetera. In order to determine this, we analyzed the data fetched with SODATO for all four companies for 1 year - with the crisis in mid-year of the measured period. The aim of our social text analysis was to determine sentiment of the user-generated text data on the four companies' Facebook pages, as well as look into recurring

topics during the crisis.

## V. FINDINGS

In this section, we first present the interactional patterns revealed by the Social Set Analysis and deeper substantive analysis of the social data using netnographic analysis, manual sentiment analysis and topic discovery.

### A. Crisis Detection

Figures 2 and 3 present the results from the temporal analysis of interactions. Figure 2(a) reveals the interactional spikes by non-admin actors on the Copenhagen Zoo's posts as well as an preliminary indication of the nature of the crises. To be specific, the spike of likes on the admin's posts and comments is an indicator of positive endorsement of the Copenhagen Zoo's activities during the crises. As can be seen from figure 2(c), in case of Jensen's Bøfhus, the admin comments received far less number of likes when compared to likes on comments made by non-admin users during the interactional peak, which is an indicator of negative endorsement of Jensen's Bøfhus activities.

Thus, we can not only detect the interactional peaks (in this case, known social media crises) but also obtain preliminary indicators of the nature of net user sentiments towards the companies during the crises. We supplement this with a deeper analysis of users' actions before, during and after the crises, a netnographic analysis of the Facebook walls, and sentiment and topic analysis of the posts and comments during the crises as presented and discussed next.

### B. Social Set Analysis

The analytical objective for conducting Social Set Analysis (SSA) was to identify the structural properties of social media crises with reference to the domain-specific theories of crisis communication and management discusses in the theoretical framework section. Specifically, we were interested in the three time-periods of before, during and after crisis. We conducted SSA across the three time-periods for (a) overall distribution of user actions (Figure 4), (b) distribution of likes by facebook users on the artefacts (posts and comments) created by the company (Figure 5), and (c) distribution of comments by facebook users on posts created by the company (Figure 6).

As can be seen in Figure 4, a disproportionately high proportion of facebook users only interacted with the facebook walls of Copenhagen Zoo (86%) and Imerco (84%) during the crises period. Even for Telenor (36%) and Jensen's Bfhus (34%), the proportion of users interacting during the crises is much higher compared to the total time period. To put it differently, SSA of actors across the time-periods of before, during and after crises confirms not only the operational definition of a social media crises but also reveals the voluminous and transient nature of user attention (that is, there many more actors interacting during the crises but they stop interacting after the crises has passed). How this change in user behaviour occurs could be a function of not only the type of social media crises it is but also the type of social media crisis communication and management strategies employed by the companies.

Figure 5 shows the temporal distribution of facebook users' likes to the artefacts (posts and comments) created by the company (facebook wall administrator). Based on associational sociology and social influence theories in social psychology, we conceptualize the action of a "facebook like" as a positive association with the artefact (facebook post or comment) and/or actor (facebook user). This type of SSA reveals the positive endorsement of the company's communication actions before, during and after the crises. As can be seen from Figure 5, surprisingly high proportion of total likes were received during the crises for the Copenhagen Zoo (84%) and Imerco (75%). This can be a structural indicator that the social media crisis might actually be a net positive for the companies concerned in terms of customer loyalty and brand parameters. We examine this further in our netnographic and sentiment analysis.

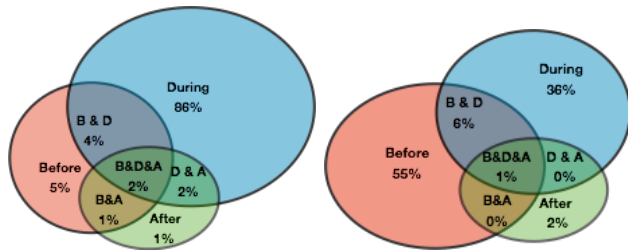
Figure 6 shows the temporal distribution of facebook users' comments to the posts created by the company. We find that the proportion of comments before and during the crises are comparable in for Jensen's Bfhus (45% and 46%) and Telenor (29% and 66%) whereas Copenhagen Zoo (3% and 94%) and Imerco (3% and 94%) have highly skewed distribution of comments during the before and during periods of the social media crises. Since facebook doesn't have a "dislike" button, comments are the only artefact for users to express negative associations, sentiments and expressions (also positive sentiments and expressions). Given the distribution of likes for Copenhagen Zoo and Imerco's posts and comments, the SSA of comments reveals an interesting pattern of higher likes for the company's artefacts as well as higher number of comments.

