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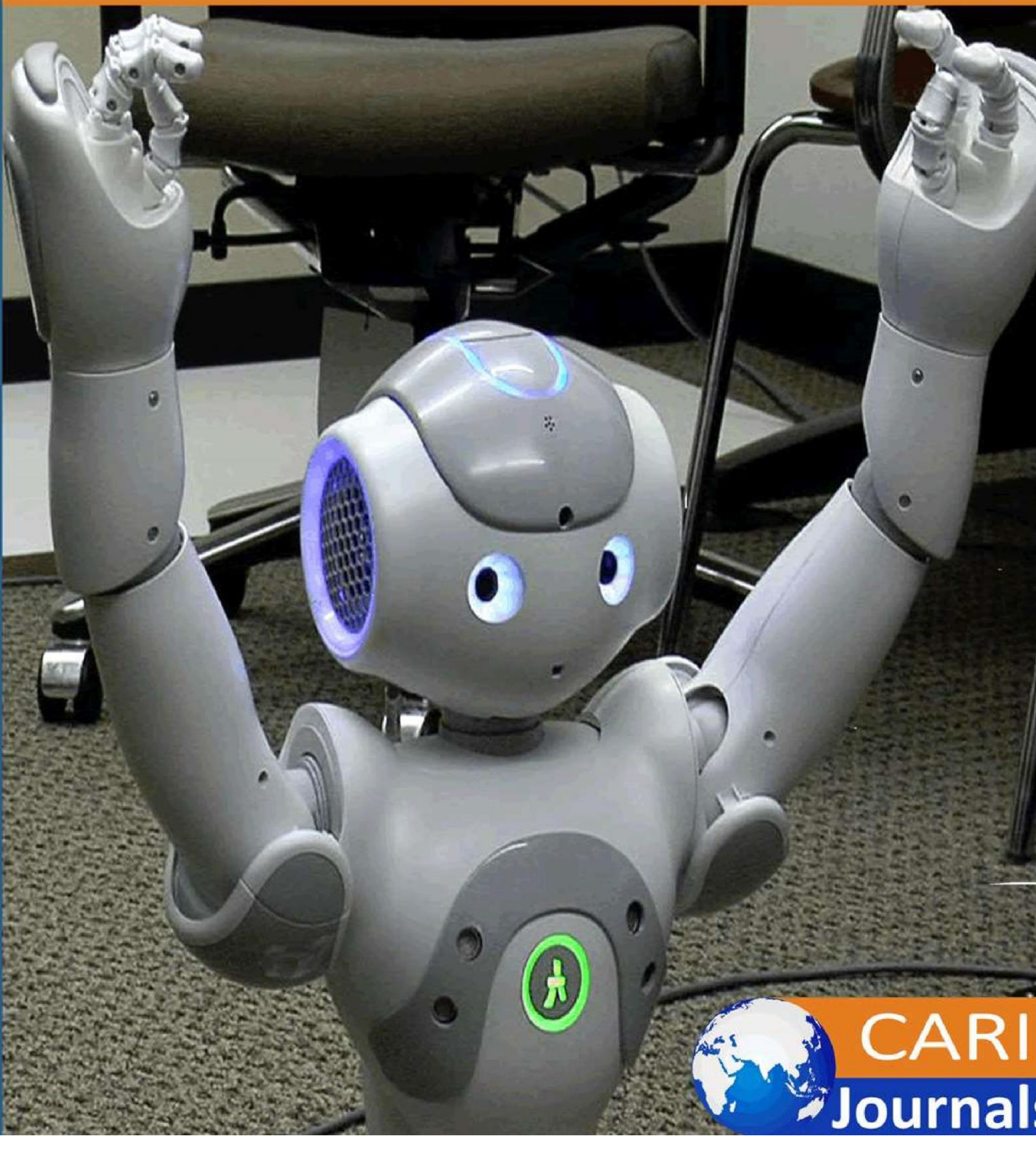

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Legal Protection of Indigenous Knowledge Systems through IKS for Large-Scale Enterprises

