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# Managing Creativity to Develop Absorptive Capacity:The NIH Syndrome and the Implementation of Open innovation Business Model

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## Abstract

The benefits of the open innovation business model and the absorptive capacity necessary to acquire and utilize external knowledge have been discussed extensively. An emerging literature stream has identified certain intra-organizational antecedents of absorptive capacity. However how firms recognize potentially valuable external knowledge to be able to start the knowledge absorption process has not been discussed. This paper suggests creativity management and argues that stimulating meaningfully novel behavior positively influences the recognition ability and the communication it enhances alleviates the Not-Invented-Here syndrome. Based on the absorptive capacity and organizational creativity literature a model consists of five hypotheses is derived and tested on a sample of 346 Danish SMEs. The results indicate that creativity management plays a positive role in the development of recognition ability.

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# MANAGING CREATIVITY FOR ABSORPTIVE CAPACITY:

# THE NIH SYNDROME AND THE IMPLEMENTATION OF OPEN INNOVATION BUSINESS MODEL

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The benefits of the open innovation business model and the absorptive capacity necessary to acquire and utilize external knowledge have been discussed extensively. An emerging literature stream has identified certain intra-organizational antecedents of absorptive capacity. However how firms recognize potentially valuable external knowledge to be able to start the knowledge absorption process has not been discussed. This paper suggests creativity management and argues that stimulating meaningfully novel behavior positively influences the recognition ability and the communication it enhances alleviates the Not-Invented-Here syndrome. Based on the absorptive capacity and organizational creativity literature a model consists of five hypotheses is derived and tested on a sample of 346 Danish SMEs. The results indicate that creativity management plays a positive role in the development of recognition ability.

**Keywords: Absorptive capacity, creativity, NIH, OI**

## INTRODUCTION

The open innovation (henceforth "OI") business model (Chesbrough, 2003) and the benefits of opening up the innovation process to external knowledge sources have been discussed lately in the literature (e.g. Laursen and Salter, 2006). One of the premises of the OI business model is that firms acquire and exploit external knowledge to develop innovation (Chesbrough, 2003). A wide range of external knowledge sources can be identified, e.g. universities, consultants, customers, suppliers, competitors (Chesbrough, 2003) but it is also known that openness has limits; over-search hampers the innovation performance (Katila and Ahuja, 2002) and increasing openness brings decreasing returns (Laursen and Salter, 2006). Firms need absorptive capacity (henceforth "ACAP"), the capability which enables the firm to predict the nature of new technologies and to invest in them (Cohen and Levinthal, 1994). There have been different views on the dimensions of ACAP but it is mostly agreed that ACAP has recognition, acquisition, assimilation, transformation and exploitation of external knowledge dimensions (Lane et al, 2006, Lichtenthaler, 2009, Todorova and Durisin, 2007, Zahra and George, 2002). The recognition dimension of ACAP is particularly necessary to comprehend new developments and start the knowledge absorption (Todorova and Durisin, 2007). However, Not-Invented-Here (henceforth "NIH") syndrome, which lessens the extent that a team is willing to expose itself to new ideas with time (Katz and Allen, 1982), prevents the firm from recognizing and utilizing new external knowledge. This paper focuses on the ability of recognizing external knowledge.

Although ACAP has received massive research interest, researchers` insight on how organizations develop this capability has not matured to date (Volberda et al, 2010, Lewin et al, 2011). ACAP has long been associated with the conduct of in-house R&D (Lane et al, 2006) but the OI business model recommends that firms reduce in-house R&D and act as knowledge connectors (Chesbrough, 2003:52, 58-60). Many innovations are characterized as the novel integrations of previously existing bodies of knowledge (Chesbrough, 2003:53) and the products increasingly embody different technologies combined inter-connectedly (Brusoni et al, 2001). Given that making these combinations require recombinant search of different technologies and science guides this process (Fleming and Sorenson, 2004), the decreasing R&D,

particularly the decreasing investment on research, may narrow the fields and industries that the remaining R&D employees can monitor. This structural change raises the question that how the firm develops ACAP to recognize external knowledge.

