

# Knowledge Exchanges in the Global Organization – Learning from the Genius of Al-Biruni

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**Abstract—** The post-industrial organization is typically knowledge-intensive and collaborative, without which success is not possible. Its key processes involve bringing teams across organizations (vendors, clients, sub-contractors, service providers, suppliers etc) together in order to share and create knowledge. This paper posits that knowledge exchange across boundaries is not new and we could learn from history. The historical works of Abu Rayhan Al-Biruni (973-1048AD), a Persian polymath scholar who made significant contributions in diverse fields of study, were examined using frameworks of knowledge assets and knowledge flows. The knowledge flows of knowledge assets were plotted and studied using Boisot's I-space model and the knowledge transfer to and from Al-Biruni was studied using Gupta and Govindarajan's knowledge transfer framework. The factors that have contributed to the tremendous achievements in scholarship by the genius of Al-Biruni were found to be the possession of multiple intelligences, a balance of wisdom with an ability to positively influence his environment and a strong value system within which he operated. The research suggests that possessing multiple intelligences and a balance in wisdom enables the people involved in multi-national, cross-cultural and cross-lingual knowledge transfer to be able to give better form and structure to knowledge enabling easier and better knowledge diffusion.

**Keywords—** knowledge diffusion, knowledge management strategy, international knowledge flows.

## I. INTRODUCTION

It is well known that the success or failure of a global organization depends on a relationship of trust, mutual financial benefit, and the effectiveness of knowledge exchanges between vendor and client. The last mentioned point is the subject of this article. More specifically, the article examines how knowledge can be captured and shared effectively so as to promote collaboration and superior group performance. Although many theories of knowledge transfer and diffusion have been promulgated in the last decade or so that the idea of knowledge management has been in vogue ([1],[2]) it is obvious that the process cannot be new. In fact, it could well be medieval. This article narrates the genius of a forgotten scholar who pursued knowledge and truth as he attempted to bridge the gaps in

the understanding between two ancient civilizations. More specifically, although by no means the first ([3]-[17]), this article is a homage to the qualities and abilities of a genius that allowed knowledge transfers in complex and difficult circumstances.

Al-Biruni was born in 973AD, in the suburb of Kath, the capital of Khwarazm, which is now a region of Uzbekistan on the southern shores of the Aral Sea. At an early age of his career, he was a scholar at the court of the sultan of Khwarazm. However, his tenure at his court came to an end when sultan Mahmud of Ghazna conquered Khwarazm and took him as a prisoner along with other scholars. Al-Biruni lived and worked for most of his life at the court of Sultan Mahmud and his son Masud. He had accompanied Mahmud on his campaigns into India, which lasted for about thirteen years (1017-1030AD). It was during those campaigns that Al-Biruni learned Sanskrit and took extensive notes, which he later published in what is now considered the most authoritative account of medieval India [13]. At the twilight of his career, Al-Biruni had written more than 180 books in more than twenty different subject areas including astronomy, mathematics, geography, chronology, mechanics, medicine, mineralogy, history, literature, religion and philosophy ([13],[15]). His study on India is considered one of the most accurate and definitive research about the Hindu culture and an account of India during that time period.

Even today, Al-Biruni's works on India are a major source for appreciating ancient Hindu culture and the achievements of the Indus civilization in the fields of science and arts. He had toured India for 13 years in the early 11th century AD and had translated 27 classical works from Sanskrit to Arabic having learnt Sanskrit himself. His works on India are a key source of information on Indian conditions between the period of Hieun Tsang's (the famous Chinese Buddhist monk and scholar) visit to India in the 7th century and the writings of Ain-e-Akbari (written by Abul Fazl during the administration of the Mughal Emperor Akbar's empire in India) in 1590 AD [18]. Al-Biruni's work on India contains an account of Hindu numerals [19]. He compared Hindu verses with the Quran and supported Hindu works with Quranic verses [18]. He was also the first of all the known scholars who had compiled a scientific

system of the Jewish Chronology [5]. In doing so, Al-Biruni conveyed the vast treasure of Indian scientific information to the Islamic world and beyond [18].

His works represent a scientific renaissance in comparison with the aspirations of his contemporaries [20]. However, the works of Al-Biruni, even though comparable only to the works of Leonardo da Vinci in the scope of scholarship, are not as well-known in the western world as other scholars of similar achievement [21] and he is often referred to as a forgotten scholar. His high scientific stature has also led to a controversy in modern times about the national origin and allegiance of Al-Biruni. There are reports of controversy in modern politics and he has been claimed by several nations as their own. The Soviet Union had claimed him as their own because he was born in the region which was until recent years Soviet Central Asia. Iran had also claimed him because he spoke Khwarazmian, a dialect of Persian and so did Pakistan and Afghanistan because he lived a good part of his life in Sind and near modern Kabul. The Arab nations also consider him as their own because he wrote most of his works in Arabic [13]. Despite the fame during his time, the grave of Al-Biruni which lies in modern day Afghanistan has been neglected and completely forgotten. Based on existing historical documents the grave of the scholar, in whom Afghanistan takes pride for his academic and scholarly writings, lies to the east of the city of Ghazni (the capital of south-central Ghazni Province). A number of academic and cultural foundations have described this negligence as a cultural shame for Afghanistan [22].

Al-Biruni did remarkably well in creating knowledge, acquiring knowledge, capturing it in his works and quite effectively diffusing it from his several travels and most notably his time in India. This is of particular interest since barriers of distance, language and culture which Al-Biruni overcame are barriers for knowledge flows and communication even to this day and age. The scope of scholarship and the contributions that he made were also some of the forms of communication technologies that we have today. He also did not enjoy any form of intellectual property rights and incentives which modern scholars receive. Studying the person involved, the environment in which the person operated and the link between the person and the environment would be useful in understanding the knowledge assets involved and the knowledge flows to and from the two societies (the Hindu and Arab world), as Al-Biruni modestly made no claims about being the originator of any of the knowledge he discussed. To better study these, the person is studied for his intelligence and wisdom, the characteristics of the environment are also studied and the links between them are also studied using well-established models of knowledge flows.

Revisiting the works of Al-Biruni, studying his methodology and understanding his view of knowledge also provides us with some valuable lessons which can be learnt

and applied in today's knowledge societies. Specifically, in the context of outsourcing, there is a still-relevant lesson to be learnt on how gaps across cultures and geography may be bridged.

## II. BACKGROUND THEORIES

### A. Theory of Multiple Intelligences

To study Al-Biruni and his contributions and to understand the person (the knowledge source himself) involved in contributing so much in knowledge it is necessary to study the intelligence and wisdom possessed by the knowledge source. Howard Gardner ([23],[24]) proposed the theory of multiple intelligences where he held a pluralist idea of intelligence consisting of nine basic types of intelligence. These nine types are described as follows:

- 1) *Visual-spatial intelligence*: This type of intelligence signifies the ability to recognize and use the patterns of wide spaces and confined spaces. The possessors of this type of intelligence show good spatial judgment and have the ability to visualize using their minds.
- 2) *Verbal-linguistic intelligence*: This type of intelligence involves the person's ability the ability to learn languages, the capacity to use language to accomplish certain goals and sensitivity to spoken and written language. They learn best by reading, taking notes, listening, discussion and debate. They also exhibit skills in explaining, teaching and learn foreign languages very easily.
- 3) *Logical-mathematical intelligence*: Those who possess this type of intelligence have the capacity to analyze problems logically, carry out mathematical operations and investigate issues scientifically. It entails the ability to detect patterns, reason deductively and think logically. This type of intelligence is associated with scientific and mathematical thinking.
- 4) *Bodily-kinesthetic intelligence*: People who have bodily-kinesthetic intelligence show better learning by involving muscular movement. They often learn best by doing something physically, rather than by reading or hearing about it. They possess mental abilities to coordinate bodily movements.
- 5) *Musical-rhythmic intelligence*: Those who possess this type of intelligence have the skill in the performance, composition and appreciation of musical patterns. Language skills tend to be highly developed in those whose base intelligence is musical.
- 6) *Interpersonal intelligence*: People with high interpersonal intelligence have the capacity to understand the intentions, motivations and desires of other people. This allows them to work effectively with others. They have a high sensitivity to others' moods, feelings, temperaments and motivations. They typically learn best by working with others and often enjoy discussion and debate.