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Abstract

The formation of the Association of Southeast Asian Nations (ASEAN) Economic Community (AEC) in 2015 has created new challenges for small and medium-sized businesses (SMEs) in Malaysia. These challenges are in addition to the consequences of globalization that have already been experienced by low-cost nations such as India and China. It is critical for small and medium-sized firms (SMEs) to keep their competitive edge because they are the backbone of the Malaysian economy. A business can increase its competitiveness by implementing the kaizen idea of continuous improvement. Challenges and opportunities for small and medium-sized firms to adopt kaizen are explored in this article. Several factors were found to play a role in the effective execution of Kaizen. Among these were an articulated business plan, effective management of company information, employee agency, and two-way dialogue between upper and lower-level management. Another important factor was having a Kaizen champion on staff. However, environmental monitoring systems still do not have enough evidence to justify the semantic description of these many data sources. The compatibility issues can only be resolved with a tailored semantic middleware solution. Detailed herein is the design of a cross-domain middleware system capable of semantic integration and inference generation from a variety of data sources. Improved environmental monitoring systems are possible thanks to semantic technology's application to the prediction and forecasting of complicated environmental phenomena.

Keywords: *Indigenous Knowledge Systems, Large-Scale Enterprises, small and medium-sized businesses (SMEs)*

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1. INTRODUCTION

'Kaizen' is derived from two Japanese words, 'kai' meaning change and 'zen' meaning for the better [1]. A Japanese philosophy known as kaizen encourages the implementation of incremental enhancements that are the result of persistent effort. Everyone in the business, from the highest-level management to the lowest-level workers, is required to participate in order to make these very little improvements. The personnel are required to strive steadily toward greater job standards in order to accomplish the long-term improvement that is desired. The Japanese manufacturing sector successfully used the Kaizen approach after World War II.

It is crucial to prioritize the preservation and responsible use of bioresources in view of the fact that they are vulnerable to environmental changes and human interference. An agreement on the Aichi Biodiversity Targets (ABT) has been reached by the parties; these targets promote worldwide actions to aid in biodiversity conservation. Similarly inspiring are the United Nations' Sustainable Development Goals (SDGs) outlined in Agenda 2030. Natural resource management and conservation have been practiced by indigenous and traditional groups for millennia. These communities, in addition to the government's efforts, are predominantly found in remote and rural areas. Indigenous and traditional communities describe this population. A staggering 370 million indigenous people, also referred to as "first" or "original" people, are believed to inhabit almost 20% of our planet. For many communities, biodiversity is deeply ingrained in history and culture [2]. Their cultural unity and diverse knowledge are firmly grounded in the environment, allowing them to manage natural resources sustainably and protect the environment in a world that is constantly changing [3]. "The knowledge, innovations, and practices of indigenous and local communities around the world." That is how the Convention on Biological Diversity puts it when it defines traditional knowledge.

This information is built via experience through trial and error over the course of several centuries [4]. Furthermore, this knowledge represents the reciprocal relationships that exist between humans and their environments, and it is shared from one generation to the next through the process of cultural transmission. Having traditional and indigenous knowledge systems that are pertinent to biodiversity preservation is crucial for human survival, especially in rural and isolated areas around the globe! Therefore, it is crucial to preserve the traditional knowledge systems that are vital to the livelihoods of millions of people. Indigenous communities play an important role in protecting biodiversity, managing a variety of ecosystems, and managing natural resources. Countless examples of effective resource management have been recorded on a global scale.

The utilization of this knowledge has contributed to the protection of biodiversity, especially the rare species, as well as to the preservation of the biodiversity [5]. Indigenous knowledge systems contribute significantly to the socioeconomic development of developing nations, which rely more heavily on biodiversity and bioresources. For example, in India, the People's Biodiversity Registers (PBRs) record information about biological resources, including their status, uses, and management, as well as traditional knowledge about biodiversity [6]. Therefore, the documentation is crucial for appropriately appreciating and protecting this valuable knowledge. The most populated, tallest, and largest mountain range in the world—the Himalayas—is situated in Asia. This area is rich in biodiversity, including both common and rare species, and it is part of a very diverse region in terms of geography and ecology [7].