The importance of other intra-organizational antecedents for developing ACAP has been recently raised (Lane et al, 2006, Volberda et al, 2010). Of the previous research on these antecedents, Szulanski (1996) defines possessing common language and skills, Minbaeva et al (2003) and Lenox and King (2004) discuss the managerial practices, van den Bosch et al (1999) and Jansen et al (2005) discuss organizational forms and combinative capabilities. In sum, while research on the intra-organizational antecedents has yet to mature (Volberda et al, 2010), it is known that certain organizational design, forms, managerial attitudes and HR practices are likely to be organizational antecedents of ACAP. Nevertheless, most of this research exemplify the adoption and intra-organizational transfer of a particular technology and describe the role of these different antecedents for this purpose. For instance, van den Bosch et al (1999) describe the adoption of the multimedia complex technology and Lenox and King (2004) discuss the adoption of pollution prevention system. Szulanski (1996) and Minbaeva et al (2003) discuss the transfer of knowledge within one firm. Antecedents facilitating the recognition of potentially valuable external knowledge (Todorova and Durisin, 2007) from different sources are not explicitly defined in earlier research. In other words, these studies do not define one or more technologies which complement or compete with the one being adopted by the firm for doing innovation.

This approach for studying the organizational antecedents of ACAP explains the development of this capability after the benefit of this particular technology has been understood. An example is the adoption of the OI business system. The currently known organizational antecedents of ACAP are relevant to the intra-firm diffusion of this business system and the requisite of making structural changes in the firm to accommodate this approach to doing innovation. But it is less sufficient to explain how a firm aiming to exploit a range of external knowledge sources theoretically available to it (Chesbrough, 2003) recognizes the potential of different external knowledge. In this sense, in addition to the organizational antecedents discussed

by the current ACAP literature to facilitate the adoption, and the utilization of external knowledge, other antecedents stimulating diversity in the firm leading the employees to search and recognize external knowledge in the absence of traditional R&D remain to be studied.

This paper suggests the use of organizational creativity mechanisms (Bharadwaj and Menon, 2000) as another organizational antecedent. These mechanisms are institutionalized approaches to managing the creative potential of employees and can be actively promoted by the management. Programs and tools for idea generation and linking these ideas to business problems are defined to be organizational mechanisms. Their main function is to stimulate meaningfully novel behavior in the firm (Bharadwaj and Menon, 2000). The study argues that the regular use of these mechanisms creates variation in the organization. This variation leads to discovery of new knowledge needs and stimulation of internal communication (Hardagon and Bechky, 2006). The communication among employees for seeking help on knowledge needs acts as "activation triggers" (Zahra and George, 2002:193-194, Todorova and Durisin, 2007) and starts the knowledge-sharing among employees with different expertise in R&D teams. This process activates gatekeepers in the firm to monitor the environment and recognize new developments. Based on the theoretical discussion on the ACAP, NIH and organizational creativity literature, a model is established and a set of hypotheses is derived. The model is tested on a 346 Danish SME sample to study the relationships. The paper shows that creativity management is likely to be associated with the recognition and the assimilation dimensions of ACAP.

This finding adds to the organizational antecedents of ACAP literature which discusses different organizational forms, and practices supporting the acquisition, transformation and exploitation of external knowledge but is less clear on the recognition dimension. Explaining the recognition of external knowledge through unleashing employees` creativity sheds light on the NIH problem. The paper argues that this problem is alleviated when the employees generate ideas, communicate and discover their own knowledge needs, and thus become more open towards external knowledge. This alleviation is likely to increase internal communication and facilitate the implementation of the OI business model.

## THEORY AND HYPOTHESES

### Creativity and the Recognition Ability

Managing creativity through the active promotion of organizational creativity mechanisms (Bharadwaj and Menon, 2000) stimulates novel behavior by developing problem finding orientation, building interest, expertise and divergent thinking ability along with relevant communication (Ford, 1996).

If employees are "deliberately requested for active thinking", they encounter actions involving both novelty and discrepancy (Louis and Sutton, 1991:67). Certain challenges related to their ideas` application emerge (Hargadon and Bechky, 2006:490). The self-discovered problems rather than ones being assigned by others motivate employees intrinsically and pique interest in taking action (Dillon, 1982). These challenges generate questions to ask colleagues (Hargadon and Bechky, 2006, Louis and Sutton, 1991). Some problems can be overcome with colleagues` input. Some other times the interactions among employees lead to building upon other colleagues` ideas and re-framing the original questions into new questions collectively (Hargadon and Bechky, 2006). Divergent views trigger creativity (Nemeth, 1997) and discussions on these divergent views rather than a generally agreed view stimulate broader and unbiased search for new information (Nemeth and Rogers, 1996).

