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Operationalizing Critical Mass As The Dependent Variable For Researching The Diffusion Of eMarketplaces – Its Implications

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Abstract

E-market in this paper is regarded an innovation. Traditionally, researchers studying the diffusion of information technology innovations regard "adoption" of technologies by individual and organizations the dependent variable. This paper breaking away from tradition quips what if we regard critical mass the dependent variable? Critical mass seems an appealing dependent variable for an e-market can attain critical mass only when adequate number of end users adopt and participate. However, critical mass can be regarded the dependent variable only when we are able to predictively measure critical mass. Potential adopters' expectation regarding an e-market's profitability is proposed a measure for critical mass. Critical mass is explained here a moving target. The exact point in time at which an e-market would attain critical mass cannot be specified just as the market equilibrium in reality cannot be specified. The dynamics of attaining critical mass and not critical mass per se should be of interest just as it is about market equilibrium. Can critical mass theory as applied in this paper be used for researching the emergence of open source communities? When then does an open source community attain critical mass?

Key words: *Inter Organizational Systems, IOS, diffusion, adoption, implementation, electronic markets, critical mass and critical mass theory.*

1 Introduction

The term "critical mass" is often casually used not just by the business community but also among academics. Try presenting "critical mass" notion to an academic audience, almost every one regardless of their scientific understanding of the topic will have a say on it. Such a request is NOT made for venting out one's experience. The critical mass term just as "strategy", "governance" and "business model" is widely used and those aware of it have a subjective understanding of what it implies. Critical mass originates

from nuclear physics in where it denotes the minimum amount of nuclear material that must be present for a self sustaining nuclear fission reaction to occur (Oliver et al. 1985).

Social science researchers have applied the critical mass notion for explaining the diffusion of innovations (Rogers 1995). The notion is recognized to have high relevance with regards to innovations that are networked in nature such as telephones, e-markets, electronic mail, Internet and groupware systems (Katz and Shapiro 1986; Shapiro and Varian 1998). In the e-market context, the term denotes adequate levels of participation that can be measured for instance by the number of participants, catalogues and transactions, attaining which is what they aim for. An e-market is assumed to continue existing once it is in being due to network externalities; all or nothing proposition by Markus (1987) explains the rationale.

2 Literature Analysis

Unlike in physics where the exact instance at which a nuclear reaction would take off is predicted, in the social sciences area the critical mass term has been used in the "we know when it has happened" sense (Artle and Averous 1975; Markus 1987). The critical mass and the effect of it have been analyzed in the information systems area mostly in the form of economic modeling work (Clemons and Kleindorfer 1992; Wang and Seidmann 1995).

Table 1: *Critical Mass As Studied in the Information Systems Area*

Economic modeling strand	Explaining the growth curve of a networked technology post occurrence	Field study that analyze the effect of critical mass in the adoption decision	Economic modeling informed by field study data
e.g. Clemons and Kleindorfer 1992, Wang and Seidman 1995 and Kauffman and Wang 2002	Gurbaxani 1990, Rai et al. 1998 and Dutta and Roy 2003	Bouchard 1995, Damsgaard and Lyytinen 1998 and Lou et al. 2000	Teng et al. 2002; the author work like to position his work in this strand.

In another strand, researchers have attempted explaining the diffusion of networked information technologies such as the Internet and the BITNET (Dutta and ROy 2003; Gurbaxani 1990; Rai et al. 1998). These analyses are based on data that represent the event as it has occurred. The most representative explanation is the one that is best able to overlap the growth curve. Just as Rogers' (1995), their models assume population a static variable and inflection point is defined by a percentage of the population which varies from 16% as in the case of Rogers (1995) to 37% to 50% as in Rai et al. (1998) case. They follow up their explanatory modeling with a detailed analysis of factors underlying their respective network's actual growth curve.

A few field study based analysis have included critical mass as an independent variable that affects one's decision to adopt a networked technology (Bouchard 1993; Damsgaard and Lyytinen 1998; Lou et al. 2000). Teng et al. (2002)'s work marks the emergence of a trend in where economic modeling based on field study data is being done. In the recent years, there has been an increase in the attention provided to researching the role of critical mass in the diffusion of networked information technologies; see for example the research by (Dutta and ROy 2003; Kauffman and Wang 2002; Lou et al. 2000; Teng et al.