- 7) *Intrapersonal intelligence*: People with high intrapersonal intelligence have a high capacity to understand oneself, to appreciate one's feelings, fears and motivations. It involves the ability to reflect on past experiences in order to manipulate future experiences. This refers to having a deep understanding of the self and reacting appropriately in different situations.
- 8) *Naturalistic intelligence*: People with this type of intelligence recognize, categorize and draw upon features of the environment. They are at ease in different environments and they easily relate themselves to their natural surroundings.
- 9) *Existential intelligence*: People with this type of intelligence have a good understanding of the rules, behavior and attitudes that govern life. This type of intelligence has to do with philosophical issues of life and those who possess this type of intelligence learn best by thinking about analytical questions.

### B. Triarchic Theory of Intelligence

Sternberg [25] defined human intelligence as a “mental activity directed toward purposive adaptation to, selection and shaping of, real-world environments relevant to one's life”. Sternberg [25] proposed a ‘triarchic theory of intelligence’ consisting of three essential components of human intelligence:

- 1) *Practical/Contextual intelligence*: This type of intelligence gives the ability to do well in informal and formal educational settings and to adapt and shape one's environment. This has to do with the individual's ability to fit to the context by adapting, selecting and shaping one's environment.
- 2) *Experiential/Creative intelligence*: This type of intelligence gives the ability to deal with novel situations and the ability to effectively automate ways of dealing with novel situations so they are easily handled in the future.
- 3) *Componential/Analytical intelligence*: This type of intelligence gives the ability to process information effectively. They possess the ability to break down problems and solve it in an analytical manner.

### C. Balance Theory of Wisdom

Sternberg [26] also proposed the “balance theory of wisdom” where he defined wisdom as the application of intelligence and experience as mediated by values toward the achievement of a common good through a balance among intrapersonal, interpersonal, and extrapersonal interests, over the short and long terms, to achieve a balance among adaptation to existing environments, shaping of existing environments and the selection of new environments.

### D. Information space model for Knowledge Flows

To understand the approach of Al-Biruni in knowledge diffusion and knowledge flows it is necessary to understand

and identify the knowledge assets and the flow of knowledge. Max Boisot [27] proposed the information-space (I-space) model, a framework used for the dynamic analysis of knowledge flows in individual human beings, organizations and institutions made up of these. This framework takes the structuring and sharing of information to be positively related—i.e., the more one can structure information, the faster and more extensively one can share it. The structuring of information is represented by the two dimensions of codification and abstraction and the sharing of information is represented by the diffusion dimension.

- 1) *Codification*: Codification involves assigning data to categories to give it form. This dimension measures the speed and ease with which knowledge or an object of experience can be unambiguously assigned to given categories. The greater the speed and ease of assignment, the higher is the degree to which the categories have been codified [27].
- 2) *Abstraction*: This dimension measures the number of perceptual and conceptual categories required to capture knowledge or an object of experience. The fewer the categories required, the greater the generality of the phenomenon and the higher its degree of abstraction. This involves a reduction in the number of categories that knowledge must be assigned for a phenomenon to be apprehended [27].
- 3) *Diffusion*: This dimension measures the percentage of a given population of data processing agents—the individuals, groups, firms, etc.—for whom an item of information has relevance that can gain access to an information event in a given time period. The higher the percentage of this population that can gain access to a given information event, the higher is its degree of diffusion [27].

According to Boisot [27], new knowledge moves around the I-space in a cyclical fashion. The creation and diffusion of new knowledge essentially activates all the three dimensions of the I-space in a particular cyclic sequence called a “social learning cycle” or SLC. The movement in the I-space typically consists of the following six phases:

- 1) *Scanning*: The first phase involves identifying opportunities and threats in available data and patterning this data into idiosyncratic insights possessed by an individual or a small group.
- 2) *Problem-Solving*: This is the process of giving structure and coherence to insights gained from scanning and codifying them.
- 3) *Abstraction*: This phase generalizes the application of newly codified insights to a wider range of situations.
- 4) *Diffusion*: This phase occurs when newly codified knowledge and insights are shared with the target population.
- 5) *Absorption*: In this phase, the newly codified insights are applied to different situations. This may occur by learning-by-doing or learning-by-using.

6) *Impacting*: In the last phase, abstract knowledge is embedded in concrete practices in organizational rules and practices.

E. *Model for Knowledge Transfer*

It is also necessary to understand the knowledge flows in the knowledge transfer that was initiated by Al-Biruni as a result of his works numbering around 180 [13]. He had acquired knowledge from several sources marking a knowledge transfer where he received knowledge and later by means of his written works, he transferred knowledge. Gupta and Govindarajan [1] proposed a model for the transfer of knowledge that exists in the form of know-how between subsidiaries of multi-national corporations. They had studied the knowledge flows between individual subsidiaries of the firm in four domains: knowledge outflows to the peer subsidiaries, knowledge outflows to the parent corporation, knowledge inflows from the peer subsidiaries and knowledge inflows from the parent corporation. They observed that the knowledge flows between subsidiaries to be a function of the following five factors:

- 1) *Value of source unit's knowledge stock*: When the value of the knowledge stock is high there is a direct relationship with the amount of knowledge transfer that takes place.
- 2) *Motivational disposition of the source unit*: The units with a strong motivational disposition to share overcome knowledge hoarding tendencies and share knowledge allowing knowledge flows.
- 3) *Existence and richness of transmission channels*: Knowledge flows cannot occur without existing transmission channels and the richness of the transmission channels used has a direct relationship with the knowledge flows and knowledge transfer.
- 4) *Motivational disposition of the target unit*: The receiving unit which realizes the potential value of the knowledge being transferred has a strong tendency to receive the share knowledge. A high motivational disposition to receive at the target unit has a positive influence on knowledge flows between subsidiaries.
- 5) *Absorptive capacity of the target unit*: The absorptive capacity of a unit is the ability of the receiving unit to recognize the value of new information, assimilate it and apply the knowledge that they acquire. The difference in absorptive capacity between receiving agents differs because of the difference in prior related knowledge and the extent of inter-unit homophily. The greater the absorptive capacity, the greater will be the knowledge flows.

III. RESEARCH METHOD

This section provides a description of the research methodology employed in this research by providing a description of the data sources used and the lens of analysis used to analyze the object under study. The methodology

used to apply the background theories discussed in the previous section is also described. To study the contributions of Al-Biruni in different areas during his lifetime, his works are studied under three interrelated areas:

- The knowledge source (Al-Biruni) and the link with knowledge assets,
- The environment and methodology of Al-Biruni's research,
- The link between the person and the environment.