Not all employees of the organization are connected to the external environment to search new information (Allen, 1977). Boundary spanning employees, e.g. gatekeepers, expose themselves to knowledge sources outside of the firm more often than do other employees (Allen, 1977). These employees are high-performance employees who other people often consult (Allen, 1977:163). It is expected that these boundary-spanning employees are in contact with external knowledge sources being informed of the ideas, opportunities and challenges their firm faces (Louis and Sutton, 1991) when communication between them and other employees are enhanced. Employees, on the other hand, are expected to approach external knowledge more positively due to the intrinsic motivation of finding problems themselves (Dillon, 1982, Unsworth, 2001) and raised interest in new knowledge accordingly. Thus;

H1: The use rate of organizational creativity mechanisms is positively related to the recognition ability.

**NIH Syndrome and ACAP in Open Innovation**

NIH is defined as *"the tendency of a project group of stable composition to believe it possesses a monopoly of* its field, which leads to rejection of new ideas from outside to the likely detriment of its performance" (Katz and Allen, 1982:7). According to Katz and Allen (1982), the NIH syndrome is likely to be related to the decrease in communication. With employees` roles and functions settling in time, the perceived need to communicate within the team declines. The knowledge base in the team becomes specialized (Cohen and Levinthal, 1990). The emerging knowledge monopoly and complacency perception causes employees to lose touch with the new developments gradually (Katz and Allen, 1982). External ideas become too distant to be recognized and appreciated (Cohen and Levinthal, 1990). This distorted perception decreases the external knowledge a team may receive from outside (Katz and Allen, 1982).

Noting the difference between the research "R" and the development "D" functions of R&D (Chesbrough, 2003:33) and the difference in characteristics of scientists and engineers (Allen, 1977, 1997) is worthwhile in the context of the OI business model. The reduction of R&D, particularly, research and scientists in the business model affects the communication patterns, and, thus, the NIH syndrome. The communication patterns of R&D scientists are different than those of R&D engineers (Allen, 1977:35, 2004). Research scientists are educated to be self-motivated, problem-finding oriented and connected to the scientific community. They have the ability to read academic papers. With managerial support, they maintain their connections to the university scientists, co-author papers and keep abreast of new developments (Cockburn and Henderson, 1998). Engineers, on the other hand, are problem-solving driven, and relatively less interested and able to read academic papers (Allen, 1977). The difference in the natures of these two groups of professions is reflected in their way of seeking new knowledge. While scientists can read published papers and communicate among themselves, engineers tend to reach new knowledge mostly by verbal communication through personal contacts (Allen, 1997, Katz and Allen, 1982).

Unless actively managed to retain connections and to keep communication within the team strong, the decrease in research and the increase in knowledge integration and development activities mostly led by engineers (Katz and Allen, 1982) make the R&D team vulnerable to NIH. Particularly communication within the organization and external knowledge sources such as universities, public research institutions are hampered by NIH, albeit not communication with suppliers and vendors (Katz and Allen, 1982).

Managing creativity to stimulate generation of ideas is likely to lead to increased communication opportunities in R&D teams through raising questions among engineers and between engineers and gatekeepers. This communication transmits different ideas and challenges associated with these ideas. Gatekeepers are expected to be consulted on problems more often when the communication is enhanced. The mental alertness the communication stimulates and the emergence of gatekeepers to search for information are likely to reduce the NIH syndrome. Thus;

Hypothesis 2: The use rate of organizational creativity mechanisms is negatively related to the NIH syndrome.

ACAP is defined as the ability to "recognize the value of new information, assimilate and exploit it for commercial ends" by Cohen and Levinthal (1990:129). The ability to recognize external knowledge means understanding the principles of this knowledge and predicting the findings of various trials with it prior to its acquisition (Fabrizio, 2009).

