Managerial Cores in Open Science: Interpreting 'Open' With Library and Information Science

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Open Science promotes scholarly communications through collaborations between societal agents by sharing information that is accessible and reusable for everyone. The benefit of science and society promotes transparent and reproducible open knowledge creation and engagement of societal actors to enhance scientific knowledge. This study focuses on the core concepts of Open Science and Library and Information Science discipline to delineate a relational association between the two. This study also tries identifying the motivational traits in Library Management and Open Science by interpreting Maslow's Need Theory and Schwartz's Value Theory. Lastly, this study traces technology acceptance by library professionals with the elaboration of the Technology Acceptance Model given by Davis. Libraries provide open access and sharing of resources, information storage and retrieval, data handling and research data management, and guide researchers on open access publishing, open licensing, and others. In the proposed Technology Acceptance model conceived by the authors, the external factors actively or passively influence the attitude and behaviors of library professionals to use technology and systems for promoting Open Science initiatives and practices.

Introduction

The concept of 'Openness' is intermingled with 'Open Science' that predominantly handles four cores; Open Data, Open Source, Open Methodology, and Open Access (Kraker et al., 2011). Further, there are more to consider expanding "Open Science" that engulfs Open Educational Resources (UNESCO,2002), Open Peer Review (Ross-Hellauer 2017), Open Engagement, Open Scientific Knowledge, Open Innovation, and Infrastructures (UNESCO Recommendation on Open Science OPEN SCIENCE, 2021).

A visual representation of Open Science with all its conjectures may be portrayed as follows.

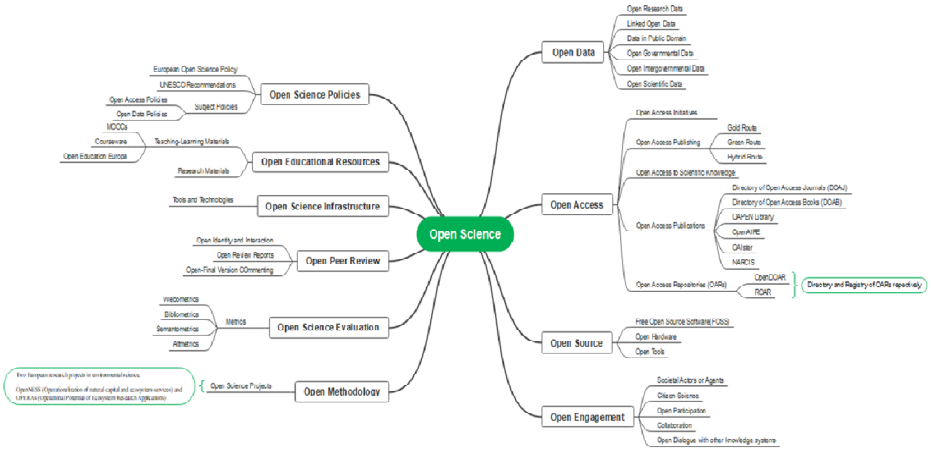

Figure 1: Core concepts of Open Science

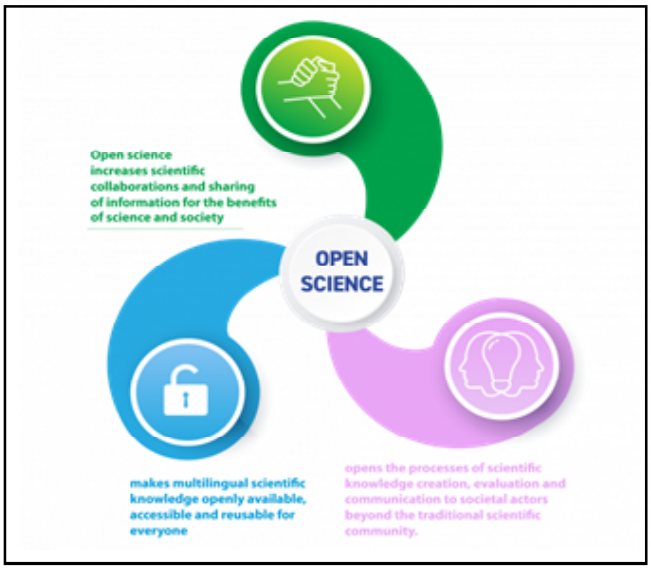

Figure 2: Definitional Analysis of Open Science (UNESCO)

