

Difussion of Innovation Initiatives in the Public Health Sector: Towards Enhancement of Health Care Services

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Abstract:- The advancement of technology and rapid changes around the globe serve as driving force for the organisations to align their systems, processes, policies and operations to remain competitive organisations in the 21st century and beyond. In this regard, organisations, are required to effectively manage innovative initiatives to cope with these challenges. However, diffusion of these innovation initiatives remain a major challenge to realise the desirable outcome, particularly in the public health sector for delivery of quality health care service. This article sought to bring light in the way diffusion of innovation initiatives is being carried out in the public health sector. In this article, Diffusion of Innovations Theory is used as a theoretical framework to explore various approaches for effective communication of innovation initiatives to enhance service delivery in the public health sector. In the process of analysing theatrical perspective, it is observed that organisations are characterised with poor diffusion of innovation initiatives and as a result adopters are not fully involved in the implementation of such innovation initiatives. In addition, this article proposes some of the key elements that are considered as the building blocks of diffusion of innovations namely, an understanding of innovation concept, communication channels, time management, social systems and the S-Curve diffusion of innovations. This article further highlights characteristics of diffusion of innovations model that may enhance innovative management in the public health sector. These characteristics include relative advantage, compatibility, complexity, trialability and observability.

Keywords:- Diffusion of innovations, innovation initiatives, public health care sector, quality health care service.

I. INTRODUCTION

Innovation initiatives in the public health sector are seen as a solution to cope with demand and development of technology in the area of high-tech medical equipment for the provision of quality health care service. Mayer (2012) supports this notion by indicating that for the public sector to cope with rapid changes globally there is a need for the development of innovative management approaches, techniques and strategies for service delivery improvement, specifically, for the public health sector to provide quality health care service. However, it is evident in the developing

countries such as South Africa that service delivery improvement remains a major challenge, among others, due to poor diffusion of innovations and ineffective innovative management strategies and approaches. According to Roger (2003), poor diffusion of innovation initiatives serve as a contributory factor of inability to realise desirable outcome, which is service delivery improvement or product development. Specifically, in the public health sector that the needs of citizens regarding the provision of goods and services are often not met to their satisfaction. For example, the Public Protector's report of 2012 regarding service delivery in the Limpopo provincial department of health reveals, among other things, concerns of citizens regarding problems pertaining to poor health care service. According to the Public Protector's report (2012), the Department of Health in Limpopo remains characterised with poor processes, systems and ineffective policies, which often contribute to poor service delivery to the citizens (Office of the Public Protector, 2012).

These failures have a bearing on the provision of quality health care services to citizens. The notion regarding consistent provision of poor health care services is supported by the annual audit reports compiled through the Office of the Auditor General of South Africa. For instance, in the period between 2006 and 2019, the Limpopo Department of Health received ten qualified, two disclaimer and one adverse audit opinions (Office of the Auditor General, 2006–2019).

These reports from the Office of the Auditor General (2006–2019) further reveal non-compliance by indicating that management of the Limpopo Department of Health has failed drastically to comply with the requirements of relevant legislative provisions and supply chain processes. In the year 2011, the situation was exacerbated by the cabinet's invoking of section 100(b) of the Constitution of 1996, which requires that provincial governments that are failing to meet their legislative mandates be placed under administration of the national government.

The National Department of Health has further initiated service delivery measures such as Health Information Systems (HIS), Tele-medicine and National Health Insurance (NHI) in an attempt to improve the provision of quality health care services as well as to ensure universal health coverage to all citizens. Despite these innovation initiatives, an improvement on service delivery

in the form of quality health care services has not been evident or recorded in the Limpopo Department of Health. In this regard, this article sought to investigate how diffusion of these innovation initiatives are undertaken through exploring Diffusion of Innovations Theory as the theoretical framework to enhance the provision of public health care service.