The resource base and ecological functions provided by the Himalayan Biodiversity are undeniably vital to the survival of countless people in the uplands and the descent streams [8]. The Indian Himalayan Region (IHR) is home to a plethora of Himalayan species because of the wide variety of biophysical conditions found there. The reason behind this is that the IHR is situated in the Himalayas. Two separate biogeographical zones make up the IHR; one of these zones includes the Himalayas, and the other is the Trans-Himalaya-Tibetan Plateau. Not only do these two zones encompass the Ladakh Mountains in Jammu and Kashmir, but they also include the following seven bio-geographical provinces: Sikkim (Northern Sikkim), North-West (Jammu and Kashmir and Himachal Pradesh), West (Uttarakhand), Central (Sikkim-Darjeeling Himalaya), and East (Arunachal Pradesh including the north-east region). The region's bounty of biological resources is a direct outcome of the conservation and management efforts of the local population. There is general agreement that the Indigenous Health Research (IHR) is unique among health organizations in its emphasis on IKP. Both the preservation and management of biodiversity rely heavily on these techniques, which have been essential in guaranteeing food security [10].

Within the IHR, traditional wisdom and methods of resource management have been preserved and passed down over many generations. Numerous indigenous and cultural groups in the area have contributed to the development of these distinctive practices, which are fundamental to the people's culture. Interactions between these people and wildlife and the natural world also serve to reinforce their cultural norms, which in turn makes biodiversity management and protection more challenging from a cultural and religious perspective [11]. Local people's devotion to and care for natural spaces, such as sacred landscapes, woods, and groves, is an excellent example of in-situ biodiversity conservation [12]. This is a helpful strategy that might be used for biodiversity management and utilization under climate change scenarios. In order to mainstream and reinforce discourses on sustainable ecosystem management, this project aims to document the indigenous knowledge of communities in the IHR that rely on natural resources.

2. LITERATURE REVIEW

The term "indigenous knowledge" (IK) and "indigenous knowledge systems" (IKS) are used to describe the body of information that is specific to a particular community or culture [13]. Universities, research institutes, and commercial companies all contribute to what is known as the "international knowledge system," but IK and IKS are considered distinct from this larger body of information. Research and development of current scientific systems is the scientific and technological endeavor of human civilization on a worldwide scale. This knowledge is known as international knowledge. The current pathways and methods for the development, affirmation, and diffusion of scientific information are maintained and continued through the acquisition of this knowledge through formal education and "book learning," which is further reinforced by internships, training, mentoring, and further study.

Additionally, indigenous peoples' wisdom is acknowledged as a treasure trove of information peculiar to certain geographical and cultural settings. Within the realm of indigenous medical knowledge systems, there are a variety of practices that have spread beyond their original communities and gained global recognition, such as acupuncture. These practices range from those practiced by small indigenous communities to those practiced by entire nations, as seen in Ayurveda and Unani, respectively, as well as other IKS. Information, knowledge, practices, and rituals (IKS) pertaining to agriculture, healthcare, food preparation, education, and the management of natural resources is the cornerstone of decision-making at the local level in indigenous communities and cultures [14]. This includes the management of natural resources. Because of the politically "loaded" character of the word, it is difficult to define and categorize IK and IKS. As a result of the large number of individuals who may have feelings of insult or resentment as a result of being termed indigenous or not being included in the indigenous category or grouping, the process of defining what and who is considered "indigenous" is a complex one.

Some of the questions that may arise while discussing indigenous claims include the duration of a community's and its ancestors' occupation of specific areas and whether or not there was a previous inhabitant of the land. The situation gets more complicated as the number of individuals of different nationalities and backgrounds grows, and the conversation has to break down into whether or not only indigenous populations should be included. There are a number of names that have been suggested, mentioned, and used to describe this extensive body of information known as IKS [15]. Examples of such things include indigenous technical knowledge (ITK), ethno-ecology, folklore, traditional wisdom, ecological knowledge (TEK), and people's science. Traditional wisdom is also included in this category. In spite of the fact that there are many different definitions that have been proposed for IKS, there is a general agreement regarding what it is and how useful it is.

This consensus is founded on an epistemic community's shared grasp of the subject of traditional knowledge in different settings and their shared focus on the same semantic space. To try to operationalize a definition of IKS in context, it is easier to enumerate features of both IK and IKS. First and foremost, IKS are inherently local; they originate from and are shaped by the people who reside in a certain location, drawing on their unique history and culture. Imitation and demonstration are common ways that IK is passed on from one person to another. Practical involvement in daily life leads to IK, which is continually reinforced through trial and error. The lack of a solid foundation in explicit theoretical knowledge is a major issue with IKS. First and foremost, IK is community-beneficial since it is founded on practical experience and empirical knowledge [16].