As shown above, UNESCO provided a universal definition of Open Science in November 2021. The pictograph portrays that Open Science promotes scholarly communications through collaborations between societal agents by sharing information that is accessible and reusable for everyone to benefit science and society. It helps promote transparent and reproducible open knowledge creation and engagement of societal actors to enhance scientific knowledge. 'Open Science' originated in the late 1980s through Free Open-Source Software (FOSS) movement. Eventually, the action got momentum. The complexity portrayed in present

literary evidence is the delusion of defining Open Science. Open Science as a term neglects its position in knowledge hierarchy as it cannot be expressed by the trilogy of Infra-position, Supra-position, and Juxta-position.

Library and Information Science (LIS) deals with data and specific information. The science of information management is more or less structured. Documents managed by libraries emphasize two prominent aspects, storage and retrieval, apart from other associative elements. The library allows access to such documents through its mechanism, which everyone can access (UNESCO-University of the People), which may be considered the primitive conditional for Open Science.

This study focuses on the core concepts of Open Science and its relation to library and information science disciplines. The objectives of this study are- (a) to identify how "Open Science' fits in the Library and Information Science discipline, (b) to trace implications of motivational issues both in Library Management and 'Open Science,' and (c) to investigate how these motivational factors promote 'Open Science,'(d) to trace acceptance of technology by LIS professionals to foster Open Science.

2. Literature review

Open Science is a collaborative culture that promotes the open sharing of data, information, and knowledge to foster scientific research and understanding in the broader scientific community with technology's help (Ramachandran et al., 2021). Libraries and librarians can play a pivotal role in accelerating Open Science adoption by campaigning for different advantages, guiding researchers on open data and access, and enhancing the expertise in meta-knowledge (Making Open Science a Reality OECD, 2015).Libraries can engage in Open Science movement by focusing on four core areas of Open Access and Open Access Publishing, Research Data Management, E-infrastructure and Citizen Science (Ayris &Ignat, 2018). Academic libraries can provide leadership, information services, research data management services, and research collaborations to support open science by sharing available data, open access resources, educational resources, and even open methodologies (Tzanova, 2020). For implementing Open Science practices, initiation of expert training sessions in technological enhancements, framing of Research Data Management policies promoting data stewardship, FAIR Data, and segmentation of open science implementable among related disciplines through any institution's library and information wing (Bagchi, 2021). Researchers and research groups are keen on promoting and encouraging Open Science policies, whereas "the majority of academic staffs are either unaware of or unwilling to implement it because incentives and career advancements still support the traditional way of conducting research" (Saarti et al., 2020). Libraries can directly influence the Open Science movement by developing organizational infrastructure in support of open science through managing the growing number of open access resources, available science initiatives, and projects by encouraging open research by guiding open access publishing, use of open licenses, sharing of open data and by conducting open science seminars and workshops (Redkina, 2021). Motivation is the backbone of the growth and productivity of individuals in a work ambiance. Motivation is of two levels in the working

environment of libraries; need-factor, especially for lower cadre library staff, and profession-related motivation for growth and development of library professionals (Umeozor, 2018). Technology Acceptance Model (TAM) recognises external variables which influence two types of behavioural attributes. A study on the use of virtual library by the undergraduate students using demographic factors "sex, level of study, cumulative grade point average, and computer knowledge" identified as antecedents of perceived usefulness and perceived ease of use (Akinbobola& Adeleke, 2016).

3. Method

The present study is a Critical Co-relational Study of Open Science and Library and Information Science (LIS). To satisfy the study's objectives, it focuses on the core principles of Open Science and LIS to delineate a relational association between them. This study also focuses on the motivational factors working as accelerators in promoting Open Science. However, there are notable theories of motivation, but for this study, only two correlated theories have been used. Maslow's Hierarchy of Need Theory is considered the first scientific motivation theory, and Schwartz's Theory emphasizes the value of "Openness," which is the core of Open Science. This paper tries to critically analyse both theories to determine how these factors are implemented in library management and open science. Lastly, this paper attempts to dig into the cores of library management to discover the adoption, adaption, and adeptness (Rogers, 1962) of open science practices with the application of the Technology Acceptance Model (Davis et al., 1989).