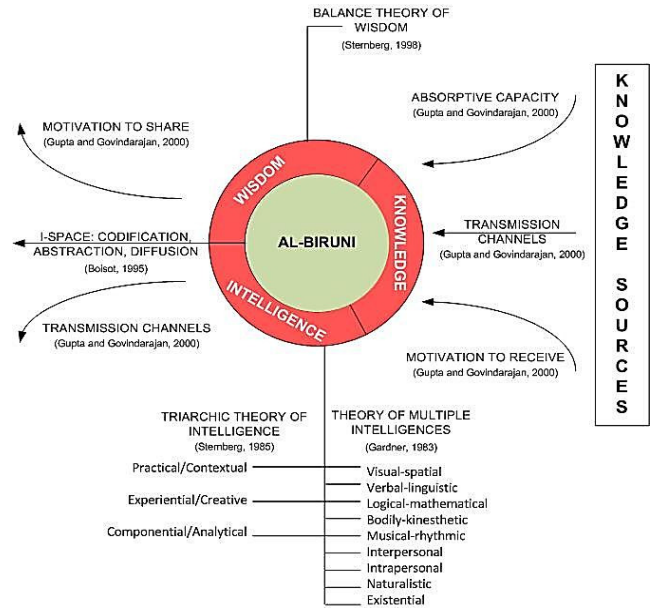


Figure 1: Framework for analysing Al-Biruni's contribution to knowledge assets and flows.

The sources used to study the works of Al-Biruni are based on the works of several authors commenting on the life and achievements of Al-Biruni in different subject areas. The primary source used to study the works of Al-Biruni in India is Edward C. Sachau's *Alberuni's India* [20] which was a direct translation in the year 1887 of Al-Biruni's works on India. The other sources used to study Al-Biruni's contributions are journal publications and reports from several researchers and scholars who had written about his contributions based on their study of his work in different areas.

To study and understand the knowledge capability of Al-Biruni, Gardner's [23],[28] 'theory of multiple intelligences' is used to understand the balance between multiple intelligences that he would have used to acquire knowledge and transform the acquired knowledge from different sources to intelligence. Multiple intelligence theories have been used to study the effects in a classroom [28], study populations [29] and as a catalyst for learning [24]. The study of the different components of intelligence is done based on anecdotal evidence from different data sources to

suggest the different types of intelligence that he possessed. An alternate theory of multiple intelligence proposed by Sternberg [25] called the 'triarchic theory of intelligence' is also applied to study the knowledge source from another perspective of human intelligence. The study of Al-Biruni's multiple intelligence is done based on evidence from research by several authors on studying his contributions in most of his areas of scholarship. Sternberg's [26] balance theory of wisdom is also used to study how Al-Biruni himself has achieved wisdom to effectively adapt to and shape the environment. The discussion on his wisdom is made based on qualitative evidence from the different data sources available relating to the work of Al-Biruni in India which provides a more detailed description of his life in India.

In order to establish the contribution of Al-Biruni to knowledge flows and knowledge transfer, eight subject areas where Al-Biruni had made a significant contribution were chosen. The eight chosen knowledge disciplines are Hindu culture, medicine, astrology, astronomy, anthropology, mathematics, comparative religion and geology and geography. In order to understand and map the knowledge flows of these knowledge assets, the I-space model proposed by Boisot [27] is used. The I-space model has been used to study information flows in analyzing the evolution of social computing [31] and in explaining the comparative success of computer-based tools [32].

A five point scale was used to map the knowledge assets in the I-space based on anecdotal evidence. The scale used is displayed in Table 1. The scale does not refer to any quantitative or absolute value for codification, abstraction or diffusion. The scale is used to qualitatively compare the effect on the knowledge assets before and after the works of Al-Biruni. Here the I-space model is used solely for the comparison of the contributions as a result of Al-Biruni's work in different disciplines. An SLC curve is plotted for the first phase before Al-Biruni started working in that area and a second phase curve is plotted to compare the contributions as a result of his works in the respective areas.

TABLE I  
SCALE USED TO PLOT THE SOCIAL LEARNING CYCLE ON THE I-SPACE

SLC Phases: Before and after the works of Al-Biruni					
<b>Codification</b>	High	Med-High	Med	Med-Low	Low
<b>Abstraction</b>	High	Med-High	Med	Med-Low	Low
<b>Diffusion</b>	High	Med-High	Med	Med-Low	Low

To better understand the knowledge transfer that would have taken place while Al-Biruni made most of his contributions to scholarship, Gupta and Govindarajan's [1]

model of knowledge transfer is used to study the transfer of knowledge that would have occurred while he received knowledge and while he transferred knowledge. First, Al-Biruni is studied as the person receiving knowledge. His motivation to receive, transmission channels used and his absorptive capacity are studied. Secondly, Al-Biruni is studied as the person who transferred knowledge. His motivation to share and transmission channels used are studied based on evidence in his written works on India because of the availability of more detailed text and descriptions. Figure 1 diagrammatically summarizes the framework through which Al-Biruni's contribution to scholarship is studied in this article.

#### IV. ANALYSIS AND FINDINGS

##### A. Theory of Multiple Intelligences

Applying the theory of multiple intelligences [23],[28], we find sufficient evidence to suggest that Al-Biruni possessed a high level of multiple intelligences. The intelligence of Al-Biruni is analyzed using the triarchic theory of intelligence [25] and again we find that Al-Biruni possessed more than one type of intelligence which is clearly displayed in his variety of work and the scholarship achieved during his lifetime.

- 1) *Visual-spatial intelligence*: Harley and Woodward [33] had noted that Al-Biruni made several contributions to cartography and that he had specialized in those aspects that were not studied by other geographers of his time in the Islamic world. Cartography is the subject dealing with making maps and this subject area requires high visual-spatial intelligence. That Al-Biruni possessed this type of intelligence is evident from his contributions to cartography in his work *The Chronology of Nations* which was written during the early years of his scholarship while he was still in his mid-twenties (circa 1000AD). He had also written about seven methods to project a spherical surface on a flat surface and had also written about the construction of astrolabes. The fact Al-Biruni possessed a high visual and spatial awareness is evident from the quality of his work [33]. Possessing this type of intelligence was the essential building block in his life of scholarship since the knowledge of cartography and chronology was a precursor to astronomy [15] and other intellectual pursuits during that time period.
- 2) *Verbal-linguistic intelligence*: Al-Biruni's excellent verbal-linguistic intelligence is evident from the number of books he had written totalling 180 [13], his ability to learn Sanskrit at the level of a scholar, the number of books he had read and translated and his discourse with Indian scholars as can be seen in his works on India. It must also be noted that apart from excellent skills in reading, speaking, writing and translating from different languages and contexts, he also possessed the linguistic ability to express new words in Arabized forms [5] and

also to critique the verbosity of the Indian authors [20]. Possessing this type of intelligence is essential in receiving knowledge from different sources and in diffusing it using language as a medium.