II. DIFFUSION OF INNOVATIONS THEORY

Diffusion of innovations is considered as the process by which innovation initiatives are adopted and used by the consumers in the case of service and product innovations while in the case of process innovations, organisations are considered as beneficiaries of the desirable outcome (Smith, 2006). The development of Diffusion of Innovation Theory became a critical issue for discussion in the early 1990s. Theories such as Tarde (1903), Schumpeter (1934), Walter and Adey (1966) as well as Rogers (2003) have played an important role in triggering a discussion platform on diffusion of innovations and creative destruction theories. In addition, the works by Rogers and Shoemaker (1971) as well as Zaltman, Dancan and Holbek (1973) present a vast quantity of findings and paradigms on understanding the diffusion of innovative management theories. These efforts are concurrent with articles by Warner (1974) and studies by Elkin (1983) and Russo and Herrenkohl (1990). These scholars call into question the generalisation of many of the standard concepts of diffusion theory, which suggests the need for either more general theories or acceptance of the fact that diffusion theory represents extensive explanation on diffusion of innovation initiatives to yield the desirable outcome.

Although existing applicable theories such as Diffusion of Innovations Theory and Creative Destructive Theory have often been found to be deficient, their significant role in fostering innovative management in organisations including public service institutions cannot be ignored (Green, Garcia & Roditis, 2014). Feller and Menzel (1977) note that effectiveness of public policies through fostering the use of new technology could be based on Diffusion of Innovations Theory and, to a large extent, the Creative Destruction Theory. In this article, a focus on the Diffusion of Innovations Theory as a framework for effective fostering of innovation initiatives in the public health sector is taken into consideration.

A. Fundamentals of diffusion of innovation theory

Diffusion of Innovations Theory (DOI) has been developed in an attempt to bring a clear understanding of fostering innovative management approaches and strategies in organisations, including public institutions. Green, Garcia and Roditis (2014) indicate that Diffusion of Innovation Theory presents a long history of attempt to bring clear understanding to spread ideas and actions within social systems.

Green, Garcia and Roditis (2014) further highlight conflicting ideas of the French social theorists Gabrielle Tarde and Gustav Le Bon. The two scholars played an imported role in the development of Diffusion of Innovation Theory. Tarde (1903) as quoted in Green, Garcia and Roditis (2014) postulates three phases of Diffusion of Innovations Theory: First, repetition, which consists of an inventor and imitator; second, opposition, which consists of diverse interpretations to the impressions or changing circumstances; and third, adaptation, in which a new balance is achieved by the imitators after reconciliation of such interpretations is made. Furthermore, Le Bon (1903) considers diffusion as a result of a collective instinct or behaviour, with little room for interpretation of innovations.

Similarly, the original study on Diffusion of Innovations Theory conducted by Tarde (1903) set the scene on the development of innovative management by introducing the original S-Curve diffusion of innovations. Rogers (1995 in Smith, 2006) asserts that diffusion path typically follow the S-curve due to the fact that social factors can be particularly influential in terms of the willingness of people to adopt innovation initiatives. It is further observed in Newsland report of 2005 that the S-Curve diffusion of innovations is of current importance because most innovations are characterised by the S-shaped rate adoption (*Newsland* report, 2005). Although, the S-Curve Theory is generally accepted, it has been confronted with considerable critiques (Den Heijer & Groen, 2010).

In contrast, scholars such as Christensen (2000), as well as Sood and Tellis (2005), argue that the prediction value of S-Curve Theory is relatively low. These authors further indicate that it can be difficult to apply the theory in complex situations such as the evolution of technology. Despite these critiques, Den Heijer and Groen (2010) believe that S-Curve diffusion of innovations (see Figure 1 below) has been considered as a critical instrument to measure the rate of diffusion of innovations in public intuitions.