4. Relational Conjugation between Open Science and LIS

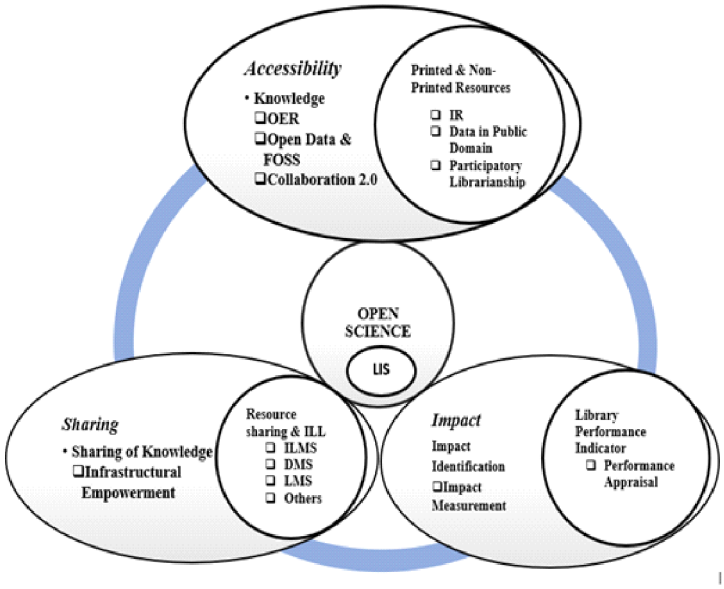

Figure 3: Relational cores of Open Science and LIS

The intertwined relationship between Open Science and Library and Information Science (LIS) may be schematically represented by the figure above (figure 3). Open Science can be divided into three broader groups that represent the entirety of Open Science, namely- (1) Accessibility of Knowledge through Open Educational Resources (OER), Open Data, Free and Open-Source Software (FOSS), and collaborations between societal agents (Collaboration 2.0), (2) Sharing of Knowledge by empowering technology, innovations, and infrastructures, (3) Impact identification and measurement for selection of most relevant information. It is hypothesized that these three broader concepts of Accessibility, Sharing, and Impact can also be incorporated into the LIS domain.

The accessibility to Library and Information Science is manifested through printed and non-printed resources via Institutional Repositories (IR), data available in the public domain, and participatory librarianship. Furthermore, sharing of resources is delineated through Inter-Library Loan (ILL), Integrated Library Management Systems (ILMS), Data Management Systems (DMS), Library Management Systems (LMS), and others. Lastly, the impact is measured by library performance indicators like performance appraisals, LibQual+, ServQual, and various ISO standards. Thus, significant components of Open Science fit into the LIS domain, revealing that research and public data management create raw data (creativity).While process, analyzing, and preserving data extend curability and interpretability and help in disseminating (accessibility and discoverability) the data. Moreover, library holding assures the reusability of the data by providing meta-information to protect the data.

5. Open Management in Libraries through Motivational Traits

In 1943, Abraham Maslow provided fundamental principles of motivation that fit into any organizational ambiance. Even though these guidelines were primarily conceived for profit-making establishments, their cores are universally applicable as motivational triggers in any organized setup. Out of five prescriptions Maslow made, three seem more inert, and one is exerted and thus is related to social-emotional development. While tracing the motivational issues in library human resource management, 'Love and Belongingness', 'Self Esteem' and 'Self Actualization,' and 'safety needs' by Maslow play significant roles in the sustenance of libraries.

By accepting these four as the centrifugal force in any work ambiance under the humanoid managerial system, a new motivational model was mooted in 1992 and further sharpened in 2012 by Shalom H. Schwartz, who extended the very values of employee motivation on a more holistic scale. In this paper, the authors tried to identify the analogous components prescribed by both Maslow and Schwartz.