In addition, the repetition that is a hallmark of IK helps with memorization and reinforcing of concepts. As a culture or community grows and develops, its IK is likewise likely to be in a perpetual state of flux, with new examples appearing and old ones disappearing. IK is dynamic, in contrast to the static ideas that are commonly held by formal academia regarding IKS. Because IKS is more open to sharing with the general public than other types of knowledge, notably global science, which is now overly focused on intellectual property, the term "people's science" was coined to describe the information that is available to the general public. IKS have a tendency to be socially isolated and grouped within a community, generally in an asymmetrical manner. This is attributable to the fact that they are deeply rooted in the local culture, customs, and rituals. The clustering and segmentation could be based on age, gender, or even a particular subgroup of the population, depending on the demographics of the community that is being discussed [17].

IK is typically transmitted from one generation to the next through the recollections of "special" people. These individuals are recognized as the guardians of a particular community's IK due to their rituals, political influence, or experience. They are considered to be specialists in their profession. Indigenous knowledge (IK) is not something that is innate to any one person or region; rather, it is something that develops naturally within a society through the exchange of experiences and interactions among its members. Overall, IKS can be described as a functional organization. It is essential to note that IK is entrenched in wider cultural traditions; as a consequence, it is challenging to differentiate between rational and irrational acts and knowledge [18].

3. ROLE OF IKS IN GENDER INCLUSIVENESS

Women and elders in indigenous communities have a unique responsibility to perform as primary caregivers and keepers of cultural heritage, biological variety, and traditional wisdom. Since they are more intimately linked to the environment, mountain women are innately better knowledgeable about biodiversity and its preservation. When it comes to managing ecosystems, women in the Himalayan region put in more time and effort than males do. They have a wealth of traditional information on farming and forest management practices, with women and elders being the main keepers and transmitters of this information. Historically, women in the IHR have been the backbone of the household and the farm. Gender dynamics and roles in biodiversity protection are complicated and contentious, but they are not simply resolved. For example, women have four of the nine committee seats in the Uttarakhand forest council (van panchayat).

Upon conducting field visits in the Pithoragarh district, however, we were unable to locate any female members in the majority of these committees. A small number of research found that men consistently undervalue women's expertise. The results of our field investigations corroborate the idea that women have little to no say in major policy decisions. Women in developing nations, such as Nepal and India, tend to take a back seat. According to their findings, women carry out the majority of domestic and community-based tasks, but they are underrepresented in village committees and decision-making processes. Despite the CBD's explicit recognition of women's contributions to biodiversity conservation and sustainable use, women's voices are underrepresented in policymaking. Research on gender aspects that is grounded in evidence is still in its infancy. Women must be acknowledged for their active involvement in biodiversity conservation efforts and for the important roles they play in decision-making and policy-making processes. A number of studies have shown that 80-90% of the seed needs are met through indigenous seed trade and management systems, where women play a vital role.

Hence, it is crucial to guarantee gender inclusivity, particularly the engagement of women in conservation and resource management (Fig. 1).