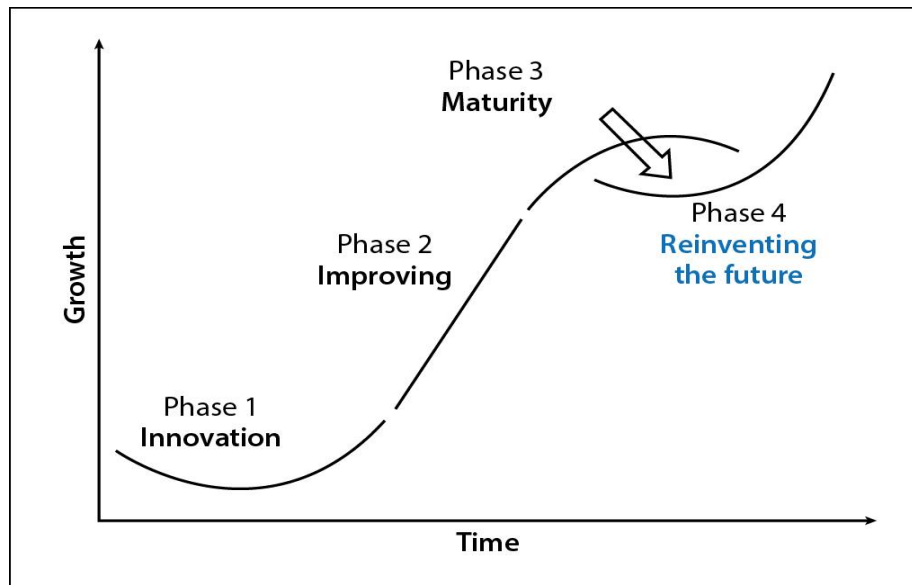


Fig 1:- The S-Curve diffusion of innovations

Source: (Den Heijer & Groen, 2010)

The S-Curve diffusion of innovations presents the adoption rate of innovation over a period of time for reinventing the future. For instance, the adoption of innovation in Phase 1 (innovation) will often start slowly with several uncertainties. In Phase 2 (improving) the adoption growth will improve relatively slowly, which indicates that the adopters are starting to understand the importance of innovation. Phase 3 (maturity) is when the largest number of adopters have accepted the innovation and the pace of diffusion of innovations has reached its peak. In Phase 4 (inventing the future) the innovation has reached a stage where it provides the desirable outcome.

In relation to health care services, the S-Curve diffusion of innovations can assist in measuring the adoption and utilisation rate of high-tech medical equipment such as X-rays, Tele-medicine and many others for service delivery improvement. For instance, when high-tech medical equipment such as X-rays and Tele-medicine are being introduced at initial stage, an uncertainty regarding the utilisation of this medical equipment is often experienced. When the officials and end-users have gained confidence in using the high-tech medical equipment, the adoption and utilisation rates slowly gains momentum and finally the desirable outcome of such high-tech medical equipment is experienced.

In his further advancement of Diffusion of Innovations Theory, Rogers (2003) posits a definition of diffusion of innovations as the process by which innovation is communicated through certain channels over time among the members of a social system. Rogers (2003) further explains communication as a process in which participants create and share information with each other in order to arrive at a common understanding. In the definition of diffusion of innovations, Roger (2003) observes at least four key elements that are considered the building blocks of Diffusion of Innovations Theory, namely, innovation,

communication channels, time and social system, as discussed hereunder.

➤ Innovation

It is important to extend the description of innovation as an element of Diffusion of Innovations Theory in order to distinguish between processes and creative ideas. Scholars such as (Leadbeater, 2003; Mulgan & Albury, 2003; Bernie, Hafsi & Deschamps, 2011) arrived at a common description innovation concept as a lengthy, interactive and social concept. Merx-Chermin and Nijhof (2005) add that the concept of innovation considers involvement of participants from various backgrounds and competencies in order to realise new creative ideas and developments in the organisation.

Lekhi (2007) concludes that to achieve some analytical clarity from an empirical definition is not easy and therefore a more objective definition would be useful. Lynn (1997) points out that processes or products should not be considered as innovations simply because a vested interest defines them as such nor should innovation simply be another word for change. Lekhi (2007) further argues that a definition of innovation in the context of Diffusion of Innovations Theory could also be too restrictive. Lynn (1997) attempts to restrict innovation to describing only original, disruptive and fundamental transformation of an organisation's overall strategic objectives on a permanent basis.