Products increasingly involve multi-technologies which develop at uneven rates (Brusoni et al, 2001) that the firm must actively search and identify new technologies to incorporate in the products. Accordingly, complementary external knowledge such as customer knowledge may be available at different times that the firm must retain its contact to the external knowledge environment. However, once the roles and functions of employees become familiar to employees with time, employees tend to maintain habitual behavior (Ford, 1996). The intra-team communication reduction with time and the associated NIH syndrome cause the team members to increasingly commit to their own ways of handling tasks and solving problems (Katz and Allen, 1982). They retrieve knowledge from the organizational memory automatically to perform established tasks

(Walsh and Ungson, 1991) and the external information filters of the firm specialize accordingly (Henderson and Clark, 1990). These cognitive and structural biases favor incremental improvements (Todorova and Durisin, 2007). On the organization level, a common reliance on predictable and reliable solutions based on past experience brings success but traps the organization by the search of familiar, mature and proximate knowledge (Ahuja and Lampert, 2001, Leonard-Barton, 1992) whose habitual use without careful consideration of the changing environment reduce the quality of actions taken (Walsh and Ungson, 1991). The NIH syndrome and the retention of habitual behavior are expected to decrease the mental alertness and deteriorate the recognition of external knowledge to be incorporated to the internal knowledge. Thus;

Hypothesis 3: The NIH syndrome is negatively related to the recognition of external knowledge.

The assimilation ability refers to analysis and interpretation of the external knowledge (Zahra and George, 2002). Engaging in idea generation and recognizing potential value of particular external knowledge raise curiosity towards external knowledge among employees. This curiosity is expected to increase the aspiration of the firm and to provide incentive to invest in the promising external developments (Cohen and Levinthal, 1990, Ford, 1996). Comprehension of external knowledge promotes knowledge assimilation which allows the firm to process the external knowledge (Zahra and George, 2002). Thus the firm is likely to give trials to comprehend the external knowledge and observe how this new knowledge works for the knowledge needs. It is expected to be;

Hypothesis 4: The recognition ability is positively associated with the assimilation ability.

Organizational creativity mechanisms provide the resources and thought processes to experiment (Bharadwaj and Menon, 2000). New knowledge may be comprehended with relatively little additional development effort or require more effort to analyze (Todorova and Durisin, 2007). New concepts can be created by reconfiguring the ways the existing knowledge and new knowledge are linked (Henderson and Clark, 1990). The acquired knowledge may be evaluated with the existing knowledge to create new insights (Zahra and George, 2002). The experiences of individuals and artifacts of the firm reflecting prior knowledge and the

newly acquired knowledge are combined and re-combined; more concrete innovation ideas are defined and articulated to become sharable within the organization (Nonaka, 1994). The thought processes, idea generation programs and tools of creativity mechanisms are likely to facilitate the analysis and interpretation of the existing and newly acquired knowledge. Thus:

Hypothesis 5: The use of organizational creativity mechanisms is positively related to the assimilation ability.

The hypotheses are summarized in the figure below:

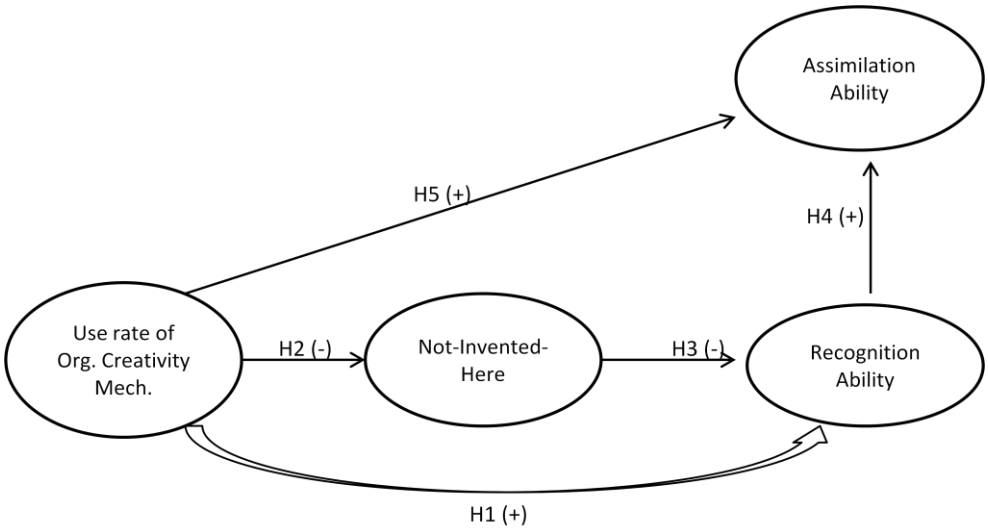


Figure 1. Theoretical Model and Hypotheses

## METHODS

### Sampling and Data

The dataset consists of a group of Danish small and medium sized organizations, with employee sizes of 5 to 499. The data was collected from mostly medium sized firms operating in medium tech industries whose NACE codes are 10-37 and 72. The research team developed the questionnaire in 2010 and pre-tested on two firms. The target population is 3086 firms, all of which were contacted by phone to invite to respond to the survey. The phone interviews resulted in 1241 company agreed to receive the questionnaire which was sent in August 2010. 352 firms responded the questionnaire after two reminders. The number of usable responses of

this study is 346. The response rate calculated on the original population is 11.5% and on the number of population accepted to receive the questionnaire is 28.6%. The questions were responded by R&D or innovation managers, except two firms whose innovation or R&D manager details could not be accessed.

**Measures and Operationalization**

Most measures are adapted from the existing literature. The following sections describe the process of the operationalization of the constructs and assessment of their validity.

Use Rate of Organizational Creativity. This construct adopted from Baharadwaj and Menon (2000) and measures the extent that the firm has instituted formal approaches, tools and resources to encourage meaningfully novel, creative behavior. The organization is asked to respond up to what extent it has a formal creativity, idea generation and innovation program, links new ideas to specific business goals, and has an innovation center or designated location to generate ideas. Items are measured from 1 (not at all) to 7 (have it and use often). Three items together indicate the degree of idea generation for new product development. Cronbach` s alpha of this construct is 0.789.

Recognition and the Assimilation Abilities. The recognition and the assimilation processes` measures are adopted from Lichtenthaler (2009). The processes includes items which are measured on a Likert scale from 1(do not agree at all) to 7 (fully agree) which provides the level of the ability of the firm. A two item scale ($\alpha$= 0.643) captures the extent the firm closely monitors new trends and technological developments and collects information from industry. The scale intends to measure the tendency of the firm to keep in contact with external knowledge environment.

The assimilation ability comprises the activities of acquisition of external knowledge and pairing this knowledge to ideas in the firm. A two item scale ($\alpha$= 0.543) captures the extent the firm acquires technical expertise from external parties and pairs the ideas with it. This scale aims to measure how the firm analyzes and interprets the external knowledge.

Not Invented Here Syndrome. (α= 0.455). This scale is adopted from Søndergaard and Burcharth (2011). A two scale item captures the extent of reluctance to use ideas and technologies from external parties and whether the employees focus on deepening existing knowledge and creating new knowledge in new product development projects (second item reverse coded).

Analyzing meditational relationships is best done with simultaneous structural relations. A two step structural equation modeling (Anderson and Gerbing, 1988) analysis is proposed to study the model. Confirmatory factor analysis specifies the relations of the observed measures to their proposed constructs and assesses the level of measurement error in these constructs. The following path analysis specifies the causal relationships with respect to the theory (Anderson and Gerbing, 1988). The validity and reliability information of constructs and the findings of the path analysis are described below. The hypotheses are tested using MPLUS 6.12 using the maximum likelihood (ML) method, with default start values and maximum number of iterations of the software used.

Table 2. Descriptive statistics

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Creativity Mech 1 | 1,00 | | | | | | | | |
| 2 | Creativity Mech 2 | 0,767* | 1,00 | | | | | | | |
| 3 | Creativity Mech 3 | 0,432* | 0,484* | 1,00 | | | | | | |
| 4 | Recognition 1 | 0,153* | 0,161* | 0,153* | 1,00 | | | | | |
| 5 | Recognition 2 | 0,157* | 0,154* | 0,169* | 0,477* | 1,00 | | | | |
| 6 | Assimilation 1 | 0,228* | 0,241* | 0,229* | 0,406* | 0,395* | 1,00 | | | |
| 7 | Assimilation 2 | 0,114 | 0,157* | 0,229* | 0,378* | 0,469* | 0,374* | 1,00 | | |
| 8 | Not Invented Here 1 | -0,044* | -0,082 | -0,041* | -0,227* | -0,207* | -0,276* | -0,111* | 1,00 | |
| 9 | Not Invented Here 2 | -0081* | -0,167 | -0,141* | -0,341* | -0,423* | -0,288* | -0,411 | 0,307 | 1,00 |
| | Mean | 2,27 | 2,31 | 2,19 | 5,29 | 5,03 | 4,00 | 4,41 | 2,46 | 5,03 |
| | Standard Deviation | 1,80 | 1,78 | 1,86 | 1,23 | 1,31 | 1,30 | 1,33 | 1,24 | 1,24 |
| | Min | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Max | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |

**Construct Analysis**

Measurement Model. Table 1 reports the means, standard deviations information and correlation among all variables. The final number of observations is 346. This number of observations is likely to be sufficient to

produce reliable and replicable models according to recommendations of Hair et al (2006). The measurement is statistically identified has 33 free parameters. The measurement model sample is 500 times bootstrapped to increase the reliability of the results.

Convergent Validity. To ascertain whether the constructs are internally coherent, several tests are conducted and convergent validity is confirmed following Hair et al (2006). Results are reported in the Table 2.

Common Method Bias. In the middle-length questionnaire, the groups of questions measuring the variables of this study are asked in the following rank; (1) the use rate of creativity mechanisms, (2) acquisition of research knowledge, (3) innovative performance level of new products and (4) absorptive capacity learning processes with other questions are scattered among these groups of questions. This rank makes the attention of the informant switch between internal firm processes and external environment forth and back, creating irrelevance against the consistency bias (Podsakoff et, 2003, Salancik and Pfeffer, 1977). Additionally, the wording of the questionnaire has been carefully selected to prevent any of the interested variables becoming salient and affecting the responses of the informant. This reduces the likelihood of item context effects (Podsakoff et, 2003, Salancik and Pfeffer, 1977). Additionally, Herman`s single factor test (CFA) is applied. The model fit deteriorated significantly that it is clear one factor solution is not representative of this dataset. The values of this fit are $\chi^2_{(27)}$=318, 20, p=0.00, RMSEA= 0,177, CFI= 0.609, TLI= 0.478.

Goodness of Fit Measures. To assess the distance between the data and the proposed model, three goodness-of-fit measures are applied. The measurement model has $\chi^2_{(21)}$=30,810, p=0.0769. The insignificant p value (at 5%) provides evidence that the main hypothesis that the estimated model provides good representation of the data cannot be rejected. In other words, the model represents the data adequately. (CFI= 0.987, TLI= 0.977, RMSEA = 0.037 ,SRMR= 0,038).

| Constructs and Items | (std)Factor Loading | t-Value | R2 | Construct Reliability | Avg Var Explained By constructs |
|---|---|---|---|---|---|
| Organizational Creativity Mechanisms | | | | 0,809 | 0,620 |
| Creativity Mech 1 | 0,831 | 26,58 | 0,691 | | |
| Creativity Mech 2 | 0,923 | 30,14 | 0,851 | | |
| Creativity Mech 3 | 0,527 | 12,12 | 0,278 | | |

| | | | | | |
|---|---|---|---|---|---|
| Recognition Process | | | | 0,65 | 0,484 |
| Explorative Lear1 | 0,660 | 14,33 | 0,531 | | |
| Explorative Lear 2 | 0,729 | 16,48 | 0,439 | | |
| Assimlation Process | | | | 0,545 | 0,374 |
| Assimilation 1 | 0,594 | 11,12 | 0,353 | | |
| Assimilation 2 | 0,630 | 11,88 | 0,397 | | |
| NIH | | | | 0,528 | 0,380 |
| Not Invented Here Syndrome 1 | 0,409 | 5,91 | 0,167 | | |
| Not Invented Here Syndrome 2 | 0,770 | 9,29 | 0,592 | | |

Table 3. Convergent Validity of Constructs and Items

**Path Analysis and Findings**

The path model also fits data adequately well since the main hypothesis that the model fits data can not be rejected. ($\chi^2_{(22)}$=30.900, p=0.0982, CFI/TLI= 0.98/0.97, RMSEA=0.034, SRMR=0.038). The standardized factor loading coefficients and their significance level for the estimated path and hypotheses test coefficients for the structural model are provided in the Figure 2.

