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Published in:
International Journal of Knowledge and Systems Science

DOI:
[10.4018/IJKSS.2018100101](https://doi.org/10.4018/IJKSS.2018100101)

Published: 01/10/2018

Document Version
Publisher's PDF, also known as Version of record


Please cite the original version:
Matsushita, H., Lillrank, P., & Ichikawa, K. (2018). Human competency as a catalyzer of innovation within health and nursing care through a perspective of complex adaptive systems. *International Journal of Knowledge and Systems Science*, 9(4), 1-15. <https://doi.org/10.4018/IJKSS.2018100101>

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Human Competency as a Catalyzer of Innovation Within Health and Nursing Care Through a Perspective of Complex Adaptive Systems

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ABSTRACT

The aim of this article is to analyze some features of nursing manager competencies as a potential agent of innovation through a perspective of complex adaptive systems. To achieve the objective, an empirical quantitative analysis of the data obtained through structured questionnaires was conducted to identify the key aspects of perceptions related to competencies. The results demonstrated a disparity between what nursing managers perceived as “my strength” and what they perceived as “critical in adopting innovation” with respect to competencies. This study empirically identified key competencies relevant to nursing managers in adopting innovation through a perspective of encompassing complex adaptive systems. The nursing managers surveyed tended to consider their strengths included interpersonal understanding, teamwork, self-control and concern for order. From a viewpoint of innovation adoption, there is room for improvement for nurses to develop such competencies as initiative, team leadership, conceptual thinking, analytical thinking, and organizational awareness.

KEYWORDS

Competency, Complex Adaptive Systems, Healthcare, Innovation Adoption, Innovation Diffusion, Nursing Manager

INTRODUCTION

Today, adaptation to innovation for healthcare institutions is one of the most important management agendas (Djellal and Gallouji, 2005; Lillrank, 2018). In particular, large acute care hospitals equipped with leading-edge technologies and high-caliber professionals are currently facing significant transformative processes due to technological innovation (Gallouji and Windrum, 2009; Matsushita, 2017; Lillrank, 2018).

The hospital where the authors conducted the research is one of the largest acute care hospitals in Japan equipped with cutting-edge technologies. Innovation based on new technologies currently introduced by this hospital includes: molecular targeted medicine, da Vinci (a surgical support robot), bone marrow transplant, Interactive voice response/computer-telephony (IVR-CT) integration,

DOI: 10.4018/IJKSS.2018100101

minimally invasive endoscopic treatment, gene-modified cell therapy, chromosome examination, high intensity open intensive care unit, telemedicine, next-generation multi-slice computed tomographic scanning, artificial intelligence diagnostic imaging system, electric medical and health records and introduction of standardized and harmonized terminology. The introduction or adoption of technological innovation has had an impact not only on clinical procedures for patient care but also on healthcare and nursing management areas such as information/knowledge management, inter-professional team collaboration, human resources management, and organizational development.

Given that a hospital is a critical social system through which adoption and diffusion of innovation occur, the in-house innovators related to a wide range of healthcare practices can play a central role in facilitating innovation adoption. Currently, in-house innovators including physicians, nurses, therapists, and medical technologists function via communication channels of inter-professional teams involving nursing managers. Thus, the process of innovation adoption inevitably requires nursing managers, who are accustomed to more ordinary accountabilities, and thus they should evolve to have a different competency set from their conventional set. However, there is a lack in empirical research work analyzing nursing managers' perception of competencies required to adopt innovation in Japan. Therefore, this study aims to empirically analyze the characteristics of competencies of nursing managers as innovation adopters, to see if they can perform their jobs and facilitate adoption of technological innovations.

BACKGROUND

The institution where this research was conducted was a Japanese acute care hospital with one thousand beds. The hospital is located in the western part of mainland of Japan. The hospital currently employs four hundred physicians, thirteen hundred nurses, one hundred pharmacists and five hundred diverse co-medical practitioners. The context of this study was based on concerns that nursing managers may not be au fait in facilitating innovation; indeed, some had to effectively adapt to new technologies while others had not. Consequently, hospital management regarded that there was the possibility for improvement in the alignment of continuing education systems in developing competencies in order to effectively adopt technological innovations. Then, senior management requested the authors to research and identify areas of improvement in competency development, especially from the standpoint of innovation adoption on the part of nursing managers.

Healthcare systems in Japan are constructed on a foundation of social health insurance, which achieved universal population coverage in 1961. A closed system, in terms of employment, has been dominant; wherein health professionals are employed by health service organizations such as hospital. It should be noted that through the reimbursement system, the government has provided financial incentives to acute care hospitals when they begin intervention based on newly introduced innovation.