Taken together, SSA results suggest that the crisis type as well as crisis communication and management strategies employed might be different across the four cases. In order to uncover the substantive nature of the interactional patterns revealed by SSA, we conducted qualitative content analysis of the big social data corpus using two methods: (a) netnographic analysis of the facebook walls before, during and after the crises and (b) manual sentiment analysis and topic analysis of posts and comments during the crises. These analysis help shed further analytical light on the nature of the crises and the crises communication and management strategies, if any, employed by the companies.

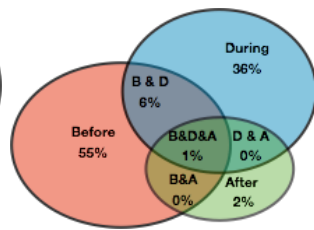
### C. Netnographic Analysis

During the crisis, Copenhagen Zoo posted 9 posts from 2014-02-08 until 2014-02-13, where they explained why they are planning to euthanize the giraffe, Marius. After the killing they tried to explain why they did it with relation to the animal's way of life. In the last two posts, they thanked people who have participated in the debate and supported them. Every time they post, they posted in both English and Danish languages, most likely due to the global attention the crisis received. Many of the posts Copenhagen Zoo posts during the crisis received a huge amount of likes, comments, and shares.

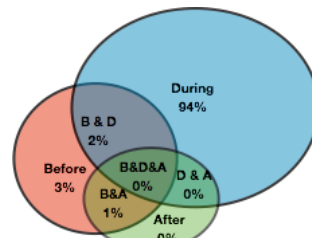
During the crisis, Telenor posted 7 posts from 2014-08-03 until 2014-08-08, of which 6 were in relation to the crisis caused by the unsatisfied customer, Anders Brinkmann. Unfortunately, the complaint itself is not to be found on their Facebook page. Therefore, the focus was only on the posts made by Telenor and the related comments. As mentioned