The relevant parameter estimate for the hypothesis 1 ("The use rate of organizational creativity mechanisms is positively related to the recognition ability*")* is non- significant with a t-value of 1.191. Thus, the meditational hypothesis 1 is supported. The hypothesis 2 ("The use rate of organizational creativity mechanism is negatively related to the NIH syndrome.*")* is also supported with a t-value of -2,628. The hypothesis 3 ("The NIH syndrome is negatively related to the recognition of external knowledge ") is supported with a t-value of -8.122. The direct link introduced to the model between the use of creativity mechanisms and the recognition ability provides insignificant result. This finding implies that the effect of creativity management on the recognition ability is mediated through the attenuation of the NIH syndrome.

It is hypothesized that *"*H4: The recognition ability is positively associated with the assimilation ability*"*. The t-value of 13.334 shows that the association between recognition and transformative ability is positive and significant as expected. On the contrary the expected association between the utilization of creativity mechanisms and the assimilation ability (H5) could not be supported (t value=1.312). These findings imply

that utilization of creativity mechanisms is, indeed, positively associated with the assimilation but this effect is not direct. It is through the attenuation of NIH and development of the external knowledge recognition ability.

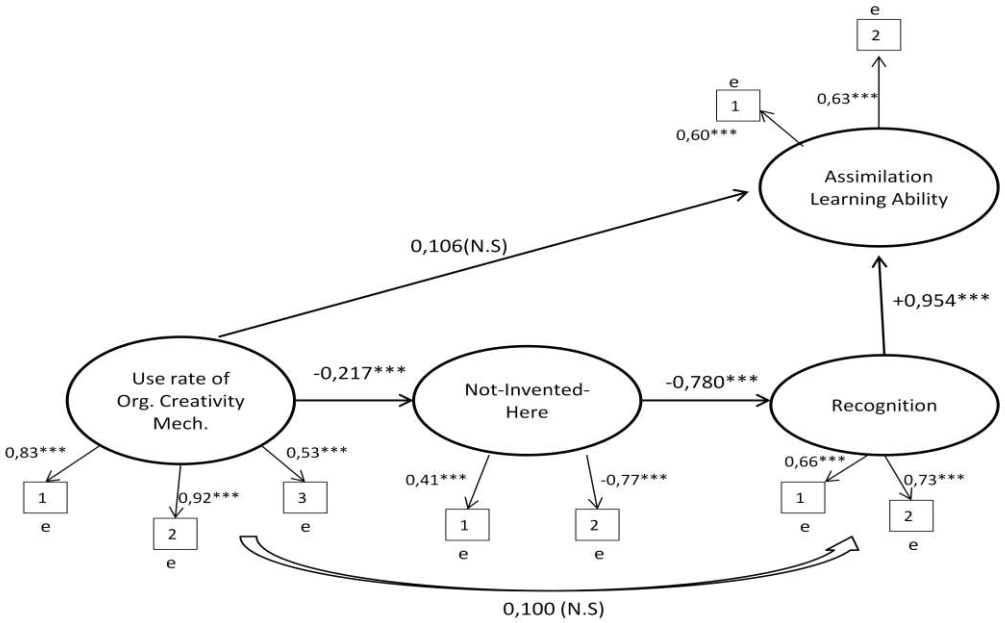


Figure 2. Estimated Path Model. Notes: Numbers in bold pertain to the structural model. *Significance at10%, **at 5% and *** at 1% two tailed test.

## DISCUSSION

This paper focused on the ability of recognizing external knowledge, the ability which allows the absorption of external knowledge to begin. Idea generation and creativity management was suggested to be related to the recognition ability and to the assimilation ability. The findings showed that recognition ability is associated with the use rate of creativity mechanisms and the relationship is mediated through the attenuation of the NIH syndrome. The assimilation ability is also found to be associated with the creativity mechanisms indirectly.

Overall, the paper showed that the creativity management and idea generation is likely to be one of the intra-organizational antecedents of ACAP. In innovation management literature perspective, finding the attenuation of NIH through the use of creativity mechanisms implies that enhancing communication among the employees and raising willingness to acquire external knowledge are important antecedents for creating the

mindset for the OI business model and thus facilitating the implementation of this model. Raising willingness and interest from within the team is especially meaningful in settings where the firm may not avoid stable position of teams (Katz and Allen, 1982). An example of such setting is SMEs. These firms may not afford relying on personal turnover to keep diversity optimum (March, 1991) or cannot rotate employees (Jansen et al, 2005) often due to limited workforce and task requisites. Exploiting the existing workforce by unleashing their creative potential to establish connections to external knowledge environment may prove to be important way of retaining communication necessary to alleviate the NIH problem.