The conventional role models of nursing managers, first-line managers in particular, have been developed as role models such as leader, administrator, manager, planner, educator, organizer, problem solver, and integrator of resources (McEachen and Keogh, 2006; Skytt et al., 2008; Studer Group, 2010). However, few studies have approached the nursing manager as an innovator role model in the process of adoption and diffusion of innovation (McSherry et al., 2011; Harris et al., 2013). Therefore, more attention should be paid on the role of innovation adoption in nursing manager objectives. As such, this research is an attempt to precipitate the expected competencies of nursing managers, specifically in the process of adoption and diffusion of innovation through a perspective of complex adaptive systems.

Complex Adaptive Systems

This study describes the contexts related to adoption of technological innovation on the part of nursing managers by applying a Complex Adaptive Systems (CAS) framework. One of the most commonly accepted definitions of CAS, based on the work of John Holland, is a dynamic network of agents acting

in parallel, constantly reacting to what the other agents are doing, which consequently influences behavior and the network as a whole (Holland, 1992). Complexity Science has been embraced by many nursing and healthcare researchers and practitioners in their quest to understand multilevel and complicated organizational behavior (Clancy et al., 2008; Griffiths, 2007; Lindberg et al., 2008).

The affinity is observed between the diffusion of innovations and CAS theory, particularly when it comes to the construction of predictive or applied hybrid models of induced change in human behavior (Rogers et al., 2005). The diffusion of innovations model delineates the complex process by which an innovation spreads via certain communication channels among members of a social system (Rogers, 2003). The CAS considers self-organization phenomena of the complex process in which various agents interact through diversified communication in adopting and diffusing innovation too. Given that a hospital is a critical social system through which adoption and diffusion of innovation occur, the innovator within a hospital can play a central role in facilitating the complex emergence of innovation adoption. The innovators may include physicians, nurses, medical technicians, and business entrepreneurs. Diffusion occurs in complex systems where networks connecting system members are overlapping, multiple, and complex. Diffusion occurs most often in heterogeneous zones, i.e., transitional spaces where sufficient differentiation among network members arises. Such heterogeneous network connections, which comprise the innovation-diffusion system, occur among innovators and other engaged members of target populations who, in Rogers' original formulation, are called "cosmopolites" (Rogers et al., 2005).

The healthcare institution, as a CAS, is constantly revising preliminary predictions by adopting ideas produced by innovative agents. In other words, a CAS is constantly self-organizing by mixing stability and creativity. The CAS depends on a dynamic mechanism of value co-creation; that is, to create new value by mixing and balancing creativeness and control in a constantly shared context-in-motion.

Competency

There may be many factors involved in communication channels via which innovation is diffused and adopted. However, this study specifically assumes that human competencies inherent in an agent play a salient role in adopting innovation.

Competency has been a research target for a number of decades. Many researchers have contributed to the formation of a theory, partly based on their predecessors' findings, about competencies for developing human resources and a sustainable competitive edge for both individuals and organizations. The first study that specifically focused on competency was conducted in the realm of psychology in the 1970s (McClelland, 1973). It defined competence "as a personal trait or set of habits that leads to more effective or superior job performance, in other words, an ability that adds clear economic value to the efforts of a person on the job."

Over the last four decades, competencies and competency models have become an inseparable part of human resource management and have been widely used as the means for increasing personal and organizational effectiveness. Human competency has been regarded as crucial in addressing healthcare, and is one of the major competitive factors that can differentiate organizational competence in terms of service quality, service provision, and service design (Fried, 2008; Hernandez, 2009; Ginter, 2013; American Organization of Nurse Executives, 2015). As such, competency modeling has currently become a globally accepted approach and a popular management agenda (Alldredge and Nilan, 2000; Bartlett and Ghoshal, 1997; Pickett, 1998; Schippman et al., 2000; Winterton and Winterton, 1999). It is obvious, however, that different researchers with various backgrounds advocate different approaches and definitions of competency (Parveen, 2002; Rankin, 2002; Suar and Dan, 2001; Ulrich, 2012).

Consequently, the questionnaire used in this study was based on the theoretical framework and definitions proposed by Spencer (1993) and later refined by Matsushita (2012). Spencer was aligned with the academic idea initiated by McClelland (1973), and further developed by Boyatzis (1982)

and Spencer (1993); that competency is an underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation. A theory of competency includes complex and hierarchical elements such as motives, traits, self-concept, attitudes, values, and skills, as well as their dynamic interactions (Boyatzis, 1982). It should be noted that human competencies, as inseparable parts of an agent, also compose a CAS. In this sense, this study regards a nursing manager as a “complex adaptive agent” particularly in the contexts of innovation adoption.

METHOD

This study was conducted in a structure that incorporated quantitative approaches. A quantitative analysis of the data obtained through the structured questionnaires (Appendix A) was conducted to identify three aspects of perception or cognitive presentation related to competencies: (1) the competencies that nursing managers perceive as indicative of their own competencies, (2) the competencies that nursing managers perceive as critical in adoption of technological innovation, and (3) the perception disparity between these two competencies.