➤ Communication channels

Rogers (2003:10) observes that most previous diffusion studies have been based on a linear model of communication. This author considers the definition of communication as the process by which a message is transferred from a source to a receiver. Such a communication consists of one individual, such as a change agent, informing potential adopters about a new idea. However, the other types of diffusion are more accurately

described by a convergence model in which communication is defined as a process whereby participants create and share information with one another to reach a mutual understanding (Rogers & Kincaid, 1981). Rogers (2003) concludes by also defining communication as a process in which participants create and share information with one another in order to reach a mutual understanding.

It is therefore necessary that innovative management approaches and strategies be effectively communicated to potential implementers and adopters through channels of communication in order to encourage their involvement. Rogers (2003) describes communication channels as the means by which a message is transferred from one individual to another. In this regard, it is worth noting that mediated communication as well as interpersonal communication are playing the complementary roles.

Electronic mass media channels such as television, radio, departmental emails as well as social media are useful for raising awareness regarding innovations. These media channels can provide images, brand name identification and also assist in the attributes of compatibility and observability. Print media such as circulars, journals, newsletters and magazines are useful for explaining conceptual and technical details and helping out with the attributes of relative advantage and complexity. It is important to note that effective communication requires clear channels of communication.

The channels of communication in the Diffusion of Innovations Theory model are illustrated in Figure 2 below.

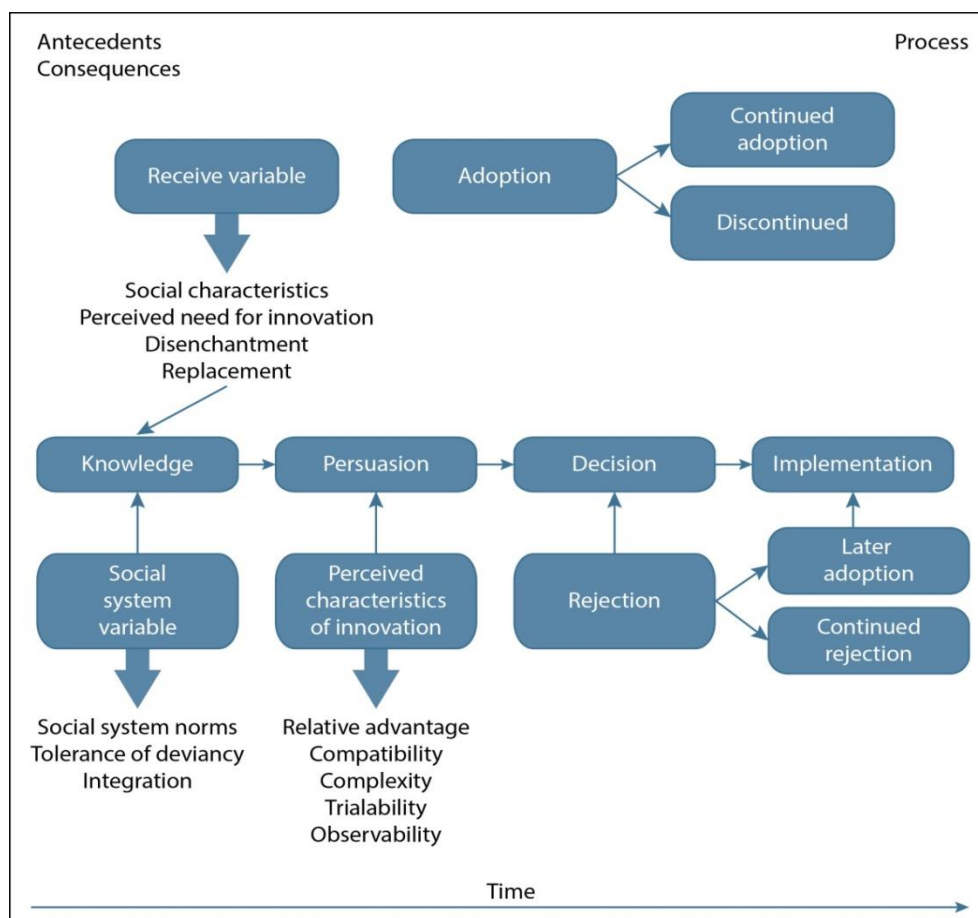


Fig 2:- Diffusion of Innovations Theory model
Source: (Adapted from Rogers, 2003)

The Diffusion of Innovation Theory model presents special type of communication that provides messages that are concerned with the creation of new ideas in the public service (Rogers, 2003). Rogers and Kincaid (1981) extend the definition of communication to a process of convergence or divergence where two or more individuals exchange information in order to arrive towards common understanding or apart in the meaning that they ascribe to certain events. These authors further explain communication as a two-way process of convergence,

rather than as a one-way linear act in which one individual seeks to transfer a message to another. In the context of health services, communication plays an important role for diffusion of innovations for all adopters in order to improve the quality of health care services.