- 3) *Logical-mathematical intelligence*: Al-Biruni's scientific and mathematical thinking is testimony of his logical-mathematical intelligence. It is the most documented of all intelligences. For example, he used this intelligence to compute the latitude of Kath at a very young age [34], to perform time of the day calculations from shadow length [4] to study and apply trigonometry in determining the solar equation [35]. This demonstrates his ability to use this type of intelligence and solve problems with real effects to the advancement of his study and scholarship in different areas of study. It should be noted that logical-mathematical intelligence has a direct relationship with other types of intelligences.
- 4) *Bodily-kinesthetic intelligence*: There is evidence to suggest that Al-Biruni possessed bodily-kinesthetic intelligence also where he used his mind to control bodily movements to solve problems and to handle objects skillfully. This trait is evident from Al-Biruni's experimental methodology for the laws of gravity, laws of motion and several other experiments related to astronomy and geography [15], [20]. He had experimentally computed the density of several stones which is accurate even to this date. He is also known to have designed a lunar and solar calendar computer using gears [36]. Experimentation used to perform a variety of this research is indicative of his high bodily-kinesthetic intelligence. He had also used this intelligence to travel across India and pursue his research where his athletic ability would have also been used.
- 5) *Musical-rhythmic intelligence*: There is evidence to suggest that Al-Biruni possessed this type of intelligence. However, in his translation Alberuni's India, Sachau [20] notes that Al-Biruni explains and describes the Gandharvas the musicians and singers who make music before the Deva (angels) when he tries to explain the classes of created beings as per Hindu tradition and beliefs. He also notes musicians and singers of praise in Greek tradition. He also explains the hunting practices of the Hindus where they sing to the animals to get them accustomed to their sound and use it for hunting [20]. He also describes the singing of melodies from the Vedas and also notes the nasal tone used in singing melodies from the Atharvaveda [20].
- 6) *Interpersonal intelligence*: Having a high interpersonal intelligence enabled Al-Biruni to carry out a lot of research in a foreign land and write his highly authoritative description of the Hindu Culture in his books on India. His methodology involved letting people speak for themselves, travelling within India and associating himself with the yogis and the Brahmins and learning their language [20]. The quality of his work

stands testimony to his high interpersonal intelligence in dealing with people. It can be inferred that he would have earned a high level of trust in allowing him to learn from them. It should be noted that Al-Biruni overcame the barriers to Hindu-Muslim communication which he described including factors like the contempt of Muslims by the Hindus (and vice-versa), the difference in cultural and religious practices and in language and the self-conceit of the Hindus and their depreciation of anything foreign [20].

- 7) *Intrapersonal intelligence*: Another aspect of his intelligence worthy of being noted is his high intrapersonal intelligence. Having survived invasion, captivity and having seeing destruction and bloodshed at different stages in his life [6] he continued on his quest of knowledge while still keeping his goals in mind without losing objective of the larger goal. He discusses lessons he learnt from his past experiences and also at one point refutes the work he had done on astrology once he was convinced that it was not scientifically provable as the truth and that it was not compatible with Islam [37]. These examples show how he used past experiences to shape future experiences which is an essential trait of intrapersonal intelligence.
- 8) *Naturalistic intelligence*: The possession of this type of intelligence enabled Al-Biruni to make most contributions to the fields of geography, astronomy and also during his study of India. Al-Biruni approached the study of nature as a devout Muslim. According to his belief system, he considered the world to be the handiwork of God and the observation and study of nature as religious duty. It is noted that Al-Biruni argued that "man does not have a right to exploit other kingdoms for his own desires, which are insatiable, but may use them only in conformity with the law of God and in His Way" [38]. He also complied with the Islamic environmental ethic which includes stewardship, preservation and protection of all creation in all its forms, respect for the privileges of other species and using no more than what is necessary [39].
- 9) *Existential intelligence*: Al-Biruni also possessed a high level of existential intelligence from his ability to discuss philosophy and compare religions such as Islam, Hinduism, Judaism and Christianity. In his work on India, Al-Biruni discusses the twenty-five elements of existence by the great sage Vysa, the different agents of Hinduism and their beliefs in existence [20], the five elements of existence of the Hindus called the mahabhuta [20] and discusses Yoga philosophy from Patanjali's Yogasutra [40]. These show that Al-Biruni possessed a high-degree of existential intelligence which allowed him to make significant contributions to these fields.

#### B. *Triarchic Theory of Intelligence*

- 1) *Practical/Contextual intelligence*: That Al-Biruni possessed and using a high degree of practical and contextual intelligence is inferred from his continued research in his birthplace Khwarazm, in Ghazna under captivity and his contributions to research and scholarship while in India ([6], [15]). His ability to adapt and shape his environment is also evident from him exhibiting the other forms of intelligence mentioned earlier as many of them require practical and contextual intelligence.
- 2) *Experiential/Creative intelligence*: Al-Biruni's experiential and creative intelligence is evident from the many contributions he has made in several fields and using multiple intelligences as discussed earlier. Some of the examples include developing a new method to calculate the radius of the earth [41], the lunar and solar calendar computer [36] and other novel ideas and bringing in diverse knowledge from different sources.
- 3) *Componential/Analytical intelligence*: This type of intelligence is the most obvious one possessed by Al-Biruni which is clearly evident from the discussions on logical-mathematical intelligence which was discussed earlier.

#### C. Al-Biruni's Multiple Intelligences

For achieving each element in his research, Al-Biruni had used one or more of the discussed intelligences combined for the pursuit of his research. For example, his research in astronomy and the many works that result from it were made possible because of the combination of visual-spatial intelligence, verbal-linguistic intelligence, logical-mathematical intelligence and bodily-kinesthetic intelligence according to Gardner's theory of multiple intelligences and a combination of practical/contextual intelligence, experiential/creative intelligence and componential/analytical intelligence according to Sternberg's triarchic theory of intelligence. Another example would be his research on Hindu culture and religion where his existential intelligence, naturalistic intelligence and intrapersonal intelligence have enabled him to pursue neutral research and write his authoritative account on Hindus and India. It can be inferred that possessing a high level of multiple intelligences aided the pursuit of scholarship of this scope and rigour during his lifespan. An imperative for global organizations and the knowledge societies that seek to develop them will be to develop multiple intelligences among its people and encourage hiring people in the organization based on multiple intelligences. This will enable the vendor and client organization to better interact, exchange and co-create new knowledge.

#### D. Discussions using the I-space Lens

To illustrate the use of the I-Space model [27], the knowledge assets of Al-Biruni were mapped on the I-space in order to understand his contributions to each of the eight

knowledge disciplines of: astronomy, astrology, anthropology, comparative religion, medicine, the Hindu culture, mathematics and geology. The following themes emerged from the study of his work using the I-space in different disciplines.

#### 1) Knowledge transfer and diffusion occurred without cultural homophily

Evidence to find that knowledge transfer and diffusion occurred as a result of Al-Biruni's work can be found from his work in the Hindu culture and anthropology. Knowledge exchanges in environments without cultural homophily is the norm of the modern global organization. For example, Al-Biruni had written one of the most comprehensive works ever on the Hindu culture and their traditions. However, we must note that the Islamic world already had access to knowledge about India through direct translations from Sanskrit to Arabic and from other works that had travelled through Iran having originally been translated from Sanskrit to Persian and further from Persian to Arabic [20].