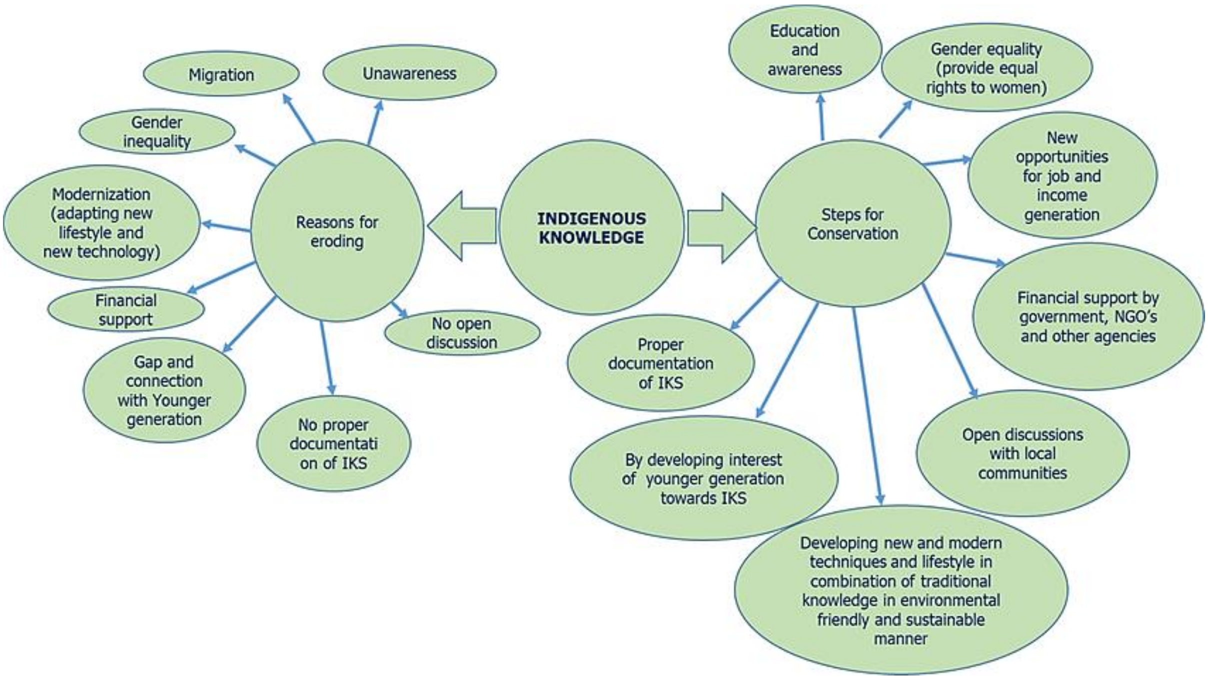

Fig 1: Measures to preserve traditional indigenous knowledge.

3.1 Contribution of IKS toward Global Obligations (SDG's)

Every single UN member state has signed on to the 2030 Agenda for Sustainable Development, which aims to ensure that all people and the planet enjoy abundant, sustainable prosperity in the years to come.

All nations, rich and poor alike, must work together to realize the 17 SDGs, or sustainable development objectives. It is assumed that Indigenous people will have a role in attaining these sustainability objectives. Even though they only make up around 5% of the global population, indigenous people are actually responsible for protecting 80% of the known biodiversity on Earth because they control 28% of the landmass. Indigenous tribes' approaches to managing the world's natural resources differ substantially among regions and climates.

This information is scientifically validated, sophisticated, comprehensive, and dynamic. When faced with environmental changes, indigenous people's traditional resource management practices have frequently shown to be resilient and sustainable. Because these resources are fundamental to the indigenous peoples' way of life, the preservation of them depends on their traditional practices and bodies of knowledge. There is a growing consensus that indigenous knowledge systems are quite comprehensive in relation to the SDGs. Indigenous peoples' understanding of MPs is crucial for promoting people's well-being.

The present COVID-19 pandemic is proof of this, since it has highlighted the importance of MPs in combating the contagious virus. Similar to how IKS promotes lifelong learning opportunities, it helps achieve SDGs like quality education, zero hunger, zero poverty, and clean water and sanitization through spring management, sustainable agriculture, and other

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means (Fig. 2). The 2030 agenda's singular goal of attaining sustainable development is thus guaranteed by all these IKS contributions.