5.1. Maslow's Need Theory in Open Science and Library Management

Maslow's hierarchy of needs theory can be incorporated into Open Science and Library Management. Human resources are an integral part of both Open Science and Library, without which none of these can sustain.

Figure 4 : Maslow's Hierarchy of Need theory in relation to LIS and Open Science

- The physiological or basic needs are for the survival of the human resources so that they can move to the next level in the work environment.
- Safety need is for the safety and security of resources in the library to avoid stealing and data security and privacy for openness in research.
- Love and belongingness- Emotional Intelligence plays a vital role in motivation in Open Science and Library on both the personal and social levels. Self-awareness, self-control, and self-regulation work as motivators at the individual level, whereas social skills like communication, i.e. both verbal and non-verbal communication, active listening, and empathy towards others, motivate everyone at the social level. Intrinsic motivation is the key to emotional intelligence skills to promote Open Science and develop good managerial skills for the library.
- Self-esteem need is purely individualistic and depends on self-assessment, self-confidence, and independence in the work ambiance for the growth of the library. Attitude and perception of individuals in adapting skills and expertise explore openness in science and research for the betterment of society.
- Self-actualization is being more open in society to flourish openness through open and quality education, research, and knowledge. Library management may serve this purpose by open access to resources, Open Educational Resources (OERs), and open research data management.

5.2. Schwartz's Value Theory as motivational factors in Open Science

Schwartz's Value Theory expresses values in a sequential order forming a continuous circular structure representing motivations (Schwartz et al., 2012). The theory redefined the values proposed in 1992 by extending ten (10) values to nineteen (19) represented in a circular sequential diagram with the central circle

representing core values. Then the second circle overlapped over the first one represents two bipolar values where "Openness to Change" is reciprocal to "Conservation Values" and "Self-enhancement values" reciprocal to "Self-transcendence values." The third circle overlapping over the second one represents personal and social focus. The outermost circle represents "growth" (Anxiety free) and "self-protection" (Anxiety avoidance). This theory greatly influences the concept of Open Science as it also embeds two approaches, one is the positive approach toward openness, and the other is the negative approach toward open science, as represented in the figure below. This study only considered the inner two circles as these core values express motivational factors.