Friedmann [42] noted the originality of the works of Al-Biruni with respect to Indian religion in his works on India as "informative, descriptive and non-polemical". Despite being a devout Muslim, he engages in a clear and objective discussion and debate about the works on India. He further notes [42] that Al-Biruni had also made clear distinctions between the religious beliefs of the common people and the elite. The impact of diffusing highly abstract knowledge as a result of the works of Al-Biruni about God to the common people may never be known as much as to the elite. It has also been argued that his work on India is the first book by a Muslim which shows an interest in the religion, philosophy, and customs of a non-Muslim people. He compares the polytheistic and monotheistic beliefs of the different religions quoting from those who believed in Hinduism, Judaism, Christianity and even Islam. He knew Persian but preferred Arabic for most of his writing because he felt that Arabic was more suitable for academic pursuit [14]. The works of Al-Biruni allowed the diffusion of knowledge with his structured writing on the Hindu culture by contextualizing the knowledge to suit the needs of his readers. Having provided literature in Arabic from several translations from Sanskrit literature and from social intercourse with scholars and people alike in the region, there was greater abstraction which in turn enabled greater diffusion. . In global organizations where usually the vendor and client organization have different background knowledge and different areas of strength in knowledge, understanding the client organization and packaging knowledge in the client's context will enable the vendor organization to effectively diffuse knowledge to the client and vice versa.

To compare the contributions of Al-Biruni in his works that codified more knowledge about Hindu culture and

made the knowledge of Hindu culture more abstract. The comparison of the three dimensions of the I-space model in the two phases before and after Al-Biruni’s works on Hindu culture is shown in Table 2. This generated a greater abstraction of the knowledge of Hindu culture enabling a far greater diffusion in due course of time. The current state of knowledge on Hindu culture has reached maximum diffusion such that it is no longer proprietary knowledge but textbook knowledge that is readily available to those who want to learn about Hindu culture as a result of Al-Biruni’s works on India and the Hindu culture. This is shown diagrammatically in Figure 2.

TABLE II  
COMPARISON OF THE PHASES OF THE SLCs OF HINDU CULTURE SHOWING THE CONTRIBUTIONS OF AL-BIRUNI

Hindu Culture	Codification	Abstraction	Diffusion
Before Al-Biruni	High	Med-High	Med
After Al-Biruni	High	Med-High	Med

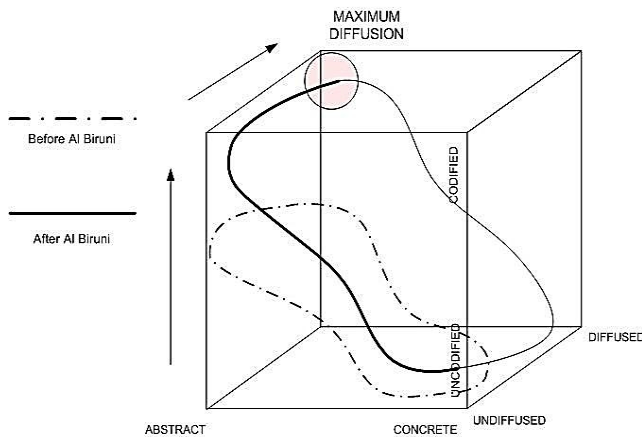


Figure 2: Comparison of the phases of the SLCs on I-space.

As an illustration, Al-Biruni is considered to be the first anthropologist [43] and in Sachau’s Alberuni’s India the chapter titles themselves reflect the modern anthropological interests with chapters on castes, on rites and customs with other castes and the issues of women [43]. It is important to note that Al-Biruni’s methodology was to let the Hindus speak for themselves and to present a picture of the Indian civilization as told by its people. Al-Biruni spent time and effort in acquiring Hindu sources, learning Sanskrit and translating directly from primary Sanskrit sources. Unlike the history of India in the pre-Islamic period, Hamidullah [54] noted that Al-Biruni’s account of India serves as the sole source of history about India during his time period. From this it can be inferred that Al-Biruni gave form and

structure to anthropological interests permitting its diffusion in due course of time.

2) Knowledge was diffused with high transmission (and hence diffusion) capacity arising from his high absorptive capacity

Possessing a very high absorptive capacity allowed Al-Biruni to receive knowledge from different sources and diffuse it using his high transmissive capacity which arose from his high absorptive capacity. Evidence to support this can be found by applying the I-space model to his work in astronomy, medicine and geology.

Of all the scientific areas which Al-Biruni had worked on, astronomy is probably his most well-known and most widely acknowledged contribution. Indeed, Al-Biruni’s first passion in his pursuit of knowledge was astronomy. Chronology which is used to study the sequence of events over time is related to astronomy because astronomy is the tool used to measure time. Until he had this depth of knowledge in astronomy and thus chronology, he felt that his findings could not be applied as universal truths. He also felt that it was important to know this to study the relationships of various events and occurrences in history [15]. Durant [45] noted that Al-Biruni wrote treatises on the astrolabe, the planisphere, the armillary sphere; and formulated astronomical tables for Sultan Masud. He further writes that he took it for granted that the earth is round, noted gravity as “the attraction of all things towards the center of the earth” and remarked that astronomic data can be explained as well by supposing that the earth turns daily on its axis and annually around the sun, as by the reverse hypothesis. While in India, he compared, critiqued and translated the works of Aryabhata and Brahmagupta with notes on their contributions [16]. His methodology for the study of astronomy was theoretical, observational and experimental. He significantly adds to the scientific debate on astronomy and also reports several of his findings which he derived experimentally. From this it can be inferred that his works had increased the body of knowledge of astronomy that is available and thus increasing the size of the social learning cycle. Sachau [20] considers his work on astronomy titled Al Qanun Al Masudi (The Canon of Al Masudi) the “greatest work” ever of Al-Biruni. Having applied, studied and critiqued the existing methods of astronomy aided by his high absorptive capacity and by creating new knowledge in astronomy, Al-Biruni had made knowledge of astronomy more abstract, more codified and thus more diffused.

Unlike his studies on most other areas, Al-Biruni does not seem to have made a special study of Indian medicine. He merely used available translations (and complains of their incorrectness) and also translated treatises directly from Sanskrit. He also wrote the Kitab-al-Saidana, which is an extensive materia medica that combines the then existing Arabic knowledge on the subject with the Indian medicine ([15],[17]). Sachau [20] notes that there already existed

knowledge of medicine from India and Persia among the Arabs at that time. Sachau [20] also suggested that the source of Al-Biruni's knowledge on Indian medicine is the famous work on medicine - the Caraka written in Sanskrit. Tschanz [46] describes Al-Biruni's contributions to pharmacy and medicine and credits him for providing one of the finest definitions of the pharmacist and providing details on how the pharmacist must better perform in medicine. There is evidence to suggest that the works of Al-Biruni on medicine has been passed on through the years and diffused to different sources. Savage-Smith [47] mentions the existence of a painting illustrating the abdominal birth of Julius Caesar made in 1307AD on a copy of his work suggesting that the medieval Islamic physicians employed post mortem Caesarean sections. By translating directly from the Indian primary sources to the Arabs, Al-Biruni's work increased the codification on the available literature on medicine. There is no evidence of a significant change in the level of abstraction. He had however aggregated knowledge from different sources and combined them in his written works enabling a greater diffusion. It can be inferred that there has been a greater diffusion to the Arab world as a result of his works.