The competencies and their abbreviations that were adapted in our study were as follows; Team Leadership (TL), Directiveness (DIR), Developing Others (DEV), Team Work (TW), Achievement Orientation (ACH), Initiative (INT), Customer Satisfaction Orientation (CSO), Concern for Order (CO), Flexibility (FLX), Analytical Thinking (AT), Conceptual Thinking (CT), Information Seeking (INF), Expertise (EXP), Impact and Influence (IMP), Interpersonal Understanding (IU), Relation Building (RB), Organizational Awareness (OA), Self Confidence (SCF), Self-Control (SCT), and Organizational Commitment (OC). The full list of twenty competencies and their definitions are provided in Appendix A.

In order for us to quantify the degree of perceived importance and cognitive ranks as well, the nursing managers were requested to read the list of competencies and their definitions and select the six items they considered most important. The researchers assigned 6 points to the number 1 item, 5 points to the number 2 item, 4 points to the number 3 item, 3 points to the number 4 item, 2 points to the number 5 item, and 1 point to the number 6 item in order to quantify relative perceived importance of competencies.

Ethics

This survey project was examined and later authorized by the research ethics committee of Tokyo University of Information Sciences (Authorization number: 30-012). The survey and questionnaire were also approved by the Center for Human Resources Development of the hospital. When questionnaires were distributed to the employees, confidentiality was duly protected to safeguard the rights, privacy, and anonymity of persons involved. Letters explaining non-disclosure and confidentiality terms were shared to all of the survey participants prior to the collection of the questionnaires.

Analytical Frame and Research Questions

By encompassing the aforementioned discussions, an analytical frame was originally designed in order to address the research question of this study (Figure 1). The analytical framework and research questions were set as follows:

In a particular context in healthcare institution, new technologies inevitably influence diversified clinical practices and procedures provided by healthcare professionals including nursing managers. Since healthcare professionals perform their jobs by utilizing their competencies, the competencies inherent in healthcare professionals continuously alter to effectively accommodate new technology innovation. By adopting new technologies, agents or healthcare professionals in turn extend and develop their competencies and adapt themselves to new technologies. Then, clinical innovation, or the new clinical method to utilize newly introduced technology, is created and emerged by the recursive and constant linkage of such competency and technology. As such, this analysis framework

recognizes dynamically the human competence in the linkage between new technology and new clinical service creation.

Here, the research questions were put simply, those were; (1) what human competencies, if any, are expected to enhance and accelerate new technology adoption? (2) What are the differences between the self-reflective “as is” perception about strong competencies and the preferred “*should be*” perception when nursing managers consider themselves to be an adopter of new technological innovation?

Our empirical research was conducted in cooperation with the acute care hospital primarily based on such analytical framework and the research questions.

RESULTS AND FINDINGS

A total of 112 nursing managers (average year 43.6 years old; average service year 14.2 years) replied to the distributed questionnaires (Appendix A). Survey Question 1 (Q1), “What are your strengths in terms of competencies?” measured each nursing manager’s perception of their personal strengths in competencies, whereas Question 2 (Q2), “What competencies do you believe are critical to adopting new technologies?” measured which competencies they perceived to be critical for adoption of new technological innovations. A comparison between the two questions suggested a subjective gap between the self-reflective “as is” perception about strong competencies and the preferred “should be” perception when nursing managers consider themselves to be an adopter of new technological innovation (Figure 2).

Disparities varied significantly among the 20 competency items (Table 1). Here, disparity indicated differences in score between “my strength” and “critical for technology adoption”. When

Figure 1. Analytical frame: co-evolution model of new technology and human competency