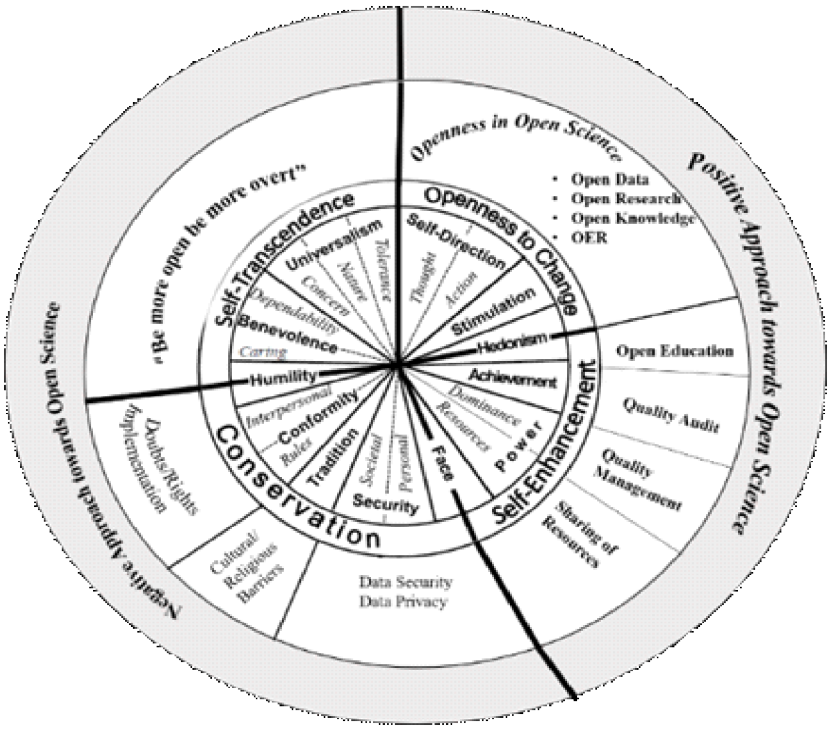

Figure 5: Schwartz's Value Theory and Open Science

Figure 5 shows the positive approaches that promote the concept of Open Science by relating "Openness to change" with "Openness in Open Science," which is the kernel of Open Science. Open data, Open Research, Open Knowledge, Open Educational Resources (OERs), and Open Methodology flourish in research. As Schwartz prescribes, Self-enhancement is acquired by Hedonism, Achievement, Power, and Face. In the case of Open Science, the thrust is quality education achieved by Open Education, sharing resources and knowledge, quality management, and quality audit. Thus, these factors work as motivators under Schwartz's perception of 'self-enhancement' in Open Science. The negative approaches in Open Science are represented through "Conservation" and "Self-Transcendence". Data privacy and security

cover societal and personal spaces where the social focus seems prime. The concept of 'Tradition' and 'Conformity' under Conservation in Schwartz's theory collides with cultural or religious barriers and doubt/ rights implementation of Open Science. "Self-Transcendence" is the combination of three sub-types; benevolence, universalism, and humility are represented in Open Science as be more open be more overt, which expresses the core meaning of open science, which reflects the openness of data with protection and security for use and re-use for the benefit of its yield.

5.3. Pyramid Structure of the Library

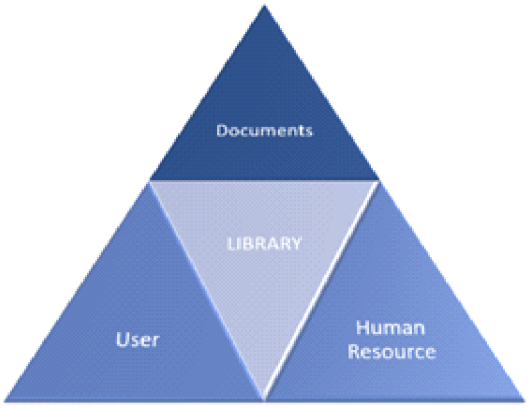

Figure 6: Pyramid Structure of Library

Figure 6 shows that the major components of the library may be placed as a pyramidal structure as all the components are interdependent; the pyramid's base is the Human Resources and the Library Users. Both contexts deal with library resources or documents; one provides access to the resources, whereas the other promotes the use of documents.

5.4. Schwartz's Value Theory as motivational traits in Library and Information Science (LIS)

The core nineteen values prescribed in Schwartz's Value Theory can be embodied with the Library and Information Science discipline concepts, as in figure 7. Each of these values is discussed in detail below,

- Self-direction: Schwartz divided the conceptual definition of 'Self-direction' into the thought that expresses creativity, interest, imagination, and action, which expresses goals, decisions, planning, and self-independence, respectively. This value can be represented as 'Motivation' through intrinsic factors that are inherent, i.e., thought, and extrinsic factors that focus on outcomes, i.e. action.
- Stimulation: Schwartz's perception of the value 'Stimulation' consists of three sub-types: excitement, novelty, and challenge. From the perspective of the LIS domain, this value relates to human resource management that supports each sub-types of stimulation.