Such a simple conception of human communication may accurately describe certain communication acts or events involved in diffusion, such as persuasion of employees to adopt an innovation process in the provision

of health care services to the citizens. Rogers (2003) asserts the characteristics of the diffusion of innovations model that may enhance innovative management in the public service. These characteristics include relative advantage, compatibility, complexity, trialability and observability as are discussed below.

- *Relative advantage*

Relative advantage as a characteristic of Diffusion of Innovation Theory is an extent to which an innovation is perceived as better than the idea it supersedes. The degree of relative advantage may be measured in economic terms, but social prestige, convenience and satisfaction are also important factors. The degree of relative advantage is often not concerned much if an innovation has a great deal of objective advantage. However, what matters is whether an individual perceives the innovation as advantageous. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be.

- *Compatibility*

Compatibility is a degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. An idea that is incompatible with the values and norms of a social system will not be adopted as rapidly as an innovation that is compatible. The adoption of an incompatible innovation often requires the prior adoption of a new value system, which is a relatively slow process.

- *Complexity*

Complexity is regarded as an extent to which an innovation is perceived to be difficult to understand and use. Some innovations are readily understood by most members of a social system; others are more complicated and such innovations can be adopted more slowly. New ideas that are simpler to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understanding.

- *Trialability*

Trialability is an extent to which an innovation can be experimented with on a limited scale. New ideas that can be tried and tested on the segment plan will generally be adopted more quickly than innovations that are not divisible. An innovation that is trialable represents less uncertainty to the individual who is considering it for adoption, who can learn by doing or acting.

- *Observability*

According to Rogers (2003), observability is an extent to which the results of an innovation are visible and can be observed by others. The more potential adopters are exposed to the results of an innovation, the more the likelihood of their adopting such innovation. Such visibility stimulates peer discussion of a new idea, as friends and colleagues of an adopter often request innovation-evaluation information about it. The interpersonal communication plays an important role in changing opinions and reducing uncertainty about the innovations, as potential adopters are seen as credible and important

sources to provide first-hand experiences and legitimisation of the new ideas.

Rogers (2003) highlights that peer pressure and social learning play a significant role not only on the final adoption decision stage, but also during the evaluation of the attributes of diffusion of innovations. This is particularly important when initial relative advantages are low (high adoption costs or low observability), in which critical mass has not yet been achieved (thus representing higher learning and adoption costs for early adopters), or when the innovation is not obviously compatible with current social or group norms.

In such cases, certain innovation roles become crucial in the development of innovative management. Walter (1966, in Feller & Menzel, 1977) supports the notion by indicating that fundamental analysis of diffusion in the public service resides centrally on the findings of leadership and management as well as the concept of innovation. This is mostly characterised by complexity, formalisation, centralisation and interpersonal relations as determining factors for adoption of innovations.

➤ *Time management*

Time management as an element of diffusion of innovations process plays an important role in determining the quality and the milestone of the innovative management process. Rogers (2003) highlights that most behavioural science researches are often timeless and as a result the time dimension is ignored. Rogers (2003) places strong emphasis on the time as an important aspect of any communication process. Although, it is observed that most communication studies do not often deal with the issue of time explicitly. Whitrow (1980, in Rogers, 2003) highlights that time can be regarded as a concept that cannot be explained in terms of something more fundamental.

It is worth noting that time does not exist independently of event or process but is an aspect of every activity. Although time has been considered as one of the variables in diffusion of innovations process, the measurement of time dimension by means of a respondent's recall can be highly questionable due to the complexity of innovation. The time dimension that is involved in the diffusion of innovations management process entails various aspects.