From his work in geology and geography, Al-Biruni states that he has himself determined the latitudes of eleven towns of India which he had visited. His chapter on the physical geography of India deals with its important towns, rivers, oceans, roads and itineraries noting the exact distances between towns which proves that his knowledge of the topography of northern India is very sound. The geographical and physical factors of a country play an important part in its history and there is geography behind history. The information contained in Al-Biruni's chapter on India's geography is useful for the historians of ancient and early medieval India [10]. Al-Biruni is now often considered as the father of geodesy for his achievements in this field [16]. He concluded that roughly only a quarter of the Earth's surface is habitable by human beings and that the continents were separated by a vast sea, too dark and dense and too risky to even try to navigate [16]. Al-Biruni considered geographical knowledge as important as other branches of science. He made observations on the formation of mountain chains, the origin of the Indian plain and describes climatological factors very close to modern concepts [3]. It is also noted that some of his geographical explanations like his explanation of the origin of oceans are more religious than scientific [3]. By adding to the body of knowledge and by giving form and structure (under different sections of physical and mathematical geography) he had achieved a higher degree of abstraction and codification. This enabled Al-Biruni to diffuse a greater amount of knowledge.

3) *Knowledge was diffused as a result of a motivation to diffuse knowledge arising from a holistic view of knowledge*

Al-Biruni held a holistic view of knowledge and used his motivation to engage in scholarship and knowledge diffusion. His view of knowledge enabled him to engage in neutral debate and also diffuse knowledge in the best possible way. This is evident by applying the I-space model to his work in astrology, mathematics and comparative medicine.

Al Biruni wrote a manual on astrology that till this day serves as a wonderful work on astrology which also contains a lot of elements which was used in astronomy. Johnsen [48] reveals that Al-Biruni's motivation to write on astrology was for a young Muslim girl named Rayhanah who wanted to learn about the stars but was not permitted to attend school because women were not permitted to school in those days. Islamic schools in that era were exclusively for boys. Al-Biruni's Book of Instruction in the Elements of the Art of Astrology was written for Lady Rayhanah, one of the members of the Khwarizm court who was carried off to Ghazna by Mahmud in 1017. Lady Rayhanah was known to be very curious and inquisitive in her nature and had a craving for scientific knowledge. Al-Biruni even dedicated the book to her [49]. The instructions given in the book were comprehensive beginning with sections on geometry and arithmetic leading to a thorough exposition of Ptolemaic astronomy that includes a detailed description of the use of the astrolabe. This is followed by sections on geography and chronology. Al-Biruni also insists that one cannot be an astrologer without a good knowledge of any of these ancillary sciences. He had made astrology highly abstract by recognizing five divisions of judicial astrology and clearly describing them [49]. In his works, Al-Biruni also brought out the semantic differences between astronomy and astrology [50] and later he published a refutation of astrology since he felt that it was not based on science and conflicted with his views of Islam [37]. He believed that the Arabs did not have access to the Hindu methods of astrology and began with a sense of responsibility to diffuse these methods to them. However, his refutation towards the end served as a block to diffusion which further prevents the progress of the knowledge of astrology on the social learning cycle.

Al-Biruni made significant original contributions to the field of mathematics. Al-Daffa [51] has acknowledged his contributions in this field. He notes that Al-Biruni was among the early mathematicians who laid the foundations of trigonometry. He was a physicist as well and studied aspects like specific gravity, the origin of artesian wells, carried out geodesic measurements and determined the circumference of the earth all using mathematics. Perhaps, the most important contribution made by Al-Biruni was using mathematics to fix the direction to Mecca in mosques all over the world. He combined the laws of algebra and geometry and used the law of sines to determine the circumference of the Earth [52]. From this it can be inferred that his works have increased the body of knowledge of

mathematics that is available thus increasing the size of the social learning cycle.

Al-Biruni compared different religions within a framework of Islam comparing religions to his own faith. Al Biruni, a devout Muslim, was by no means sympathetic to Hindu beliefs or wisdom but he made an intellectual effort to report the Hindu beliefs objectively so that the Muslims would be able to approach and pursue the knowledge of the Indians with a Hindu perspective. Al Biruni also provides a detailed view of the Hindu belief of reincarnation which is contradictory to the Muslim faith [48]. Al Biruni noted that Greek, Indian and Sufi mystics essentially taught the same doctrine. In his work, Al-Biruni quotes the Bhagavad Gita and mentions the saying of Sage Vyasa: "Learn twenty-five by distinctions and afterwards adhere to whatever religion you like; your end will be salvation". He speaks of the Hindu scholars having enjoyed the divine help of God which he interpreted as being inspired and guided by divine inspiration [20]. Sachau [20] notes that any such statement in later times would have led the Muslims to find fault and denounce his heathenish work. On occasions, Al-Biruni points out to the readers the superiority of Islam over Brahmanic India [20]. He compares and contrasts the democratic equality of men with the castes of India, the matrimonial law of Islam with degraded forms of it in India, the cleanliness and decency of the Muslims with the filthy customs of the Hindus. However, he criticizes the Arabs and though he dares not criticize Islam [20]. In his work on India, whenever he speaks of the dark side of the Hindus, he also compares and points out the manners of the ancient Arabs and says that they were as bad, if not worse than the Hindus. The motivation for this was to hint that Muslim readers should not to be too haughty towards the Hindus who were trodden by the savage hordes of King Mahmud and that the ancient practitioners of Islam themselves were not blameless [20]. Al-Biruni quotes from several religious works apart from his own in his work including Hindu ideals from the Bhagvadgita, the words of Sufi philosophers and ideals from Christian and Jewish texts. Sachau notes that his work on Hindu philosophy is probably unparalleled. Sachau mentions that the quotations of Zoroastrian, Christian, Jewish, Manichaen and Sufi sources are not very numerous. His quotations of Sufism are from well-known representatives of Sufism and he does a credible job at his comparisons [20]. India, in the knowledge of Al-Biruni, was Brahmanic and not Buddhist in his time period. In the early eleventh century, it seems that there were no traces of Buddhism in Central Asia, Khurasan, Afghanistan, and North-Western India. Sachau notes that it is surprising for a man of the inquisitive nature of Al-Biruni to know scarcely anything about Buddhism and did not have a means of procuring the information. Sachau also mentions that his notes on Buddhism are limited and derived from a poor source. Al-Biruni had knowledge on Jewish and Christian beliefs and practices and he compares them in his work on India [53]. From this it can be inferred that by comparing

religion, Al-Biruni made knowledge on comparative religion abstract permitting its diffusion in due course of time. He also was the first Islamic scholar to display pluralism in Islam by receiving religious ideas from different religions and comparing them with his own religion within the framework of Islam.

#### *E. Synthesis of the Knowledge Diffusion Method of Al-Biruni*

To study the knowledge transfer between the various sources and his ability to transfer knowledge, Al-Biruni's works on India is studied and evidence is found to substantiate knowledge transfer under different factors under the framework of knowledge transfer defined by Gupta and Govindarajan [1].

#### *1) Motivation for Al-Biruni to receive and transfer knowledge*

Al-Biruni in his preface claimed to have been incited by the master Abu-Sahl to codify in written records his knowledge about the Hindus as a help to those who want to discuss religious questions with the Hindus and as a repertory of information to those who want to associate with them [20]. He quoted the words of Hindu scholars and mentions them despite the possibility that it be called heathenish doctrine because the Muslims are supposed to be the followers of the truth. He went on to say that his book is a simple historic record of facts [20]. Al-Biruni was guided by a desire to justify that Islam indeed supports intellectual progress and serves as a proof that the Muslim can rise above the prejudices of training and tradition to make mankind at large the subject of impartial study [5]. It is also a demonstration of what benefits might have been conferred on India by Islam so far back as the eleventh century, had the conqueror (Mahmud of Ghazna) of that vast territory of India been guided by the counsels of one who lived under his shadow (Islam) and "not engaged," as Sachau observed, "in fighting the Hindus, but in trying to learn from them, to study Sanskrit and Sanskrit literature, and to translate Sanskrit books into Arabic". He wrote that "their state (i.e. doctrinal position of the Indians) resembles that of Christianity; for it is based upon (the principle of) doing good and abstaining from evil; as (for instance) absolutely refraining from the infliction of death, throwing one's tunic to the snatcher of one's cloak, turning one cheek to the smiter of the other, and praying for and blessing one's enemies. Such, by my life, is a noble rule of conduct! But worldly people are not all philosophers, and, indeed, the greater part are ignorant and transgressors. The sword and scourge can alone restrain them, for without them the regulation of society (administration of justice) cannot be accomplished. Thus it is with India..." [20] suggests that while Al-Biruni was writing this he must have had in mind the verses in the book of Mathew in the Bible " Whosoever shall smite thee on thy right cheek, turn to him the other also," and "If any man will . . . take away thy coat, let him have thy cloak also".