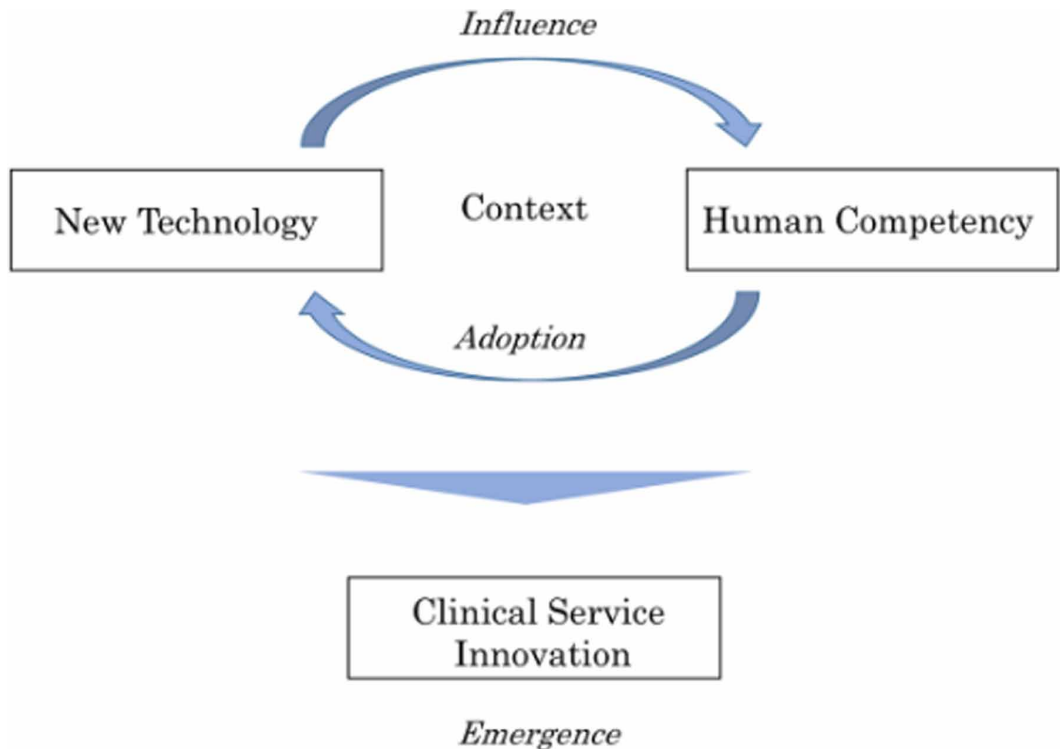


Figure 2. Perception disparity between “my strength” and “critical for new technology adoption”



score of “critical in technology adoption” was greater than that of “my strength”, the disparity score simply became negative (-). Likewise, when the latter was greater than the former, the score became positive (+).

Positive disparities were comparatively greater in competencies such as Initiative (282), Team Leadership (113), Conceptual Thinking (133), and Analytical Thinking (113), whereas negative disparities were comparatively greater in competencies such as Interpersonal Understanding (-261), Teamwork (-245), Self Control (-199), and Flexibility (-152). It should be noted that in this survey t-test and p-value (significance probability) analysis are not appropriate, as we quantified the ranking recognized in 20 competency items.

IMPLICATIONS AND DISCUSSION

Based on the aforementioned survey results, the competencies nursing managers perceived to be critical in adopting new technological innovation were interpreted by describing some of the characteristics related to competencies. One possible interpretation of the data obtained could be as follows:

Competencies Adaption to Technological Innovation

In identifying subjects, the fundamental driver for an adaptive nursing manager is information seeking, i.e. there is an underlying curiosity and a desire to know more about things, people, or issues. The agent makes an effort to get more pieces of information both qualitatively and quantitatively, never accepting situations at face value. The adaptive agent not only seeks information but also processes information by utilizing analytical thinking; that is, understanding a complex situation by breaking it into observable pieces, or tracing the embedded implications of a situation in a step-by-step causal way. Simultaneously, he or she is competent in integrating holistically analyzed subjects, if any, into

Table 1. Disparity between “my strength” and “critical for technology adoption”

	Critical for new tech. adoption	My strength	Disparity
1.Team Leadership	264	92	172
2.Directiveness	97	54	43
3.Developing Others	106	111	-5
4.Team Work	140	385	-245
5.Achievement Orientation	145	144	1
6.Initiative	310	28	282
7.Customer Satisfaction Orientation	98	201	-103
8.Concern for Order	39	126	-87
9.Flexibility	149	301	-152
10.Analytical Thinking	184	71	113
11.Conceptual Thinking	167	34	133
12.Information Seeking	171	40	131
13.Expertise	50	132	-82
14.Impact and Influence	36	79	-43
15.Interpersonal Understanding	27	288	-261
16.Relation Building	101	250	-149
17.Organizational Awareness	130	49	81
18.Self Confidence	30	30	0
19.Self Control	22	221	-199
20.Organizational Commitment	86	109	-23

concepts by effectively executing conceptual thinking, or the ability to identify hidden patterns or inter-connectivity between situations and contexts that are not obviously related, and to identify key or underlying issues in complex situations. Nursing managers who are competent in adopting innovation are expected to have such cognitive competencies as information seeking, analytical thinking, and conceptual thinking in a close-knit environment, while interdependent relations with other agents acting within different contexts may also help.

By constantly interacting with various agents and utilizing aforementioned cognitive competencies, nursing managers are expected to have a strong initiative; she or he is keen in identifying a problem, obstacle or opportunity and willing in adopting innovation to address current or future problems or opportunities. A higher level of initiative manifests itself in relations with other agents in the competency of team leadership; the intention to take a role as a team or other group. In other words, this could be a desire to lead others in adopting technological innovation as Rogers (2003) describes an “innovator”. However, adaptive nursing managers are well aware of the negative spillover of technological innovations; they can often precipitate opposition, confusion, conflict, and complication for networks of agents who are accustomed to conventional ways of doing things. To effectively cope with such circumstances, nursing managers are also competent in organizational awareness or the ability to understand the power relationships in his or her network or in another network. They may also appreciate at the higher levels, the position of the institutions in the larger world.