These aspects include the innovation decision-making process by which an individual passes from first knowledge of an innovation through its adoption or rejection, the innovativeness of an individual or other unit of adoption, that is, the relative earliness or lateness with which an innovation is adopted by other members of a social system, and an innovation's rate of adoption in a system, usually measured as the number of members of the system who are adopting innovations in a given period. In this regard the time factor becomes an important element in the innovation management process (Rogers, 2003).

➤ *Social system*

Rogers (2003) describes a social system as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organisations and the sub-systems. The system may include members of common interest in a group, for example, teachers from a particular school, medical doctors in a hospital or administrators in government departments. Each unit in a social system can be distinguished from other units based on their common interest. All members cooperate to the extent of seeking to resolve a common problem in order to reach a mutual goal. It is highlighted that the sharing of a common objective binds the system together (Rogers, 2003).

It is important to note that diffusion often occurs within a social system because the social structure of the system affects the innovation's diffusion in several ways. For example, lack of coherence in the social system may affect diffusion of innovations. Rogers (2003) indicates that the social system constitutes a boundary within which an innovation diffuses. The social system basically involves aspects such as social structure that may affect diffusion of innovations process, the effect of norms on diffusion, the roles of opinion leaders and change agents, types of innovation decisions, and the consequences of innovation. These aspects involve relationships between the social system and the diffusion of innovations process. A social system as an element of diffusion becomes relevant regarding the innovative management process for service delivery improvement in public institutions.

III. TRENDS OF DIFFUSION OF INNOVATIONS

Diffusion of Innovations Theory globally is considered to have yielded significant results in most areas of innovative management improvement. These include areas such as science, sociology, education, the health system and technology (Richardson, 2009). The works of various theorists on diffusion of innovations (Ryan & Gross, 1943; Rogers, 2003; Al-Gahtani, 2003; Kauffman & Tecyatassansoontom, 2005; Kilmon & Fagan, 2007; Oliver & Goerke, 2008 and Tabata & Johnsrud 2008) have demonstrated considerable amount of evidence that the spread of innovations has reached many parts of developed countries as well as in the developing countries.

➤ *Diffusion of innovations in developed countries*

The spread of globalisation in developed countries has often set the tone on the effective development of Diffusion of Innovations Theory. Richardson (2009) highlights the fact that through diffusion of information, globalisation has increased interconnections as well as the interdependency among nations and individuals across the globe. Friedman (1999) argues that although Diffusion of Innovations Theory has assisted in providing tangible results in the developed countries, globalisation has not always universally covered its key intended goal.

Richardson (2009) notes that Diffusion of Innovation Theory in the developed countries is also credited with significant contribution in increasing diplomatic relationships among countries in the area of technological advancement, economic growth, political affiliation and social issues. In contrast, these relationships have created noticeable divisions from one country to another and resulted in tensions among countries because of increasing competition.

However, the Diffusion of Innovation Theory remains a key factor in the development of innovative management for spreading innovations across the globe. In this way, governments in developing countries such as South Africa are presented with an abundance of opportunities for decision making regarding the proper advantages of the use of innovative management approaches.

➤ *Diffusion of innovations in developing countries*

The Diffusion of Innovation Theory in developing countries is seen as a major development effort in the effective implementation of innovative management approaches and strategies. The Diffusion of Innovation Theory as innovative management effort has contributed to improving the living conditions of people in developing countries. Porter and Kramer (1999, in Dearing, 2009) indicate that a test of ability to purposively diffuse-based practices, programmes and policies has been identified as the single most valuable contribution in developing countries.

Change agencies such as private foundations and government agencies have been considered as major role players in managing and coordinating the implementation of innovative management approaches and strategies to address societal problems and service delivery challenges in developing countries. It is important to note that developing countries are often characterised by challenges such as poor living conditions and poverty. In contrast, these challenges also create an opportunity for Diffusion of Innovations Theory as an intervention strategy.