2002). An overview of research strands that study critical mass in the information systems area is provided in table 2.

The above mentioned papers complement well or even extend knowledge accumulated in the inter-organizational systems (IOS) adoption field. The adoption of IOS has been researched as early as 1966 (Kaufman). A large number of field studies have been done in the IOS adoption area, most of which have studied the EDI technology. Researchers via statistical studies have researched the strength of relationship between factors such as the complexity, relative advantage, power and trust and the adoption of IOS (Chwelos et al. 2001; Hart and Saunders 1997). A process approach to researching the diffusion of networked information technologies has gained prominence since the late 90's (Damsgaard and Lyytinen 1998; Kurnia and Johnston 2000). Ramanathan and Rose (2003) have analyzed the nature of knowledge accumulation in the IOS adoption field.

3 Problem Formulation

The analysis in this paper is focused on contributing towards researching the diffusion of one type of IOS; e-market. E-market in this paper is regarded an innovation. Traditionally, researchers studying the diffusion of networked information technology innovations regard the "adoption" of technologies by individual and organizations the dependent variable (see details of review paper by (Prescott and Conger 1995)). This paper breaking away from tradition quips what if we regard critical mass the dependent variable? Critical mass seems an appealing dependent variable for an e-market can attain critical mass only when adequate number of end users adopt and participate.

A key requirement for regarding critical mass the dependent variable is predictively defining and measuring critical mass with respect to the diffusion of an innovation. Most studies treat critical mass vaguely or identify an innovation as having attained critical mass. Markus (1987), while conceptually analyzing the diffusion of interactive media highlights the need for operationalizing and measuring critical mass. Bouchard (1993) and Mahlers and Rogers (1999) explain the influence that a critical mass of users of an interactive technology has on one's decision to adopt the technology. Their focus however lies on the adoption decision than on operationalizing critical mass. Gurbaxani (1990) and Rai et al. (1998) retrospectively analyze the diffusion of BITNET and the Internet respectively. Both of them attempt defining a suitable logic for explaining the growth of their respective networks and thereby provide base for developing predictive models. In the process they seek information on the inflection point at which growth rate is at the maximum; critical mass instance.

While such retrospective analyses are certainly insightful and even required, would providing a measure for critical mass not be even more helpful in identifying the inflection point before the event has happened. Research community with prior knowledge of the measure can normatively guide practitioners towards attaining critical mass; thus making their work relevant. This paper calls for researching the diffusion of e-markets regarding critical mass the dependent variable. It clarifies further the ambiguous notion of critical mass. Furthermore, a measure for critical mass is described in the e-market context. The implications of regarding critical mass the dependent variable for research are discussed.

This paper while conceptual in nature has resulted from an embedded case study (Yin 1994) carried out for researching the diffusion of e-procurement in the Danish public sector. The Danish ministry of science, technology and innovation has recommended the use of a private owned e-market for public procurement. However, the governmental

organizations have not participated adequately as it was expected. Several stakeholders – buyers, sellers, competitors and trade associations – were queried about their involvement in the diffusion of e-procurement in the Danish public sector. The query was informed mainly by IOS adoption literatures. After having embarked upon the study, the author learnt about critical mass theory that has its origins in Sociology (Oliver et al. 1985) and its application for researching the diffusion of interactive media (Markus 1987). The ideas presented here are informed by critical mass theory related literatures and from the qualitative study done for researching the diffusion of e-procurement in the Danish public sector.

4 Argumentation Details

The following is the line of argument adopted for writing the paper; e-market is first recognized as a subset of IOS. This is done for the IOS area having been researched for almost four decades has a lot to contribute for researching the diffusion of e-markets. Second, the inadequacies of regarding "adoption" – identified as the most commonly regarded dependent variable for researching the diffusion of IOS – are highlighted. Such is done based on anecdotal data and via a literature review. Third, Oliver et al. (1985)'s critical mass theory in where critical mass is regarded the concept researched and a few relevant notions are explained. The new nature of knowledge that can be generated from applying these theoretical notions for researching the diffusion of e-markets is highlighted. Fourth, the critical mass is defined as a variable that is perceived by potential adopters in a population. The potential adopter's perception of an e-market's profitability is defined as the measure for critical mass. The research implications of regarding critical mass the dependent variable are highlighted in the final section.