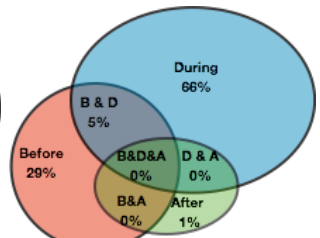
(a) Copenhagen Zoo



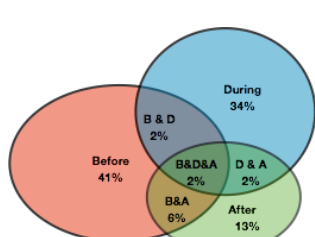
(b) Telenor



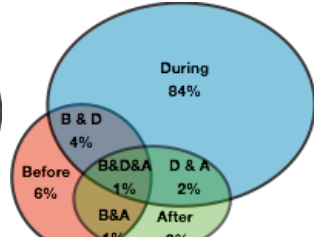
(a) Copenhagen Zoo



(b) Telenor

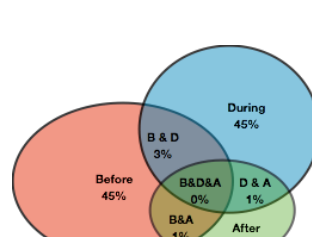


(c) Jensen's Bøffhus

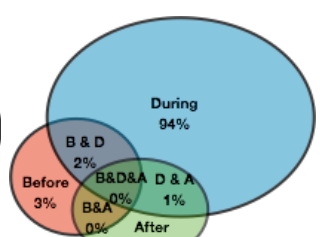


(d) Imerco

Figure 4. Social Set Analysis of actors during crisis

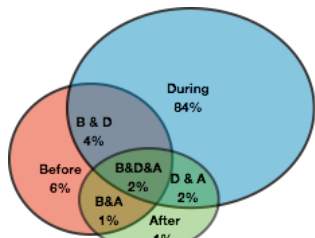


(c) Jensen's Bøffhus

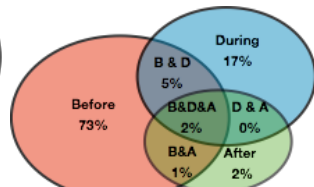


(d) Imerco

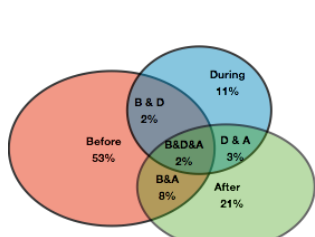
Figure 6. Analysis of actors who commented on admin posts during crisis



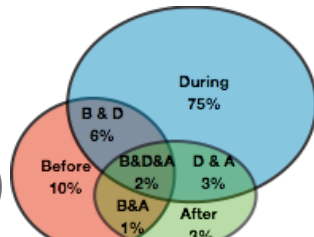
(a) Copenhagen Zoo



(b) Telenor



(c) Jensen's Bøffhus



(d) Imerco

Figure 5. Set Analysis of actors who liked admin posts during crisis

earlier, the customer service director of Telenor also made two posts on 2014-08-20 and 2014-08-22 with an apology. In the posts made during the crisis Telenor informs about their mistakes and what they are doing to try to cope with the issues their customers have had with fees and payment service. Also, they inform about that they are in the process of answering the inquiries they have received and that they, due to the many comments on Anders Brinkmann's post about his experience with Telenor, have created an e-mail address, minsag@telenor.dk in order to meet these comments.

During the crisis, Jensen's Bøffhus posted 5 posts from 2014-09-20 until 2014-09-27. However, the crisis started on 2014-09-19 as people started commenting on a post that day despite the post had nothing to do with the crisis. The 5 posts Jensen's Bøffhus made during the crisis included a link to the website of Jensen's Bøffhus where Palle Skov Jensen, who started Jensen's Bøffhus almost 25 years ago, has written an

open letter. Here he explains about the case and the decision on the rights to the name. Also, they posted a picture of and a link to an article about the interview with Jacob Jensen and Palle Skov Jensen from "Go'morgen Danmark" (ed. Good morning Denmark). Furthermore, Jensen's Bøffhus posted a radio clip from a radio station where Palle Skov Jensen is being interviewed and included a quote from the broadcast. Besides these types of posts, Jensen's Bøffhus also made a status update with a joking tone about the annual autumn storm has hit Denmark early this year and that it has done a great impression on the one responsible for Facebook, as an employee, and on Jensen's Bøffhus as a company.

During the crisis, Imerco posted 12 posts from 2014-08-25 until 2014-08-26, of which 11 were in relation to the crisis. The crisis was caused by unsatisfied customers because of a fast sold out anniversary vase from Khler. Ten posts related to the crisis were made on 2014-08-25. In these posts Imerco firstly informed about the offer after which the following posts informed about how huge the demand was and they were experiencing instability on their website. One of the posts received 238 likes, 362 comments, and 3 shares. Moreover, Imerco made posts where they informed about how many that were trying to buy the anniversary vase, about the vase being sold out, and about them working hard on improving the technical situation. Also, Imerco informed about how many people had tried to buy the vase, that there was not enough for everyone (16,000), and that they would take notes of the comments. In relation to these posts people were furious and made a lot of angry comments, complaining about the online shop not working, about the vase being sold out when they have been trying to buy the vase for hours, and suggesting that Imerco should have set maximum limit for the number of vases per person to one instead of three.

#### D. Sentiment Analysis and Topic Discovery

1) *Copenhagen Zoo*: During crisis, we found that the feedback were mostly negative with 60% negative feedback and only 27% positive, and 13% neutral. The sentiment analysis



also gave a clear indication of the topics in the comments. "Killing is wrong" is the most common topic in the comments made during crisis with 31%. This is followed by 22% that is "supporting the zoo", 20% "other", and "boycott" 15%.