In healthcare institutions, there exists a complex network of interactions among a large number of agents who are acting in parallel. When nursing managers are confronted with the opportunity to change due to unfamiliar and turbulent technological innovation, their efforts to do so are often unsuccessful. Since they are part of the change context itself, they have to act in a way that is different

from such conventional competencies of the administrative leader as interpersonal understanding, teamwork, self-control and concern for order in order to become successful change leaders.

Continuous Quality Improvement Versus Innovation

The Quality Control Circle (QCC) was a Japanese organizational practice that attracted a lot of international attention in the 1980s, 1990s and 2000s. Given that the Japanese hospitals and industrial sectors have shared the QCC method for a long period of time, it is obvious that the teams at Japanese hospitals have been influenced by the QCC approach. The surveyed hospital also installed the QCC more than twenty years ago, and since then, the QCCs have been active in daily operations. The QCC is usually mono-functional: it involves people from the same organizational unit who joined together voluntarily to find ways to improve quality in their work. It is not a way to organize work, but to organize continuous quality improvement. The QCC has no formal authority to make changes, it only solves problems and present improvement suggestions to management. Neither was it accountable for results, since it was a voluntary group (Lillrank, 2012).

A QCC, based on team activity, is a way to organize collaborative practices where a homogeneous set of competencies provided by experts is required to improve quality. The circle is the organizational unit that does the ordinary work, and has the corresponding resources, authority, and accountability. Since such tasks typically can be described as processes, this way of organizing work is the process organization – contra the functionally organized hierarchical line organization. The team-based process organization typically excels at flow efficiency, i.e., the throughput time is short, work-in-process inventories (patients waiting) are low, and patients can get rather flexible and personalized care.

The objective of QCC activities is the introduction of incremental quality improvement, not adaptation to destructive innovation fundamentally transforming the way of regular work. Therefore, if a hospital relies too much on QCC activities, then it will lose the organizational behavior to fundamentally change the work itself by introducing destructive innovation. QCC activities will gradually improve quality and cost reduction based on the current situation. Innovation adaptation is not so. Rather, it envisions a figure that should be, and boldly changes the present situation. In the era of change, hospitals need both operational improvement and strategic innovation as well. However, if a healthcare institution over-adapts only to QCC activities, it will be neglected to apply to destructive innovation.

Whether emphasis is on continuous quality or emphasis on radical innovation leads to conflict between conservatism and radicalism. Hospitals with strong traditionalism, such as seniority and group harmony, tend to be late for innovation adaptation. It is considered that there are such organizational problems as a background that nursing administrators regard leadership as the most important competency to adopt innovation effectively. What is required for continuous quality improvement is leadership that admits the current situation and gradually changes those. What is necessary to adapt to destructive innovation is a leadership that denies the present situation and causes a fundamental change. Nursing managers recognize that the competency of Team Work (385) in QCC activities is relatively excellent. However, nursing managers do not place importance on such teamwork in order to capture innovation. Rather, nursing managers emphasize the importance of Initiatives (310) and Team Leadership (264) to adapt to innovation.

Disequilibrium Between Competencies and Job Contexts

According to the existing job description for nursing managers, the standard accountabilities include such items as:

1. Plan, develop, evaluate and update care unit objectives
2. Secure patient safety and satisfaction
3. Improve quality of care continuously
4. Develop and retain caliber nursing staff

5. Increase efficiency by effectively controlling bed utilization
6. Conduct risk management
7. Develop and maintain desired relations with the concerned community