5 eMarket As A Subset Of IOS

An e-market is an IOS that facilitates buyers and sellers to exchange information about market prices and product offerings (Bakos 1991). EDI is an IOS that has been extensively researched during the late 80's and the early 90's. There are three parties (buyers, sellers and market host) involved in diffusing independently managed e-markets. There however are only two parties actively involved in the implementation of EDI. An e-market's host is a thinking body with survival instincts. In research so far, the role of host in the implementation of e-markets is poorly recognized.

An e-market developed by a single buyer or seller for the purposes of automating interactions with its counterparts is different from EDI in that the medium has changed. Network effects for such would be quite similar to that of EDI. An open e-market, be it horizontal or vertical that allows multiple buyers and sellers to interact among one another, would have much higher network effects when successful.

There are different types of e-markets. Kaplan and Sawhney (2000) conceptualized four types using a 2x2 matrix whose dimensions include "how businesses buy" and "what businesses buy". The understanding about e-markets since then has evolved. Researchers such as Segev et al. (1999), Lennstrand (2001), Mahadevan (2002), Choudhury et al. (1998) and Sawy (2001) have both deductively and inductively conceptualized the dimensions that define an e-market. The dimensions along which an e-market can be classified are so many - i) relationship orientation ii) revenue sources iii) transaction focus iv) ownership bias and v) market orientation and each has its subdivisions – that

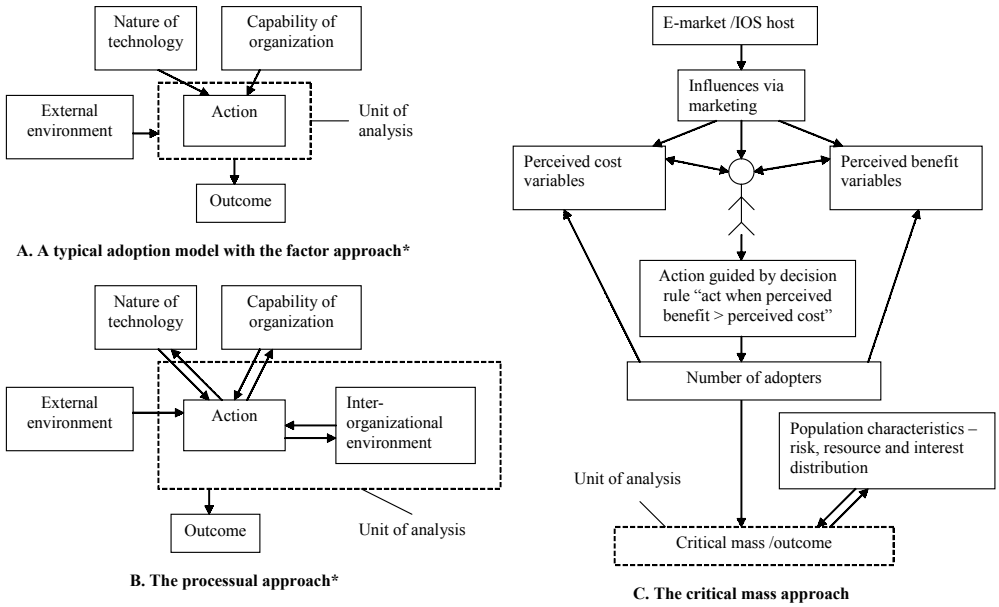
there can potentially be hundreds of types of e-market. Of the several types that exist, this paper has high relevance to those e-markets (type = open) that enrolls multiple buyers and sellers. A single buyer (e-procurement) or seller owned (web shops) e-market can be regarded as an automation effort by a proprietary. The challenges faced by open and proprietary e-markets for attaining critical mass are different.