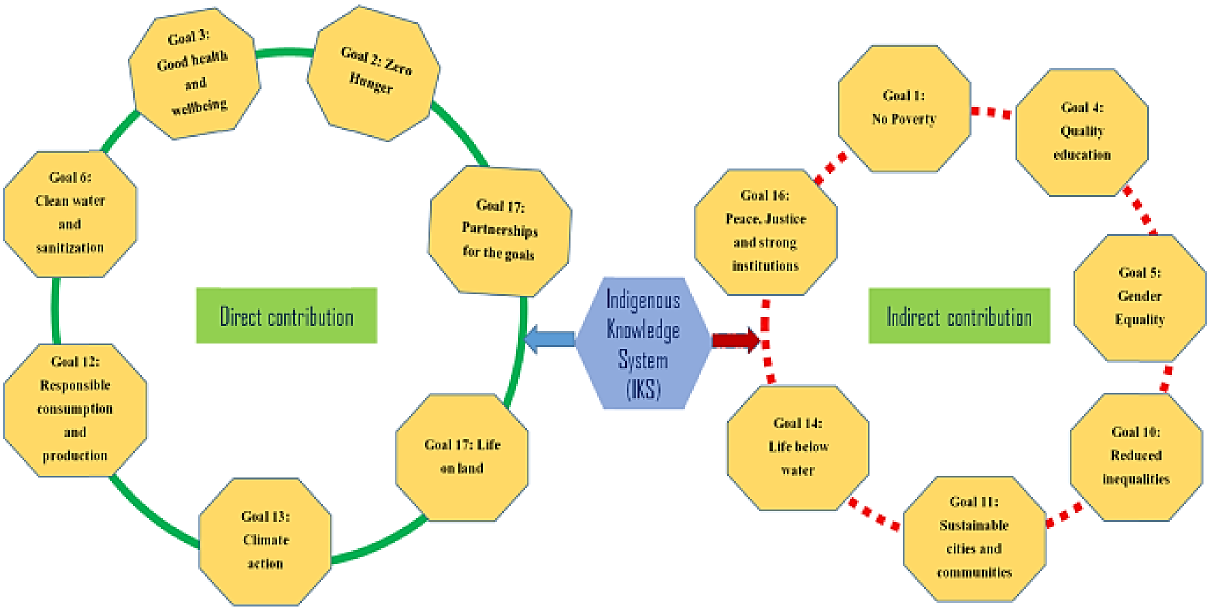

Fig 2: Impact of IKS on SDG accomplishments.

3.2 Continuous Improvement (Kaizen) implementation in the Industry

Globalization is having an impact on many businesses since the global economy is becoming increasingly interconnected. A company's decision or behavior in one region can now have far-reaching consequences in another, all because of globalization. A new level of competitiveness has emerged among industry players as a result of the increased global connectivity brought about by advancements in information technology. As a result, small and medium-sized enterprises (SMEs) need to improve their performance in terms of quality, cost, and delivery (QCD). Because in order to remain competitive, firms simply cannot afford to raise prices while sacrificing quality and delivery performance (Bane, 2002; Gulbro et al, 2000).

Due to the high level of competition in the market, small and medium-sized enterprises (SMEs) may find it challenging to gain new business contracts or have their existing ones renewed unless they can demonstrate superiority to their clients. According to research conducted by Samad (2007) on Malaysian SMEs, low productivity is one of the main obstacles these businesses confront. As a result, SMEs can use kaizen to boost their delivery performance, quality, and cost-effectiveness all at once.

The four primary domains that kaizen can enhance are affordability, flexibility, quality, and bessant et al. (1994; Choi et al., 1997). According to Imai (1986), kaizen focuses on eliminating waste, discrepancies, and strains. Some of the technologies used in kaizen, often known as the "Kaizen umbrella," include a recommendation system, TPM, QC, automation, quality improvement, zero defect, kanban, just-in-time, and total quality control (Imai, 1986).

Among Malaysian automotive industry companies, a study by Nordin et al. (2010) identified kaizen as the primary leading lean practice in the country. Another research that looked at Malaysia's electrical and electronic sectors came to the same conclusion. Teams of employees at different levels of an organization work together proactively to improve a specific area through cross-functional effort and combined abilities inside the company. This method is commonly known as continuous improvement or kaizen (Imai, 1986). As part of their Kaizen initiative, corporations are placing a premium on getting plant floor workers involved and giving them the authority to fix problems that arise on the job. Kaizen, when done right, may raise morale and a sense of responsibility among workers by getting them to reevaluate their work and how they approach it. This is due to the fact that when upper management makes its employees feel like they have a say in important decisions and how the company is doing, they are more likely to work to improve it. In order to rectify both internal and external problems in their operations, organizations implementing Kaizen will utilize the Plan-Do-Check-Action (PDCA) cycle (Imai, 1986).

Staff members will look for ways to enhance the process during the planning phase. The following stage, after determining the issue areas, is to execute the kaizen. To put the kaizen into action, workers can gain a better grasp of the present waste areas by employing methods like Value Stream Mapping (VSM) or the Five Whys technique. Employees will be asked "why" five times and given an explanation for each of the five "whys" in Toyota's Five Whys technique. The purpose of asking "five whys" is to get to the bottom of an issue. In contrast, flowcharting the procedures, processes, or activities is what Value Stream Mapping is all about. Workers might then seek for ways to decrease or do away with the process's non-value activities (waste) in this manner. Employees are typically requested by the organization to collaborate on projects through cross-functional teams. Setting an attainable goal is the following stage after the team has collected, evaluated, and analyzed all of the relevant data. Improving product quality, scrap rate, total distance traveled, space consumed, work-in-process, or staffing levels for a certain task are all examples of issue areas that might be recognized. After some time spent thinking, the group will attempt to narrow down the possibilities to those that could best address the issue at hand. The team will decide which solutions are the best and put them into action on the production floor. The third step of the PDCA cycle is to analyze the kaizen activities to see if the improvement solved the problem. Every member of the team will be able to assess their own performance thanks to the scorecard, which will be shared with higher-ups and others. The last step is to take stock of everything that has been accomplished thus far and figure out how to bring all of the company's Kaizen efforts into line with one another.