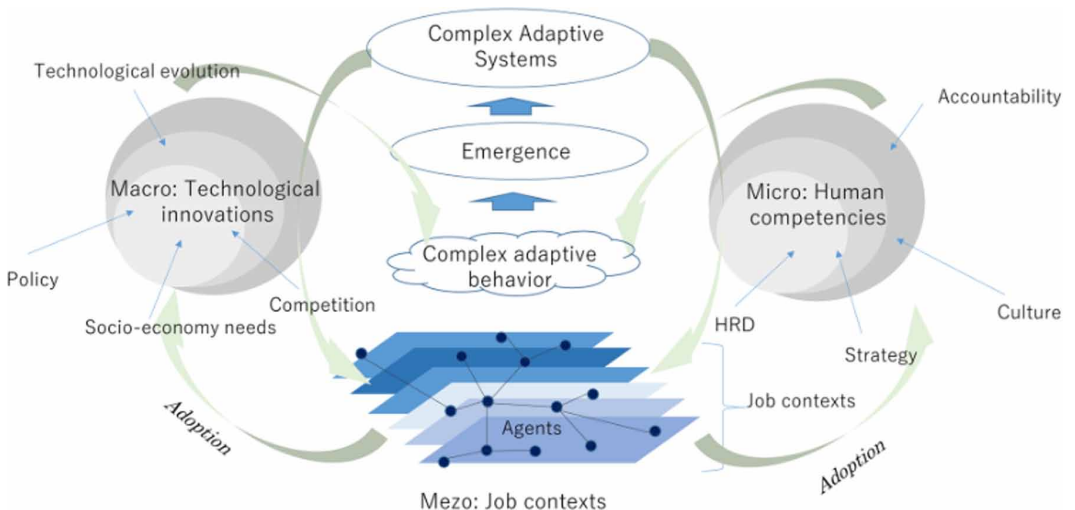
The competencies perceived as “my strength” could be a result of adaption to those conventional job accountabilities, since nursing managers have been carrying out their jobs in accordance with the job description for many years. It is possible that introduction and innovation of novel technologies could influence varied job contexts to achieve accountability for the end result. However, it is likely that nursing managers expect to acquire quite different competencies than those that nursing managers perceive as indicative of their own competencies in order to adopt innovation.

Perception disparity between “my strength” and “critical for new technology adoption” (Figure 2) suggests that human competencies are never static in a job context. Rather, competencies can be altered and adaptively evolve through ever-changing job contexts. It further implies that, at the micro level, job contexts and competencies are co-revolutionary; they are in the endless process of reciprocal evolutionary changes as they interact with one another. In other words, innovation adoption brings about disequilibrium between ordinary job contexts and required human competencies. It is not sufficient for nursing managers to have ordinary competencies in order to pursue a very different job context; that is, the adoption of innovation can result in new outcomes. Nursing managers are expected, by and large, to attain an altered state of equilibrium by continuously evolving new competency sets. Thus innovation adoption requires them to co-evolve hybrid and hyper-competency sets in concert with ever changing contexts caused by the emergence of new technologies.

As shown in Figure 3, new technological innovation influences the agents in conventional job contexts at an existing healthcare institution. Second, adaptive agents in the conventional contexts in a certain healthcare institution adopt innovation by acquiring or shifting to a new competency set. Third, adaptive actors have innate human competencies present as a catalyzer in the process of innovation adoption.

Fourth, collective interaction among agents leads to generation of complex adaptive behaviors, which in turn precipitates the application of technological innovation, i.e., innovation in clinical practices. Fifth, complex adaptive systems emerge as a result of reaching equilibrium between technological innovation and human competencies. Sixth, the state of equilibrium is broken by the presence of new technological innovations. Finally, the concerned agents are able to attain another

Figure 3. Co-evolution of technology and human competency



altered state of equilibrium by continuously adopting technological innovation and evolving new competency sets. It should be noted, however, that these seven phenomena manifest themselves simultaneously, not chronologically; these constitute some of the characteristics of complex adaptive systems.

LIMITATIONS

There are some limitations to consider with regard to the findings of this study. First, the twenty competencies used in this study do not necessarily have a solid promise to fully cover all the human competencies that it has. With adopting innovation, humans can possibly acquire completely different competency set. Second, this study extracted and investigated one of many high acute phase hospitals in Japan as a sample. Therefore, there is no strict guarantee that it generally applies to all nursing managers of all high acute care hospitals. Third, we do not have a way to validate the findings. Given that this study is no more than a single study conducted in one of many acute care hospitals in Japan, we therefore suggest that future longitudinal studies will be necessary to further examine the issues discussed in this paper.

CONCLUSION

The findings of this study indicated that nursing manager competencies required by technological innovation adoption are different from those that they personally regard to be strong personal competencies. Thus, innovation adoption requires them to co-evolve hybrid and hyper-competency sets in relation to ever-changing contexts primarily caused by the introduction of novel technologies. A nursing manager, as an adaptive agent, has innate competencies that present as a catalyzer in the process of innovation adoption in such complex adaptive systems as acute care hospitals. In the hospital, the quality control circle is not appropriate as an activity corresponding to innovation, so other types of platform for inter-professional collaboration is required. In order for nursing managers to be effective adaptive agents in technological innovation adoption, there may be room for developing such competencies as information seeking, analytical thinking, conceptual thinking, initiative, and team leadership. In an era where technological innovations are evident and imminent, continuing educational systems should also pay attention to development of such competencies.

DISCLOSURES

The authors have no conflicts of interest directly relevant to the content of this article.

ACKNOWLEDGMENT

This work was supported by Japan Society for the Promotion of Science Grant-in-Aid for Scientific Research (C) Grant Number 19K10491.