6 Inadequacies Of Regarding Adoption The Dependent Variable

Several buying and selling organizations joined/adopted Gatetrade (www.gatetrade.net) during 2001 when it was initialized. Gatetrade however did not experience a proportional surge in trading volumes as the adopters hardly participated. The adopter's use of the e-market infrastructure is vital for Gatetrade for it gets most of its revenue by charging for the transactions carried over its infrastructure. However, not all e-markets earn their revenues by charging for transactions. For instance, Scanmarket (www.scanmarket.com) leases out the use of its infrastructure to customers for a standard fee. The adopter's use of the infrastructure has no implications for Scanmarket in terms of revenue. Scanmarket through its business model thereby shifts the onus of using the e-market to adopters. The challenge for Scanmarket thus is to attract adequate number of adopters. An e-market is successfully diffused only when it is adopted and used. Hence, diffusion research should regard adoption as a phase in the implementation process and not as the objective in itself. Such line of thinking is gaining hold in the diffusion research in the recent years. DIGIT (Diffusion Interest Group in Information Technology) 2003 workshop for instance is titled "beyond acceptance: investigating post adoption phenomena". A research strand is emerging that analyzes "assimilation gaps" that exist between the adoption and the use of an innovation (Fichman and Kemerer 1999).

IOS adoption research has mostly queried factors that affect an organization's decision to adopt. A hot topic in the subject used to be "why do small and medium sized enterprises resist adopting EDI?" (e.g. (Iacovou et al. 1995)). The underlying assumption behind such an enquiry is that a change agent when aware of the factors that cause SME's to resist adopting EDI can remedy the situation and thereby enhance diffusion. It is not just the organizational and the innovation characteristics that affect one's decision to adopt but also a decision maker's perception of how many relevant others have adopted (Bouchard 1993) and how many others would adopt (Mahler and Rogers 1999). Damsgaard and Lyytinen (1998) explain that decision makers act strategically when they choose to adopt or not. Kurnia and Johnston (2000) explain that decision makers are not unidirectionally affected by organizational, inter-organizational and technology factors but they via their actions have an effect on these factors vice versa.

By focusing on an individual or an organization's adoption decision, IS research community looses opportunity to learn about the population (environment) to which adopter's belong. For instance, if adopter population can be characterized with assumptions regarding risk, resource or interest distribution, then diffusion can be predicted as an aggregated outcome. Mahajan et al. (1990) quote aggregated diffusion modeling work done in the marketing area. Such line of work has not been done in the IOS area to the author's knowledge. The implications of regarding critical mass the dependent variable are graphically explained below in figure one.



* A and B are obtained from Kurnia and Johnston (2000)

Figure 1: *The Critical Mass Approach Graphically Depicted*

7 Regarding Critical Mass The Dependent Variable

Regarding critical mass the dependent variable is appealing for the term is often associated with self-sustenance. The term has high relevance to phenomena that generate network externalities (e.g. message groups, online chat, open source communities and e-markets). For example, it is much easier to find a playing partner in one of the active Yahoo chess groups than in a lesser active online chess group. One who wants to play chess online would prefer joining Yahoo chess groups to the lesser active ones; in the process increasing activity in Yahoo and thereby its lead over the others. Yahoo chess groups can thus said to have attained critical mass. E-market is similar to that of an online chess group in that a buyer would find an e-market with a large number of sellers attractive and for sellers the vice versa. It needs to be clarified here that the terms "active" and "large" are perceived by potential adopters. What is large for some one in theory can be small for another. The challenge for an online chess community or an e-market is to cross the point beyond which a significant percentage of potential adopter's would perceive it to have attained critical mass.

Oliver et al. (1985) propose a theory of critical mass in collective action. Their objective is to explain as to why a small percentage of population takes the risk of contributing towards a collective good while a large percentage adopts a wait and see approach. Oliver et al.'s (1985) research objective when operationalized in the e-market context would explain as to why an organization risks joining an e-market that is yet to attain critical mass. An underlying assumption in the e-market context is that joining an e-market involves asset specific investments, which can take several forms such as the installation of technical infrastructure, training and redesigning organizational and inter organizational trade procedures. Thus if an organization joins an e-market that fails to attain critical mass then the organization risks loosing its asset specific investments. A rational decision would thus be to wait until an e-market attains critical mass. But if every one waits then how would e-markets attain critical mass? In reality however, e-markets

such as Elemica (www.elemica.com) have emerged into existence. Critical mass theory explains the conditions under which collective action would and would not emerge (Oliver and Marwell 2001).