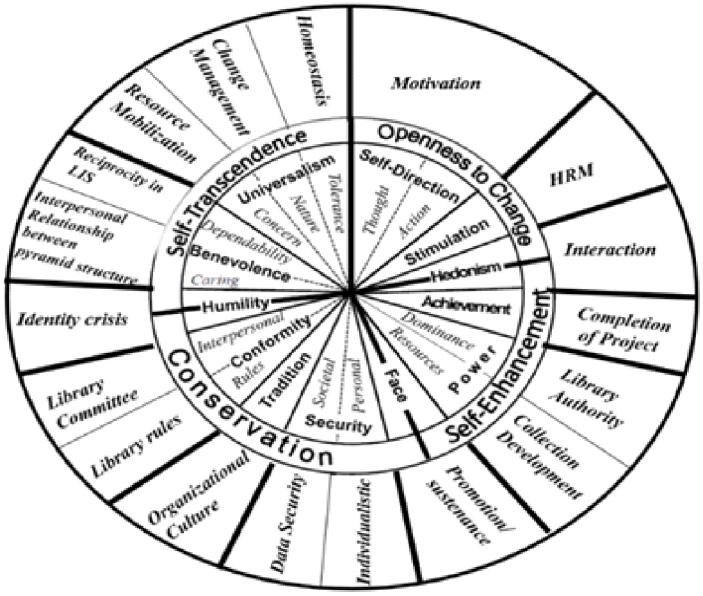

Figure 7: Merger of Schwartz Value Theory and Library Management

- Hedonism: Schwartz's theory conceptualized 'Hedonism' as only one component of pleasure that can be represented by interaction between each component of the pyramid structure (figure 6).
- Achievement: 'Achievement' value, as perceived by Schwartz, represents success and competency, which can be portrayed in the LIS domain as completing project management.
- Power: 'Power' value comprises three sub-types; dominance over people, control of resources, and face (protection and maintenance of prestige). Each of these sub-types can be manifested in library science as library authority has the power to dominate, collection development relates to the management of resources, and face is associated with the sustenance of the library and promotion of staff.
- Security: Schwartz defined 'Security' with two sub-types; personal and societal security. Whereas, in Library and Information Science, personal security refers to individual security, and societal security representsdata security for the masses.
- Tradition: 'Tradition' value can be incorporated as organizational cultures in the library science discipline.
- Conformity: The conceptual definition of 'Conformity' suggests two sub-types; interpersonal and compliance or rules, which can be reflected as library committee and library rules and regulations, respectively.
- Humility: 'Humility' value can manifest as an individual's identity crisis in a working environment like a library.

- Benevolence: Schwartz suggests the conceptual definition of 'Benevolence' with two subtypes of dependability and caring reflected in the LIS domain as the interpersonal relationship or dependability of each component among the pyramid structure (figure 6) and reciprocity in LIS.
- Universalism: 'Universalism' comprises three sub-types of tolerance manifested as homeostasis, i.e. stable and equally maintained interdependent relationship between each component in the domain, societal concern represented by resource mobilization, and lastly, protecting nature reflected as adapting to the changes, i.e. change management.

6. Technology Acceptance, Skills, and Expertise of Library Professionals to foster Open Science

Technology is one of the key factors associated with the Open Science movement. Open Science practices and initiatives directly enrich skills and expertise in information management. In contrast, library professionals are one of the leading societal agents in promoting Open Science practices. Technology has become a prevalent part of information science and Open Science. From inception to the dissemination of information, technology plays an implicit role. Thus, the Technology Acceptance Model (TAM) given by Davis in 1989 is studied to investigate the acceptance of technology by library professionals to encourage and promote Open Science.

Davis proposed that perceived usefulness and perceived ease of use influence the attitude and behaviors of individuals to use technology or systems. "Perceived usefulness is the degree to which an individual believes that using a particular system would enhance his or her job performance. Perceived ease of use is the degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis, 1989).