Sachau [20] noted that Al-Biruni had not once lost track of his objective to write on the Hindus so that his work was to afford the necessary information and training to “any one (in Islam) who wants to converse with the Hindus, and to discuss with them questions of religion, science, or literature, on the very basis of their own civilization”. He also states that he will neither convert the Hindus nor lend a hand to the missionary zealots and that his objective was simply to describe Hinduism without identifying himself with it. He writes on a variety of subjects on India, which were intended to be used to give an insight into the mode and the world of thought of the Hindus for peaceful communication with them. Al-Biruni did not share interests in common with Mahmud of Ghazna [20]. Even though the book was written in an environment of conflict between India and Islam the work of Al-Biruni provides information as a result of an impartial research. Al-Biruni sought to render Sanskrit lore to be more easily understood by the Arabs and also sought to promote Arabic learning among the Hindus [5]. The Samkhiya by Kapila, the book of Patanjali, Paulisaisiddhanta; Brahmasiddhanta; these and many other works he had translated into Arabic for his own countrymen and co-religionists while at the same time he wrote treatises in Arabic and translated it to the regional language, for the instruction of natives of India [5].

Al-Biruni was motivated to write about Indian astrology because he thought that Indian astrology had not been transferred into the ancient Arabic literature. He felt that his fellow Muslim believers who did not have an opportunity to be acquainted with the Hindu methods of astrology must have an opportunity to study an Indian book on the subject [20]. However, it must also be noted that Sachau mentions that it was probable that the works which Al-Biruni was translating (eg. the works of Varahamihira like his Brihatsamhita and Laghujatakam) were already accessible to the Arabs and mentions that books on astrology had been translated in the early days of the Abbasid rule [20].

Al-Biruni felt a strong inclination towards Indian philosophy and constantly compares the philosophies of ancient Greece and India and repeatedly distinguishes it from the ideals held by the crowd. He specifically compares his thoughts of pure monotheism to be like his own and says that the dark passions of the crowd over time has given rise to the difference of religion and idolatry and drifts away from the idea of one sole Almighty God [20].

### 2) *Absorptive capacity of Al-Biruni*

From all his contributions made in different areas of scholarship, it can be noted that Al-Biruni had a high absorptive capacity for different types of knowledge in different areas. Having a high absorptive capacity enabled him to quickly learn and create new knowledge and receive knowledge that was already codified in the form of written literature, receive knowledge that he learnt from his interactions with people and also receive knowledge from his many interactions with the scholars in India and the

different people he met during his pursuit of scholarship. He also had a high absorptive capacity to receive knowledge by observation and experimentation. It must also be noted that the view of knowledge held by Al-Biruni was more universal in nature and not restricted to a preconceived frame of mind. This would have required a high level of absorptive capacity on the part of Al-Biruni to create, receive or transfer knowledge. It should also be noted that this high absorptive capacity not only enabled him to receive knowledge but also enabled him to transmit and diffuse knowledge acquired as a result of his high absorptive capacity. His high absorptive capacity was a result of him having multiple intelligences that allowed him to receive from different languages, different subjects, create new knowledge and diffuse knowledge in a form that is useful to its intended recipient. For successful knowledge transfers between the client and vendor organization, the people responsible for managing knowledge transfers must ensure that motivation for sharing and receiving is a necessary criteria that is established before initiating knowledge transfers. Having people with high absorptive capacity will enable better knowledge exchanges which is essential for modern organizations.

### 3) *Transmission channels*

Sachau [20] described the early transmission channels for knowledge between India and the Islamic world in his work Alberuni's India. The contributions of India reached Baghdad by two different roads:

- i. A part of the knowledge came from direct translations from Sanskrit to Arabic.
- ii. The other part had travelled through Iran having originally been translated from Sanskrit to Persian and farther from Persian to Arabic.

The communication between India and Bagdad also occurred in two different periods:

- i. The first was in between A.D. 753 – 774 when Sindh was under the rule of the Khalif Mansur. There came embassies from that part of India to Bagdad. It was during this period that the Arabs became acquainted with the scientific system of astronomy from Brahmagupta, earlier than Ptolemy.
- ii. The second was between A.D. 786 – 808 under the rule of Harun Al-Rashid when the ministerial Barmak family sent scholars to India to study medicine and pharmacology. They also engaged Hindu scholars to come to Bagdad and made them the chief physicians of their hospitals and ordered them to translate from Sanskrit into Arabic books on medicine, pharmacology, toxicology, philosophy, astrology and other subjects.

However, later with Al-Biruni's travel and visit to India he researched and learnt things directly from the primary sources by learning Sanskrit, talking to the Indian scholars,

by experimentation and direct observation in India. This increased the richness of transmission channels of knowledge to reach Al-Biruni thereby increasing the richness of transmission channels that Al-Biruni used to diffuse knowledge by providing more detailed and structure knowledge in his literature.

#### 4) *Barriers to Knowledge Transfer*

Cultural homophily which is considered an issue for knowledge transfer also acted as a barrier for communication between the Hindus and the Muslims. Al-Biruni writes that there were five reasons which separated the Muslims and the Hindus [20]:

- i. First, he mentions that unlike other nations they differ in the nature of their language of communication. He says that learning Sanskrit is difficult for one who chooses to learn the language. He also says that it is because of this reason that it is very difficult to translate their works and express an Indian word in Arabic writing. He also mentions that even though the Hindus boast of this enormous range in their language, it actually is a defect.
- ii. The second barrier which he mentions is the religious prejudices of the Hindus. He says that their religion is completely different and that the Hindus, by religion, are not allowed to receive anybody who does not belong to them even if he wanted to.  
The third barrier was the radical differences in the manners and culture. He mentions that the Hindus declared the Muslims as devil's breed and they even frighten their children with them and their dress and ways.
- iii. Another reason which acted as a barrier was the hatred developed for the Muslims. This hatred resulted from the attempts of the Muslims to make inroads into their country and the aversion of the Buddhists towards the countries to their west when they had been expelled on account of their religion.
- iv. The fifth reason mentioned by Al-Biruni was the self-conceit of the Hindus and their depreciation of anything foreign. He abhors the Hindu self-proclaimed superiority over every other nation, religion and science. He also criticizes their haughtiness for dividing and withholding people within their own but belonging to different castes.