The three central claims of critical mass theory are as follows; i) the likelihood of a collective good coming into existence is higher when heterogeneity within a potential adopter population is higher. Heterogeneity is characterized by interests and resources. For instance one with high level of interests and resources is most likely to contribute ii) Decision makers act sequentially while deciding upon whether or not to adopt a collective good. The theory assumes decision makers fully informed of other's action while deciding. iii) Collective action can be classified under two types based on their production function; accelerative and decelerating. Production function is a curve that explains the relationship between one's contribution towards a collective good and the likelihood of the good coming into existence. Early contributions in an accelerative production function increase the likely hood of a good coming into existence very little. The curve however grows steeply once a large percent of potential adopters find the collective good likely to exist. The decelerating curve in contrast grows steeply at first and then tapers off gradually. Markus (1987) applies critical mass theory for explaining the diffusion of interactive media. She finds interactive media diffusing in an accelerative pattern. She assumes interdependence as reciprocal instead of sequential. Reciprocal interdependence implies that one's decision to adopt influences those who are yet to adopt while at the same time one gets influenced by the perceived likelihood of the actions of those who are yet to adopt; watch while being watched.

When critical mass is regarded the dependent variable, several research issues comes into notice which when addressed help in better explaining the diffusion phenomenon. A conceptual explanation of how such is possible is hereby provided; Granovetter (1978) explains in the rioting context that the threshold to act for potential adopter population is distributed. One decides to act/adopt when he or she perceives the benefit of participation exceeding the cost of participation. In tandem with Oliver et al.'s (1985) conceptualization and Rai et al. (1998) findings, the potential adopter population is assumed heterogeneous. An e-market when having a transaction oriented business model would attain critical mass when adequate numbers of trading partners (both buyers and sellers) join/adopt and trade/participate/use. The population adopting an e-market and the population participating/using the e-market differs largely with a slight overlap. Adopters of an e-market usually are decision makers who are in the management end of organizational hierarchy. The users of an e-market on the other end are operation oriented employees like secretaries and procurement officers. Factors that affect one's adoption of an e-market and one's use of it would likely differ. Adopters and users meta-processing engine however remains the same; both act when they perceive the benefit of participation exceeding the cost of participation.

Both the adopters and the users consider the cost-benefit equation of alternatives while considering action. A potential adopter evaluating joining a transaction oriented e-market would for instance look at the option of developing an e-procurement solution or explore other types of e-markets. A user would consider the traditional ways of working a viable alternative to trading via an e-market. Adopting an e-market does not automatically imply that it will be used. Potential participants would resist using an e-market when they find the adopted e-market unattractive (explained by cost-benefit equation). Adopter's would tend to market their choice with vigor when stakes involved are high. For instance if an organization chooses to license the use of an e-market for a standard fee, it will actively market or even coerce usage so it can benefit from the investment. The extent to which an adopter is able to persuade or coerce usage is mediated by politics within an organization.

Regarding critical mass the dependent variable in the manner described above denotes a paradigmatic shift in diffusion research due to the following; variables that affect one's

decision to adopt and use are processed through a decision maker's cost-benefit processing engine. This is unlike the contemporary way of regarding independent variables directly affecting one's decision to adopt. A key implication of the proposed shift is that research findings would have much higher relevance. Such line of thinking, though not explicitly recognized, is getting hold in researching the emergence of open source communities. There have been quite a few explanations on the costs and benefits of participating in an open source community (Karim and Bob 2003, Philippe 2003 and Andrea and Rossi 2003). This conceptualization explicitly acknowledges that decision makers *perceive* costs and benefits. An e-market can act opportunistically by altering potential adopter's perception to its advantage through for instance marketing efforts. On the other hand, research efforts can inform potential adopters about evaluating an e-market.