REFERENCES

- Allredge, M. E., & Nilan, K. J. (2000). 3M's leadership competency model: An internally developed solution. *Human Resource Management, 39*(2-3), 133–145. doi:10.1002/1099-050X(200022/23)39:2/3<133::AID-HRM4>3.0.CO;2-8
- American Organization of Nurse Executives. (2015). AONE Nurse Manager Competencies. Retrieved from <http://www.aone.org/resources/nurse-leader-competencies.shtml>
- Bartlett, C. A., & Ghoshal, S. (1997). The myth of the generic manager: New personal competencies for new management roles. *California Management Review, 40*(1), 92–116. doi:10.2307/41165924
- Boyatzis, R. E. (1982). *The Competent Manager: A Model for Effective Performance*. New York, NY: Wiley.
- Clancy, T. R., Effken, J. A., & Pesut, D. (2008). Application of complex systems theory in nursing education, research, and practice. *Nursing Outlook, 56*(5), 248–256. doi:10.1016/j.outlook.2008.06.010 PMID:18922279
- Rogers, E. M., Medina, U. E., Rivera, M. A., & Wiley, C. J. (2005). Complex Adaptive Systems and the diffusion of innovations. *The Innovation Journal, 10*(3), 30.
- Djella, F., & Gallouj, F. (2005). Mapping innovation dynamics in hospitals. *Research Policy, 34*(6), 817–835. doi:10.1016/j.respol.2005.04.007
- Fried, B. J., & Fottler, M. D. (Eds.). (2008). *Human Resources in Healthcare: Managing for Success* (3rd ed.). Chicago: Health Administration Press.
- Gallouj, F., & Windrum, P. (2009). Service and service innovation. *Journal of Evolutionary Economics, 19*(2), 141–148. doi:10.1007/s00191-008-0123-7
- Ginter, P. (2013). *The Strategic Management of Health Care Organizations* (7th ed.). San Francisco, CA: Jossey-Bass.
- Griffiths, F. (2007). Complexity science and its relevance for primary health care research. *Annals of Family Medicine, 5*(4), 377–378. doi:10.1370/afm.727 PMID:17664507
- Harris, R., Janette Bennett, J., & Ross, F. (2013). Leadership and innovation in nursing seen through a historical lens. *Journal of Advanced Nursing, 70*(7), 1629–1638. doi:10.1111/jan.12325 PMID:24313536
- Hernandez, S. R., & O'Connor, S. J. (2009). *Strategic Human Resources Management in Health Services Organizations* (3rd ed.). NY: Delmar.
- Holland, H. (1992). *Adaptation in natural and artificial systems: an introductory analysis with applications to biology, control, and artificial intelligence*. Cambridge, MA: MIT Press. doi:10.7551/mitpress/1090.001.0001
- Lillrank, P. (2012). Integration and coordination in healthcare: An operations management view. *Journal of Integrated Care, 20*(1), 6–12. doi:10.1108/14769011211202247
- Lillrank, P. (2018). *The Logics of Healthcare. The Practitioner's Guide to Health System Science*. FL. Boca Raton: CRC Press / Taylor & Francis Group.
- Lindberg, C., Nash, S., & Lindberg, C. (2008). *On the Edge: Nursing in the Age of Complexity*. Bordentown, NJ: Plexus Press.
- Matsushita, H. (2017). *Innovation of Healthcare and Nursing*. Medica Publishing.
- Matsushita, H., & Kijima, K. (2012). Value Co-creation of Health Care Services through Competency Modeling. *International Journal of Knowledge and Systems Science, 3*(4), 1–15. doi:10.4018/jkss.2012100101
- McClelland, D. (1973). Testing for competence rather than for intelligence. *The American Psychologist, 28*(1), 1–14. doi:10.1037/h0034092 PMID:4684069
- Mceachen, I., & Keogh, J. (2006). *Nurse Management Demystified*. New York, NY: McGraw-Hill.
- McSherry, R., & Douglas, M. (2011). Innovation in nursing practice: A means to tackling the global challenges facing nurses, midwives and nurse leaders and managers in the future [Editorial]. *Journal of Nursing Management, 19*(2), 165–169. doi:10.1111/j.1365-2834.2011.01241.x PMID:21375618

Parveen, N. (2002). Smart enough for IT. *Human Capital*, 5(10), 56–60.

Pickett, L. (1998). Competencies and managerial effectiveness. *Public Personnel Management*, 27(1), 103–115. doi:10.1177/009102609802700110

Rankin, N. (2002). Raising performance through people: The ninth competency survey. *Competency and Emotional Intelligence*, 2-21.

Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.

Sackett, P. R., & Laczko, R. M. (2003). Job and work analysis. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), *Handbook of psychology* (Vol. 12, pp. 21–37). NJ: Wiley.