Barker (2004) notes remarkable reports on the three international development efforts in relation to diffusion of innovations in some developing countries. For an example, in Haiti, a United States Agency for international effort conducted HIV/AIDS prevention education in rural villages. Advanced technology and creative ways of information diffusion were used to make sure that information was successfully transferred to the citizens. Secondly, in Nepal where vitamin A deficiency contributes to the high rate of infant and maternal mortality, the innovation of a kitchen garden was diffused among households in the form of a neighbourhood social model.

In addition, the diffusion of innovation initiatives effort has contributed in increasing knowledge in communities and resulted into positive attitudes towards growing of vegetables and fruits, and a high intake of vitamin A nutrients in Nepal. Thirdly, in Mali during 1999, information on reproductive health was diffused to almost

500 youth through health agents and teachers. More efforts in relation to diffusion of innovations are continually conducted to improve the living conditions of people and service delivery in developing countries through international development efforts and government agencies.

IV. CONCLUSION

This article was undertaken to investigate how innovation initiatives are being managed in the public health sector for the provision of quality health care services. Diffusion of Innovation Theory is seen as the driving force for effective fostering of innovative management approaches and strategies in the public service. Greenhalgh, Robert, Macfarlane, Kyriakidou and Peacock (2004) are emphatic in stating how Diffusion of Innovation Theory can be used effectively to communicate innovation initiatives in health service delivery institutions. The Diffusion of Innovation Theory needs to be considered to play a major role in ensuring that innovative management approaches and strategies, which include programmes, policies procedures and systems aiming at service delivery improvement, are broadly spread to all public servants as well as to relevant stakeholders. This is also because the provision of public health care services requires advanced innovations for medical technology in the prevention and treatment of diseases. Failing to innovate in this way would be a risk for social, economic and political stability for many developing countries, including South Africa. It is worth noting that systematic implementation of innovative management approaches and strategies requires thorough consultation through transferring of information in the form of training and awareness campaigns (Greenhalgh *et al.* 2004). In this regard Diffusion of Innovation Theory becomes relevant to the development and implementation of innovative management approaches and strategies that are relevant in the public health sector for service delivery improvement.

REFERENCES

- [1]. Barker, K. 2004. Diffusion of innovations: A world tour. *Journal of Health Communication*, 1(13):1–7.
- [2]. Bernie, L., Hafsi, T. & Deschamps, C. 2011. Innovation in the public sector: The Institution of Public Administration of Canada Innovation Award 1990–2011. *Cahier de recherche*, CERGO.
- [3]. Christensen, M.C. 2000. Meeting the challenge of disruptive change. *Harvard Business Review*, 2000.
- [4]. Dearing, J.W. 2009. Applying of innovation theory to international development. *Rec. Soc. Practices*, 19(5):503–518.
- [5]. Den Heijer, H. & Groen, M.A. 2010. *Managerial usefulness of S-curve theory: Filling the blanks*. Bachelor Thesis Organisation and Strategy, University of Groningen.
- [6]. Elkin, S.L. 1983. Towards a contextual theory of innovation. *Policy Sciences*, 15(4):367–381.
- [7]. Feller, I. & Menzel, D.C. 1977. *Diffusion milieus as a focus of research on innovation in the public service*. Department of Economics and Centre for Study of Science and Policy, Pennsylvania State University.
- [8]. Friedman, T. 1999. *The Lexus and the Olive Tree*. New York, NY: Anchor.
- [9]. Green, L.W., Ottoson, J.M., Garcia, C., Hatt, R.A. & Roditis, M.I. 2014. Diffusion theory and knowledge dissemination, utilisation and integration. *Frontiers in Public Health Services and Research*, 3(1):1–7.
- [10]. Greenhalgh T., Robert, G., Bate, P., Kyriakidou, O., Macfarlane, J. & Peacock, R. 2004. *How to spread good ideas. Report for the National Coordinating Centre for NHS Service Delivery and Organization*. London: NHS SDO.
- [11]. Kauffman, R.J. & Tecyatassanasoontorn, A.A. 2005. International diffusion of digital mobile technology: A coupled-hazard state-based approach. *Information Technology and Management*, 1(6): 253–292.
- [12]. Kilmon, C. & Fagan, M.H. 2007. Course management software adoption: A diffusion of innovation perspective. *Campus-Wide Information Systems*, 24(2): 134–144.
- [13]. Leadbeater, C. 2003. *Overdue: How to create a modern public library service*. Laser Foundation Report. London: Demos Elizabeth House.
- [14]. Le Bon, G. 1903. *The crowd: A study of the popular mind*. London: T. Fisher Unwin.
- [15]. Lekhi, R. 2007. *Public service innovation: A research report for the Work Foundation's Knowledge Economy Programme*. Manchester, UK: Research Republic LLP.
- [16]. Lynn, L. 1997. Innovation and the public interest: insights from the private sector. In A. Altchuler & R. Behn. (eds). *Innovation in American government*. Washington, DC: Brookings Institution.
- [17]. Mayer, H. 2012. *Organisational innovation management approaches in South Africa*. Pretoria, South Africa: Innocentrix (Pty) Ltd.
- [18]. Merx-Chermin, M. & Nijhof, W.J. 2005. Factors influencing knowledge creation and innovation in an organisation. *Journal of European Industrial Training*, 29(2):135–147.
- [19]. Mulgan, G. & Albury D. 2003. *Innovation in the public sector, Strategy Unit*. Cabinet Office, London.
- [20]. Oliver, B. & Goerke, V. 2008. Undergraduate student's adoption of handled devices and web 2.0 application to supplement format learning experience: Case studies of Austria, Ethiopia and Malaysia. *International Journal of Education and Development using ICT*, 4(1):105–117.
- [22]. Porter, M.E. & Kramer, M.R. 1999. Philanthropy's new agenda: Creating value. *Harvard Business Rev*, 77(6):121, 216.
- [23]. Richardson, J. 2009. Diffusion of technology adoption Cambodia: The test of theory. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 2009, 5(3):157–171.