Oliver et al.'s (1985) critical mass theory, applied in the way described, is a suitable candidate for researching the diffusion of complex and networked technologies for it satisfies several assumptions held by researchers in studying the subject. Tornatzky and Klein (1982) recommend that the innovation diffusion research should predict, study both the adoption and the extent of use, use replicable and compare research approaches and query a decision maker before he adopts an innovation. Critical mass theory inherently is predictive in that it explains the conditions under which critical mass in collective action is attained. The author has explained earlier in this section as to how an individual's adoption and his or hers extent of use are required for an e-market to attain critical mass. Factors that affect one's perceived costs and benefits of an innovation can be acquired using replicable and comparable research approach while one considers adopting an innovation.

Critical mass theory is truly a multi-level theory for it explains the relationship between an individual's adoption decision and the emergence of a community. The theory assumes adopter's deciding on an innovation in terms of time either sequentially or as Markus (1987) explains reciprocally. Critical mass theory thus has the potential to satisfy process theorists' ((Kurnia and Johnston 2000; Lyytinen and Damsgaard 2001) call for researching the diffusion of complex and networked technologies over a period of time. The theory addresses Lyytinen and Damsgaard's (2001) claim that one acts strategically while deciding to adopt and that complex technologies are learning intensive by explaining one's decision to adopt in terms of his or hers perceived costs and benefits.

Critical mass theory assumes potential adopter population distributed in terms of interests and resources. For applying the theory one has to explain resources and interests via contextual measures. It is through measures one can analyze the distribution of interests and resources. Critical mass theory regards the diffusion of other innovations, upon which the diffusion of an innovation is contingent (Mahajan et al. 1990), a resource. A resourceful person who is interested is likely to participate in an innovation for he or she perceives the benefits higher than the costs of participation. However, one would opt out from participating in an innovation when he or she perceives the costs of participation higher than the benefits after having adopted. Several suppliers joined Gatetrade when it started expecting to benefit from selling a lot via the medium. However, when they did not sell as much as they had expected they perceived the costs higher than the benefits and hence they dropped out. This explains that innovation need not necessarily traverse through distinct stages as Rogers (1995) assumes instead it can flow back and forth with feedback mechanisms as Lyytinen and Damsgaard (2001) explains. Critical mass theory as explained above is an aggregate diffusion model (Mahajan et al. 1990) that explains the diffusion of an innovation as a result of several individual/entities decision to adopt and participate.

8 Operationalizing Critical Mass In The eMarket Context

Critical mass can be regarded the dependent variable only when we are able to predictively measure critical mass. Critical mass in nuclear physics is the amount of radioactive material required for a self-sustaining nuclear explosion. The term is vaguely measured in social sciences. The usual measure adopted is "we know when it has happened". A measure is provided in this section with which one can predict as to when a three-party B2B e-market attains critical mass.

An innovation is said to have attained critical mass when it is widely used. The validity of such an association is much higher in the case of networked technologies (e.g. e-market) for one's benefit from participation depends on who else is part of the network and to what extent the network is used (Rohlfs 1974). A network host would collect service charges for having developed the network and for maintenance from the participants for their use. This paper assumes linearity between participation and service charges collected by the host. The measure for participation depends on an e-market's business model. Participation for instance is measured by the number of transactions when an e-market collects revenues for the number of documents exchanged over its network. When an e-market charges a standard license fee for the use of its infrastructure then the participation is measured by the number of participants. An e-market, regardless of the business model, would continue to exist/would have self-sustained when it breaks even. The hosting of a B2B e-market is a costly activity. Hence, it is reasonable to assume that an e-market requires adequate participation for breaking even.

An organization needs to make asset specific investments while joining an e-market. It invests not just in technology such as for integrating its internal financial systems with the e-market but also adapt its organizational and more importantly its inter-organizational procedures. It is vital for an organization that the e-market in which it has joined self sustains for if otherwise it risks loosing its investments. The risk of investing in an e-market is higher during the early stages than in the later stages of its inception. Due to the risk factor, organizations joining an e-market would find investing during the early stages costlier than investing in the later stages. Moreover, an organization inducing (persuade or coerce) its trading partners to adopt a specific e-market is as well an asset specific investment. An organization invests lesser for inducing its trading partners when a higher percentage of the population has adopted an e-market.