Skytt, B., Carlsson, M., Ljunggren, B., & Engström, M. (2008). Psychometric testing of the Leadership and Management Inventory: A tool to measure the skills and abilities of first line nurse managers. *Journal of Nursing Management*, 16(7), 784–794. doi:10.1111/j.1365-2834.2008.00912.x PMID:19017240

Spencer, L. (1993). *Competence at Work: Models for Superior Performance*. New York, NY: John Wiley & Sons, Inc.

Studer Group. (2010). *The Nurse Leader Handbook: The Art and Science of Nurse Leadership* (1st ed.). Chicago, IL: Fire Starter Publishing.

Suar, D., & Dan, A. (2001). Competency assessment and need identification for training. *IJTD Journal*, XXXI(4), 68–76.

Shippmann, J. S., Ash, R. A., Batjsta, M., Carr, L., Eyde, L. D., Hesketh, B., ... & Sanchez, J. I. (2000). The practice of competency modeling. *Personnel Psychology*, 53(3), 703–740. doi:10.1111/j.1744-6570.2000.tb00220.x

Ulrich, D., Brockbank, W., & Johnson, D. (2008). *HR Competencies: Mastery at the Intersection of People and Business*. Alexandria, VA: Society of Human Resource Management.

Winterton, J., & Winterton, R. (1999). *Developing Managerial Competence*. London: Routledge. doi:10.4324/9780203264492

APPENDIX A: QUESTIONNAIRE

To the participants of the survey:

Please read the following list of competencies and answer the following questions.

Q1. What are the top six competencies that you think are indicative of your competencies? Select the six items from the list below and write the number in accordance with the degree that you think you are competent.

Q2. What are the top six competencies you think are critical for a nursing manager to adopt technological innovation? Select the six items from the list below and write the number in accordance with the degree to which you think each is critical.

List of Competencies

1. Team Leadership (TL)

The intention to take a role as a team or other group. A desire to lead others.

2. Directiveness (DIR)

The individual's intent to make others comply with his or her wishes. Directive behavior has a tone of "telling people what to do".

3. Developing Others (DEV)

A genuine intent to foster the long-term learning or development of others with an appropriate level of need analysis and other thought or effort.

4. Team Work (TW)

The intention to work cooperatively with others, to be part of a team, to work together, as a member of a group (rather than as a leader) as opposed to working separately or competitively.

5. Achievement Orientation (ACH)

Wants, plans, acts to meet or surpass a standard of excellence; measures outcomes against goals; innovates to improve; takes calculated risks to do something new or better.

6. Initiative (INT)

Identification of a problem, obstacle or opportunity and taking action in light of that to address current or future problems or opportunities.

7. Customer Satisfaction Orientation (CSO)

A desire to help or serve clients, to meet their needs. It means focusing one's efforts on discovering and meeting the client's needs.

8. Concern for Order (CO)

An underlying drive to reduce uncertainty in the surrounding environment. It is expressed in such forms as monitoring and checking work or information, insisting on clarity of roles and plans.

9. Flexibility (FLX)

The ability to adapt to and work effectively with a variety of situations, individuals, or groups.

10. Analytical Thinking (AT)

Understanding a situation by breaking it apart into smaller pieces, or tracing the implications of a situation in a step-by-step causal way.

11. Conceptual Thinking (CT)

The ability to identify patterns or connections between situations that are not obviously related, and to identify key or underlying issues in complex situations.

12. Information Seeking (INF)

An underlying curiosity, a desire to know more about things, people, or issues drives Information Seeking. Making an effort to get more information, not accepting situations “at face value”.

13. Expertise (EXP)

Mastery of a body of job-related knowledge, and also the motivation to expand, use, and distribute work-related knowledge to others.

14. Impact and Influence (IMP)

Actions to persuade, convince, influence or impress others, in order to get them to support the speaker’s agenda; or the desire to have a specific impact or effect on others.

15. Interpersonal Understanding (IU)

Want to understand other people. It is the ability to accurately hear and understand the unspoken or partly expressed thoughts, feelings and concerns of others.

16. Relation Building (RB)

Builds or maintains friendly, reciprocal, and warm relationships or networks of contacts with people.

17. Organizational Awareness (OA)

The individual’s ability to understand the power relationships in his or her own organization or in another organization, and at the higher levels, the position of the organization in the larger world.

18. Self Confidence (SCF)

A belief in one's own capability to accomplish a task and select an effective approach to a task or problem. Confidence in one's ability as expressed in increasingly challenging circumstances, and confidence in one's decisions or opinions.

19. Self Control (SCT)

The ability to keep emotions under control and to restrain negative actions when tempted, when faced with opposition or hostility from others, or when working under conditions of stress.

20. Organizational Commitment (OC)

The ability and willingness to align his or her own behavior with the needs, priorities, and goals of the organization, to act in ways that promote organizational goals or meet organizational needs. Source: Spencer, L. and Spencer, M. (1993). *Competence at work: Models of Superior Performance*. John Wiley & Sons, Inc.

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