3.3 Service Oriented Architecture of Heterogeneous Data Integration Middleware

The proposed data integration middleware and the necessary technologies are both described in this part, together with the technological infrastructure that supports them each. Our team settled on a multi-tiered Service Oriented Architecture (SOA), wherein functional groups comprise the components found at each layer. Each functional group (FG) consists of numerous smaller modules that together provide a high level of functionality and level-appropriate functions.

The inclusion of an inference engine component is one of the most notable elements of the middleware infrastructure that has been offered. The implementation of the inference engine and other technologies that are related to it makes it possible to generate correct inferences from the data sources. Additionally, the middleware functions as a link that connects different application communities that are based on different interfaces. Not only that, but it also provides an API for physical layer communication, abstracts complex network communication, and presents data in a machine-readable format, making it easy to use and interoperate with other systems.

4. SYSTEM ARCHITECTURE OVERVIEW

One crucial aspect of the proposed semantic level interoperability middleware is its ability to integrate both structured and unstructured data, including sensor data and indigenous knowledge. Data from weather stations, sensory data from wireless sensors, and the drought knowledge of indigenous peoples are all semantically integrated by innovative and groundbreaking middleware. The proposed architecture is comprised of four departments: data storage, data collecting, inference engine, and data publishing.

You can see the middleware's architecture in Figure 3. These FGs are designed to be deployed across different servers because of their loose coupling. Consequently, middleware processes the data in an event fashion manner to manage such massive amounts of data from many data sources. The middleware also makes use of the built-in IKON Domain Ontology that is included with the Inference Engine FG. This allows the middleware to encapsulate a collection of domain models that are used to identify entities and resources that are present in unstructured data sources. Inference Engine FG and Stream Analytics FG are responsible for processing the data, and reasoners are responsible for making a deductive inference based on the rules of the system. The data that has been deduced is disseminated by the Data Publishing FG in a number of different ways.

The next sections provide thorough information about the functional groups that make up the middleware; the RESTful3 services are built to facilitate communication between these groups.

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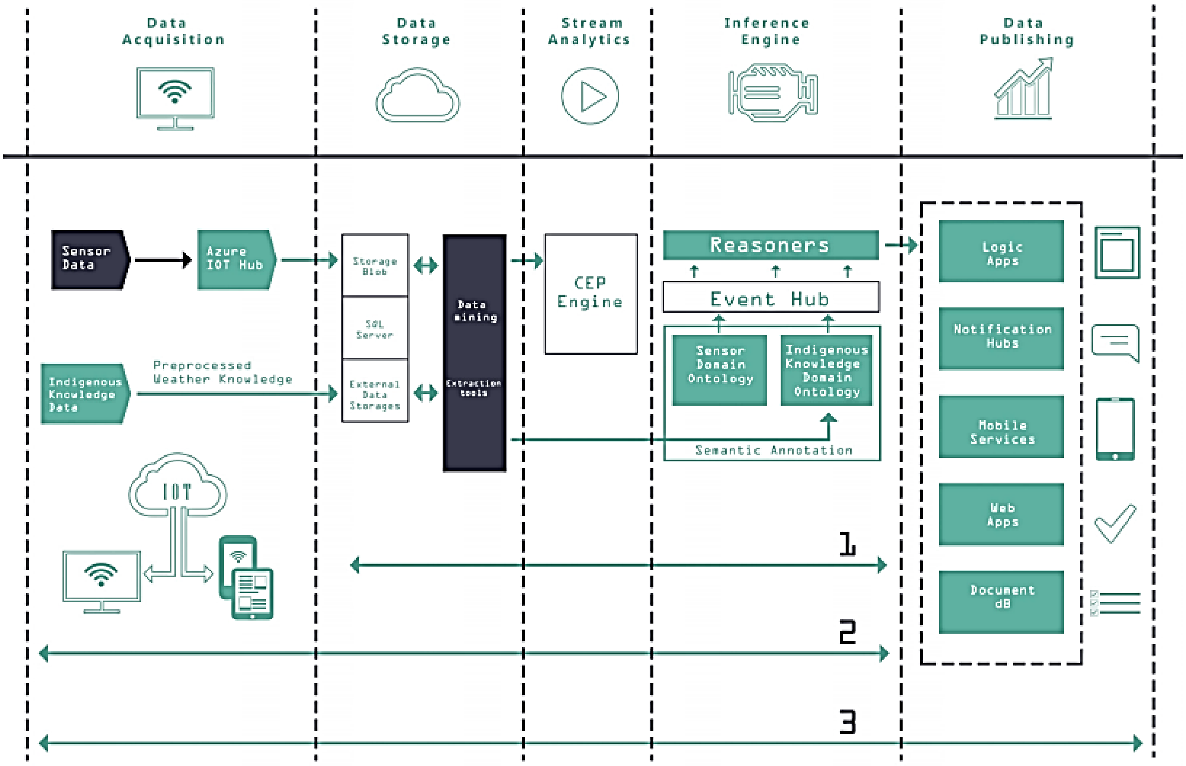