Possessing a balance of wisdom, Al-Biruni was able to adapt to his environment and select and shape his environment [26] to overcome these barriers. By adapting to, shaping and influencing the environment in which he operated in, Al-Biruni was able to overcome the barriers placed by cultural homophily and he could reach his intended audience. Sachau [20] noted that the possible readers for all his works on Indian subjects would be difficult to say, but also suggested some of the possible audience for his work. He suggests that the readers could be probably educated Muslims in Sindh or parts of Panjab

where they were living by the side of the Hindus and in daily communication with them and Ghazna and other parts of Afghanistan. In his neighborhood, there were also circles of educated men who were interested in getting the scientific works of India translated into Arabic, who were familiar with the subject matter sufficiently to criticize the various representations of the same subject.

#### F. *Knowledge Attrition*

When the Sindh region was no longer politically dependent on Baghdad, the social intercourse between the Arabs and the Indians ceased entirely soon after the two known time-periods of transfer of knowledge. Sachau [20] notes that Arabic literature had veered into other channels and there was no more mention of the presence of Hindu scholars in Baghdad or of translation of works from Sanskrit. During this time period, Greek learning had won the minds of the Arab scholars which reached them through the labours of Nestorian physicians, the philosophers of Harran and Christian scholars in Syria. Only 22 of his works have survived the ravages of time; and only a dozen or so of these have been published today [13]. Al-Biruni also repeatedly complained of the quality of the books on India offered to him, blaming the poor quality translations, corruption of the texts as a result of negligence on the part of the copyists and the lack of proper names in the texts [20]. However, there are several Indian works which Al-Biruni quotes while writing about India. Sachau [20] also regrets the loss of most of the history of Al-Biruni's native country Khwarazm and the history of the sect of the Karmatians.

Sachau [20] provides evidence to suggest that there were none after Al-Biruni who continued his work with the same level of excellence and spirit. However, he mentions that there were a few authors who did carry on his work a little later, two of whom he says were noteworthy – Gardezi (A.D. 1049 - 1052) and Muhammad Ibn Ukail (A.D. 1089 - 1099). He also mentions an author named Rashid-al-din who plagiarized Al-Biruni's *Indica* by transferring an entire chapter from it to his huge chronicle.

#### G. *Evidences of Knowledge Diffusion*

Al-Biruni operated in an environment where there was no printing press, no mass media and no communication technologies which are taken for granted in recent times. It must also be noted that Al-Biruni did not have any intellectual property protection or rights to interfere with the flow of knowledge. However, there is evidence to suggest that his works travelled great distances. It is noted that a 13th century example of an Islamic calendar computer at the Museum of the History of Science in Oxford used techniques written by Al-Biruni around 1000AD suggesting that his works on the mechanical calendar had indeed been diffused to Europe [54]. The first known drawing of a caesarean section was done by Al-Biruni and it exists in a rare manuscript in the Edinburgh University Library [55]. A search on Google Books also reveals Al-Biruni cited several

times during and before the early 20th century. His account of India is mentioned by Lockyer in 1888 [56], his Muslim view of India and the rarity of his works is mentioned by Elliot in 1867 [57], the Arabian knowledge of India as written by Al-Biruni is mentioned by Pegolotti, Marignoli and Batuta in 1866 [58] and his work in India is also mentioned by Latif in 1892 [59] among several other earlier citations. There is also evidence to suggest that his works had attracted the attention of scholars of the former Soviet Union [9]. These prove that there is evidence that Al-Biruni had successfully diffused knowledge and most notably about his works on India overcoming several barriers including culture, language and distance.

## V. CONCLUSIONS

We may therefore conclude that several factors have contributed to the tremendous achievements in scholarship in different areas by the genius of Abu Rayhan Al-Biruni. Lessons learned from him can be applied to improve knowledge exchanges in global organizations. As a practitioner of such exchanges, he possessed multiple intelligences which interacted to enable him to produce a great deal of research output during his time period. He possessed a high level of wisdom and achieved a balance between his intrapersonal, interpersonal and extrapersonal interests with a strongly held value system over both the short term and the long term and he used this to positively influence his environment. Even though his environment was not the most conducive to his life and research, he used his intelligence and wisdom to adapt, shape and influence his environment to continue with his pursuit of knowledge while still holding strong to his Islamic values. He operated within a framework of Islam and held a strong code of ethics which is evident from his character description. He held a more universal view of knowledge unlike the knowledge based on different subject areas as we know it today.

His learning and research methodology was also very conducive to knowledge flows and knowledge transfer. His research methodology included the requirement to associate with his readers and to provide a common context to his readers. When he received knowledge, his methodology was to let the object of interest to speak for itself overcoming several barriers but enabling unhindered flow of knowledge from the source to himself. While transferring knowledge he ensured that he added a context to the knowledge he received so that he could relate to his readers. He also avoided unnecessary verbosity and incorporated redundancy into learning. It can also be seen that from his research involving translation, experimentation and theoretical research, he added form and structure to newly created knowledge and existing bodies of knowledge resulting from greater codification and greater abstraction which enabled him to diffuse knowledge further. He possessed a high absorptive capacity which can be inferred to be the result of multiple intelligences and wisdom. It must also be noted

that the absorptive capacity required for the receiver of his transmitted knowledge would have been greatly reduced as a result of his research methodology. When faced with several barriers to communication, again his multiple intelligences and wisdom seem to overcome the many barriers especially cultural homophily.

The implications of this case in history can be extended to modern day challenges like in the case of collaboration across organizations and cultures. The research suggests that intelligence, wisdom, global awareness is an essential component in multi-national, cross-cultural and cross-lingual knowledge transfer. To diffuse knowledge between cultures and geographies it must be noted that giving form and structure relating to the context of the receiver will be far more effective in knowledge flows and knowledge transfer than mere translation and transfer. Possessing multiple intelligences and a balance in wisdom enables the people involved in multi-national, cross-cultural and cross-lingual knowledge transfer to be able to give better form and structure to knowledge. Global organizations must place a cultural emphasis on multiple intelligences in learning among its team members. Multiple intelligence also increases the absorptive capacity of the citizens enabling them to receive knowledge better, give greater form and structure to knowledge reducing the absorptive capacity of the recipients and increasing their ability to learn and also deal with complexity. It is worth noting that Al-Biruni wrote laboriously and transferred knowledge effectively in a day and age before the invention of the printing press and before the existence of any form of intellectual property protection or copyright (he still had a motivational disposition to receive and transfer). Global organizations must make a conscious effort to manage multiple intelligences and achieve a balance of wisdom which would result in a focus on achieving a common good. As the global economic system transforms itself to seeking competitive advantage through knowledge creation and diffusion, it is worthy to recount the legacy of a remarkable scholar who lived a thousand years ago and practiced knowledge diffusion across organizational and cultural boundaries with much effectiveness.

## Acknowledgements

The authors are part of an informal, irreverent knowledge research factory (styled on the Bourbaki group) at the Wee Kim Wee School at Nanyang Technological University, Singapore. Ravi S. Sharma is a member of faculty and Praveen Sam was a graduate student of KM. An early version of this paper was selected as a "Best Paper" in the 2011 International Conference on Smart-Sourcing. The findings reported in this article are part of the group's ongoing efforts to develop a formal understanding of knowledge management methods and policies. The authors are grateful to their colleague, the medieval historian, Prof. Emma Flatt, for her collegiate advice and sharing. They

would also like to thank Prof. Shailendra Palvia of Long Island University for his thoughtful review of an early draft

that has led to a much improved paper. Finally, they dedicate this paper as an intellectual debt to the late Indo-Arabic scholar, Dr. Edward C. Sachau, without whose treatise much of the world would have forgotten the genius of Alberuni.

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