- [24]. Rogers, E.M. & Kincaid, D.L. 1981. *Communication net- works: Toward a new paradigm for research*. New York: Free Press.
- [25]. Rogers, E.M. & Shoemaker, F.F. 1971. *Communication of innovations: A cross-cultural approach*. New York: Free Press.
- [26]. Rogers, E.M. 1995. *Diffusion of innovations*. (4th ed.) The Free Press, NY.
- [27]. Rogers, E.M. 2003. *Diffusion of innovations*. (5th ed.) A Division of Macmillan Publishing Co. Inc. New York.
- [28]. Russo, J. & Herrenkohl, R.C. 1990. Factors affecting the transfer of technology from industry/university cooperatives to sponsoring companies. *The Journal of Technology Transfer*, 15(3):21–28.
- [29]. Ryan, B. & Gross, N.C. 1943. The Diffusion of hybrid seed corn in two lower communities. *Rural Sociology*, 8(1):15–24.
- [30]. Schumpeter, J. 1934. *The theory of economic development*. Cambridge: Harvard University Press.
- [31]. Sood, A. & Tellis, G.J. 2005. Technological evaluation and radical innovation. *Journal of Marketing*, 69(3):152–168.
- [32]. South Africa. Auditor General's reports of 2006–2019. Office of the Auditor General South Africa.
- [33]. South Africa. 2012. Public Protector's Report of 2012. Department of Health in Limpopo: Pretoria. Government Printers.
- [34]. Tabata, L. & Johnsrud, L. (2008). The impact of faculty attitudes toward technology, distance education and innovation. *Research in Higher Education*, 49(7): 625–646.
- [35]. Tarde, G. 1903. *The laws of imitation: E.C. Parsons, Trans*. New York: Holt.
- [36]. Walter, D.O. & Adey, W.R. 1966. Linear and nonlinear mechanisms of brain wave generation. *Department of Physiology and Anatomy and Brain Research Institute*, 12(8):772–780.
- [37]. Whitrow, G.J. 1980. *The natural philosophy of time*. (2nd ed.) Oxford, England: Clarendon.
- [38]. Zaltman, G., Duncan, R. & Holbek, J. 1973. *Innovations and organisations*. New York: Willey & Sons.