The findings have implications to the organizational creativity literature. This literature has studied personal and contextual characteristics that enhance or impede creativity in the work place (Amabile et al, 1996, Woodman et al, 1993, particularly see Shalley et al, 2004 for a review). Creativity per se has been keen research interest but the consequences of enhancing creativity of employees and the relationship between the external knowledge environment and creativity have not been studied by this literature. Although it has been acknowledged that creativity is necessary but insufficient condition of innovation, a positive relationship between creativity and innovation has been mostly assumed rather than been tested (e.g. Amabile, 1988, Amabile et al, 1996, Woodman et al, 1993). This paper implies that encouraging employees to generate ideas plays active role in establishing connections to the external knowledge environment and supports the analysis and interpretation of the acquired knowledge. Thus the paper finds that stimulation of generation of ideas is likely to be associated with the processes of innovation by influencing recognition of new knowledge. This point apparently requires further research to reveal other associations for doing innovation in open innovation model.

**Limitations and Future Look**

In addition to the structured methods such as formal idea generation programs this paper suggests, the more informal or unstructured methods for fostering creativity emerges as another research opportunity. Throughout a couple of studies, Amabile and her colleagues (Amabile, 1988, Amabile et al, 1996) showed

that work environment factors matters for creativity. These factors, e.g. organizational motivation, innovative attitude, supervisory encouragement, work team encouragement, job autonomy, and reduction of pressures (Amabile et al, 1996), can also be topics of future research in the context of recognition and assimilation of external knowledge. Analyzing these organizational environment factors, NIH and the OI business model relationships reveals whether setting work environment conducive to creativity facilitates the external knowledge recognition and acquisition. How this work environment may help adapting the mindset and the culture in the organization to facilitate the implementation of OI business model (Chesbrough, 2003, Chiaroni et al, 2010) emerges as a research opportunity.

In addition to the creativity management this paper proposes, other ways of retaining communication and interest toward new developments in R&D teams should also be considered.

The study has limitations of which some provide further research opportunities. The measures are relatively weak; especially the NIH measure is coarse. The current scales measure the attitude towards overall external knowledge. The R&D team may exhibit different behavior towards different external knowledge. As Katz and Allen (1982) observed communication with universities is more vulnerable to NIH than is communication with suppliers. Further research may study NIH behavior according to different knowledge sources to deepen understanding on the search behavior of firms. Besides, studying supplier search and NIH relationship in the context of knowledge integration may reveal new insights. Currently, the surveys do not address knowledge integration or architectural innovation as Laursen and Salter (2006) mentioned and therefore cannot detect whether firms search suppliers for incremental, radical or architectural innovation purposes. NIH syndrome may be more prevalent for suppliers of certain type of innovation. For example suppliers whose knowledge is cognitively distant to the firm may be overlooked at the detriment of future innovation performance. A closely related future research avenue is the absorptive capacity dimensions and the NIH relationship. The intra-firm transfer of knowledge is not straightforward according to Szulanski (1996). One of the reasons of intra-firm transfer difficulty is the perceived causal ambiguity in the way certain practices are interrelated and how the system works successfully. How this causal ambiguity perception and the NIH are associated to the different

absorptive capacity dimensions remains as future research opportunity. In sum, a focused NIH study involving these opportunities to develop more detailed scales may benefit the innovation literature significantly.

Recalling the difference between scientists and engineers draws attention to the workforce characteristics, and other managerial incentives to increase job satisfaction of scientists and engineers, particularly when the structure of the R&D tasks becomes integration oriented in the OI model. Communicating the aim of the OI business model (Chesbrough and Crowther, 2006) is a way of facilitating the implementation of an open approach to innovation. Besides, selection and training of employees best adapting to this model and education of engineers supporting the OI mindset can be further research topics.

The study has other limitations. The study reflects only Danish organizations` conditions. A more heterogeneous sample in terms of origin of organizations may also provide new insights. Another limitation is the possibility of common method bias and use of cross-sectional data. Although, precautions described were taken, the presence of this problem cannot be totally ruled out especially in cross-sectional settings.

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