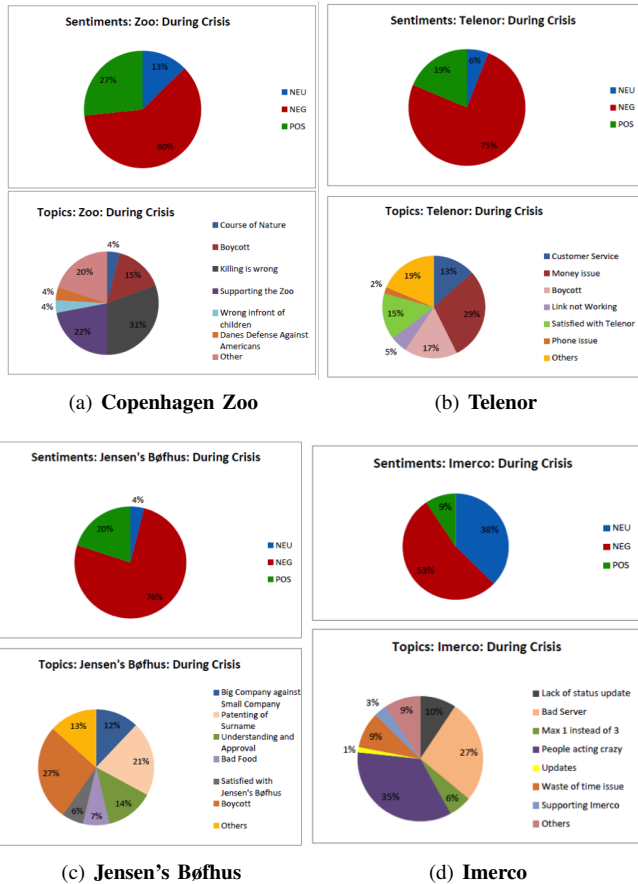


Figure 7. Sentiment and Topics Dashboards during Crisis

2) *Telenor*: During crisis, we found that the feedback were mostly negative with a percentage of 75%. The positive and neutral sentiment accounted for 19% and 6%, respectively. The sentiment analysis also gave a clear indication of the topics in the comments as well as which topics occurred most. The most frequent topic was "money issue" with a percentage of 29%. Thus, it indicates that most of the comments were related to the specific topic of the crisis - Telenor having sent late fees to customers before they have received the bill in the first place or have charged too much on the bill. People who have experienced the same issues as Anders Brinkmann have made comments regarding this topic. Furthermore, four other topics that also reached a relatively high percentage were "other" (19%), "boycott" (17%), "satisfied with Telenor" (15%), and "customer service" (13%).

3) *Jensen's Bøffhus*: During crisis, we found that the feedback were mostly negative with a percentage of 76%. The positive and neutral sentiment accounted for 20% and 4%, respectively. The most frequent topic was "boycott" with a percentage of 27%. When doing the manually sentiment counting this topic both applied people who had already boycotted Jensen's Bøffhus, people who said they would boycott them, and people who encouraged others to boycott them. The topic that reached the second highest percentage is "patenting

of surname". This topic indicates people being angry about that Jensen's Bøffhus, in their perception of the case, were trying to patenting the most common surname in Denmark. Furthermore, three of the other most common topics were "understanding and approval" (14%), "others" (13%), and "big company against small company" (12%). The first mentioned addresses people who understood and approved why Jensen's Bøffhus did what they did whereas the third mentioned topic was related to people saying that it was wrong of a big company as Jensen's Bøffhus to pursue a small company as Jensen's Fiskerestaurant.

4) *Imerco*: During crisis, we found that the feedback were mostly negative with a percentage of 53%. The positive and neutral sentiment accounted for 9% and 38%, respectively. The topic "people acting crazy" was the most common topic with a percentage of 35%. The second most common topic was "bad server" (27%) where people complained about not being able to put the vase in the basket in Imerco's online shop or the page not working etc. The third most common topic was "lack of status updates" (11%). The topic "updates" (1%) addresses people being satisfied with the updates from Imerco and could potentially have been grouped together with "lack of status updates" so that these two were named "updates". Another interesting topic is "waste of time issue" that reached 9%.