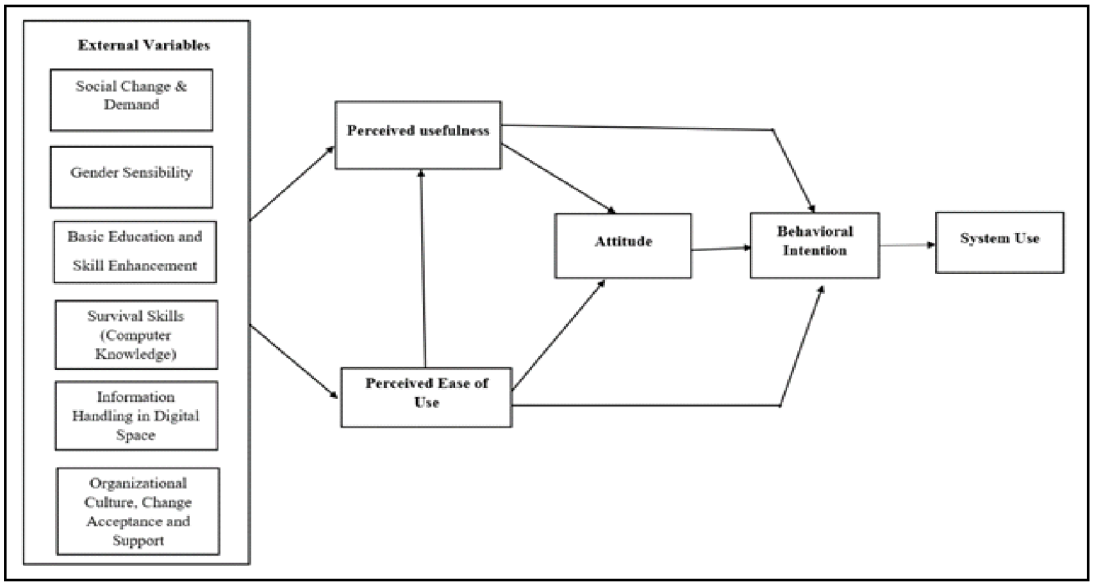

Figure 8: Proposed Technology Acceptance Model

Figure 8 is a proposed TAM model that elaborates the external factors explicitly from a library professional's perspective. The external factors in a library environment influence each professional's Perceived Usefulness and Perceived Ease of Use. Social change or demand may differ for each working under the same organization, impacting the 'perception of use' and 'ease of use'. Gender sensibility is another external factor that implies that the beliefs and cognition towards using a system may differ in male and female professionals. Basic education and skills significantly impact perceiving usefulness and adapting new technologies at ease, which may help library and information science practitioners foster Open Science. Survival skills (Computer skills and others) must be frequently updated with new technologies to adapt to the changes, reflect upon using systems efficiently, and cater to Open Science Practices for scholarly communications. Information handling in Digital Space is a crucial skill of an information professional, which influence the attitude and behavioral intentions of him/her in manipulating information in a digital ambiance. Organizational culture, change acceptance, and support push each professional for job enrichment and upliftment of job performance. These external factors actively or passively influence the attitude and behaviors of library professionals to use technology and systems for promoting Open Science initiatives and practices.

7. Discussion

The sublime relationship between Library and Information Science (LIS) and Open Science seems intertwined. The broader focus of LIS is to facilitate information use, whereas the broader focus of Open Science is to enhance access for better information use. Moreover, inner turmoil in the LIS domain invites an amount of uncertainty, whereas Open Science also has the idea of unstructured structures.

Open Science is about sharing, re-using, reproducing, and transparent research data within scientific communities to develop a better society. Libraries, Library and Information Science discipline, and Library professionals play a prime role in promoting and encouraging openness in research. Libraries provide open access and sharing of resources, information storage, and retrieval, data handling and management, and guide researchers on open access publishing, open licensing, and others. Focus on motivational traits in library management and Open Science by interpreting Maslow's Need Theory and Schwartz's Value Theory clearly depicts that motivation helps in the growth and enhancement of performances by an individual in a working ambiance. In a broader sense, motivation can be of two levels: personal level focusing on self-assessment, self-control, independence, self-confidence, and social level representing communication skills, power, achievement, dependence, concerns, change management, and others. Technology acceptance by library professionals is a continuum and further can be extended with the Technology Acceptance Model (TAM) given by Davis. The key external factors are discussed in the study that influences the acceptance of technology to use information systems and to adopt Open Science practices.

8. Conclusion

The Open Science movement helps boost research productivity by sharing transparent and reusable data and open methodologies and promoting collaborations between cross-border societal agents. For example,

during the pandemic COVID-19, there was a rapid growth in open research data for the survival of society. Though this paper readily describes the promotion of the Open Science movement in the Library and Information Science discipline, there are certain conditions to keep in mind before adaption of Open Science, like the identification of accurate, relevant, and scientific research data in the pool of available information, FAIR principles, Intellectual Property Rights, and others. In addition, citizen Science is one of the concepts related to Open Science that invites non-scientists into research (Mirowski, n.d.).

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