Sociologists make simplistic assumptions regarding threshold and critical mass. Oliver et al. (1985) explain critical mass theory through a scenario in where a population of 1000 requires collecting 100,000 to hire a lawyer for preventing the closure of a school in their neighborhood. In the example, the number representing critical mass is 100,000. Everyone while deciding whether or not to contribute towards the figure has perfect information regarding how big the kitty has grown. In reality, there is no such static number defining critical mass in the diffusion of innovations. Critical mass instead is a perceptual variable. Members of a population perceive costs and benefits of participating in an e-market differently. For example, several organizations that joined Gatetrade during the early stages of its existence did so for they expected trading over it would be the norm. While regarding their action strategic they expected higher benefits due to first mover advantages.

Potential adopters' expectation regarding an e-market's profitability is proposed as a measure for critical mass. Expectation here denotes a potential adopter's beliefs on an e-market's future. His perception about when an e-market would attain profitability accurately reflects his beliefs. One's decision to join an e-market is guided by his or her beliefs. If one expects an e-market to do very well, then he or she would want to benefit by being a part of it. If one is unsure about joining an e-market, then he or she would

adopt a wait and see approach. The duration until which one waits depends on the extent of uncertainty that he or she faces. It is the distribution of such beliefs among potential adopter population and the pattern in which individual adopter's decision is aggregated that determines whether or not an e-market would attain critical mass. As per the proposed construct, an e-market need not break even for it to attain critical mass. Instead, it is adequate when an e-market is able to attract large enough percentage (number defined by an e-market's business model e.g. whose transaction when carried out is adequate for an e-market to break even) of a population that regards trading over the e-market as way forward. The change agent should channel its marketing efforts in attracting the participation of those who have high regards about the e-market. As the percentage of population that has adopted grows, then the threshold of the remaining population decreases. Granovetter (1978) and Oliver et al. (1985) recommend such a form of aggregation.

An e-market attaining critical mass is a process that is emerging. E-market, a thinking actor with survival instincts, is expected to gain efficiency through experience. Mass media and the word of mouth; variables from Bass model (1990) play a critical role in defining potential adopter's expectation. These dynamically changing perceptions measured via potential adopters' perception on an e-market's profitability can be used for predicting as to when an e-market would attain critical mass. Those participating in an e-market would want an e-market to attain critical mass to the extent they have invested in an e-market. They would via persuasion or coercion alter a potential adopter's expectation regarding an e-market. It is quite possible for one after having invested in an e-market to develop low expectations regarding an e-markets future resulting in him or her opting out. Such however is less likely to happen when an e-market has attained critical ma(Granovetter 1978).

Critical mass as explained here is a moving target. The exact point in time at which an e-market would attain critical mass cannot be specified just as the market equilibrium in reality cannot be specified. However, measuring critical mass via one's expectation about an e-market's profitability allows for learning about factors that affect the process of attaining critical mass. The change agent when being aware of the factors can influence the process just as the potential adopters when being aware of it can evaluate an e-market. Critical mass just as market equilibrium itself should not be of interest instead it is the dynamics of attaining that should be.

9 Research Implications

An individual/organization's decision to adopt is the unit of analysis while regarding adoption the dependent variable. When critical mass is regarded the dependent variable the system and the emergence of it is brought into focus. A few prominent implications for research community caused by the shift in focus are hereby explained.

First, measures are required for explaining threshold distribution in a population. Second, e-markets from different parts of the world are increasingly getting inter-connected. Because to this a Danish buying organization is now able to log on to a Scandinavian e-market and find a supplier from Japan who is registered with a Japanese e-market without even having to shift graphical user interface. Is the Japanese firm part of the Scandinavian e-market's adopter population? How is one to define population and the effect of its growth in the diffusion of e-markets? Marketing literatures, especially the ones that discuss telecom marketing, could be helpful. Third, risk and the word of mouth are explained as assumptions explaining aggregation dynamics in the diffusion of e-markets. Could there be more such assumptions? Fourth, can critical mass theory as applied in this

paper be used for researching the emergence of open source communities? When then does an open source community attain critical mass?

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