## VI. DISCUSSION

In this paper, we first proposed a formal method for social set analysis of corporate social media crises on Facebook. The proposed method was then applied to big social data for four different social media crises. The multiple case study was informed by crisis communication and management theories. The formal method of social set analysis (SSA) was complemented by the methodologies of netnography and content analysis. In this section, we first discuss the organizational aspects the empirical results in terms of types of crisis encountered and response strategies employed. We conclude this section and the paper with some methodological reflections on the linkages between event studies and our formal method for SSA of social media events in general.

From the corporate crisis theory perspective, both Telenor and Imerco experienced the "technical error accident" type. From a social media crisis perspective, we find that they are of the type "dissatisfied customer social media crisis". In the case of Copenhagen Zoo, it can be argued that their type of crisis - both in an organizational and a social media perspective - can be categorized as "challenges". This is due to some of their stakeholders, their customers, perceiving their behavior - euthanizing of the giraffe - as inappropriate or irresponsible. Regarding Jensen's Bøffhus we find that their type of organizational crisis both can be viewed as "rumors" and "challenges". This is due to the crisis spreading a lot of rumors about them trying to patent their surname and at the same time they were being challenged with their customer's negative perceptions of them. In terms of crisis response strategies employed, Telenor in relation to their social media crisis deployed the "rebuild" response strategy. Within this strategy they used the "apology" option. We find that that Copenhagen Zoo adopted the "diminish" response strategy. Within this strategy they responded with justifications and tried to explain the scientific rationality and institutional policies

for the decision and the process. Jensen's Bøfhus employed the justification option with the diminish strategy. In the case of Imerco, they combined the two response options from the diminish strategy - excuse and justification - and the compensation option within the rebuild strategy. Finally, it seems that Imerco also employed the compensation option within the rebuild strategy by offering their customers a 20% discount due to them not being able to meet the huge consumer demand.

Based on the empirical findings from our multiple-case study we offer the following recommendations for corporate social media crisis management: (a) Utilization of social data analytics tools that includes monitoring and alert functionalities, (b) Early detection and identification of the crisis type, (c) Selection of the appropriate response strategies for the specific industry sector, (d) Involvement of Top Management Team (C-Suite), (e) Post hoc analysis of social media crisis to gain organizational as well as market insights, and (f) Capacity building of relevant competences for social media crisis communication and management

Finally, with regard to the formal model for social set analysis for corporate social media crises, we have adopted the event study methodology. Event studies is a finance methodology to assess an impact on corporate wealth (e.g. stock prices) due to events such as restructuring of companies, leadership change, mergers & acquisitions [22]–[24]. It has been a powerful tool since late 1960s to assess financial impact of changes and continues to be used extensively to examine stock price performance and the dissemination of new information [25]. While there is no unique structure for event study methodology, at a higher level of abstraction, it contains identifying three important time periods or windows. First, defining an event of interest and identify the period over which it is active (event window), the second involves identifying the estimation period for the event (pre-event or estimation window) and the final one being identifying the post-event window [24]. In social set analysis of social media crises, we have adopted the event study methodology to identify the three important time periods of user interactions on social media platforms: *before* (pre-event window), *during* (event window) and *after* (post-event window). SSA results showed the voluminous but also transient nature of interactions during the social media crises and a diversity of aggregate user behavioural patterns. SSA combined with netnography and content analysis in terms of sentiment analysis and topic discovery revealed the different strategies employed by the organizations to manage the crises and their outcomes.

In conclusion, one of the contributions of this paper is to demonstrate the suitability and effectiveness of Social Set Analysis for conceptualizing, formalizing and analyzing big social data from content-driven social media platforms like Facebook for event studies such as unexpected crises and/or coordinated marketing campaigns.

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