Figure 3: The data integration middleware design based on semantics: a high-level overview.

4.1 Data Acquisition Functional Group

The Data Acquisition FG encapsulates the modules that make up the indigenous knowledge system and the architecture that collects data from sensors. The resources for gathering data from diverse and heterogeneous sources are made available by this FG.

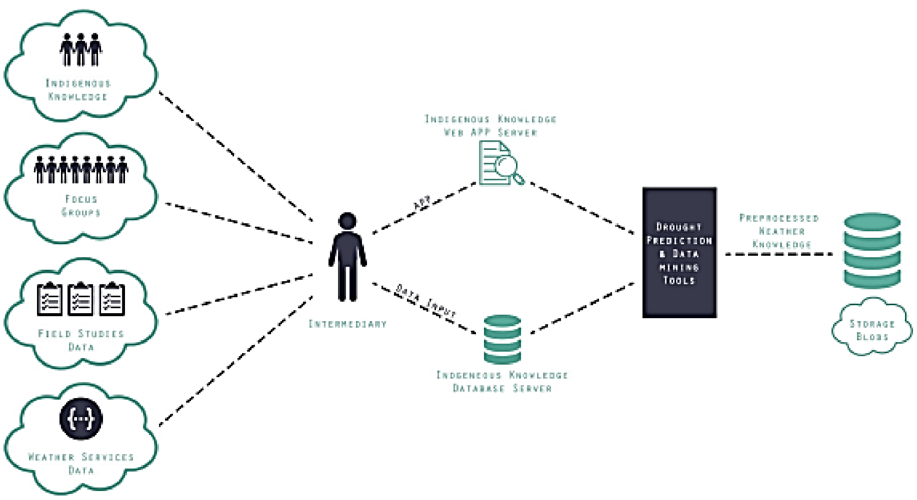

Figure 4: The Indigenous Knowledge System (IKS) module's architecture.

According to Figure 4, the Indigenous Knowledge System (IKS) module of the Data Acquisition FG offers an abstraction that can be utilized for the purpose of collecting, gathering, and documenting the indigenous knowledge that is indigenous to the local area.

To achieve the system's potential, local indigenous knowledge is crucial, since it provides the targeted degree of contextual granularity and scalability in indigenous knowledge systems. Traditional knowledge held by indigenous peoples in a particular area is often unwritten, dispersed, and based on anecdotes rather than formal documentation. Domain experts or focus groups provided the IK data via a combination of face-to-face consultations, interviews, field investigations, and meetings facilitated by an intermediary. In order to facilitate this research, an Android application was developed specifically for the purpose of remotely recording the type (pictorially), description, and geographic coordinates of natural indicators that have been detected. This information is subsequently stored in the Indigenous Knowledge Web App Server. In order to communicate with the database, the web services utilize a JDBC connection, which is the standard. A temporary storage location for the unstructured data (IK) is provided by the server that houses the indigenous knowledge database. The Data Storage FG is responsible for storing the processed data after the data mining tools have completed their processing of the gathered knowledge base.

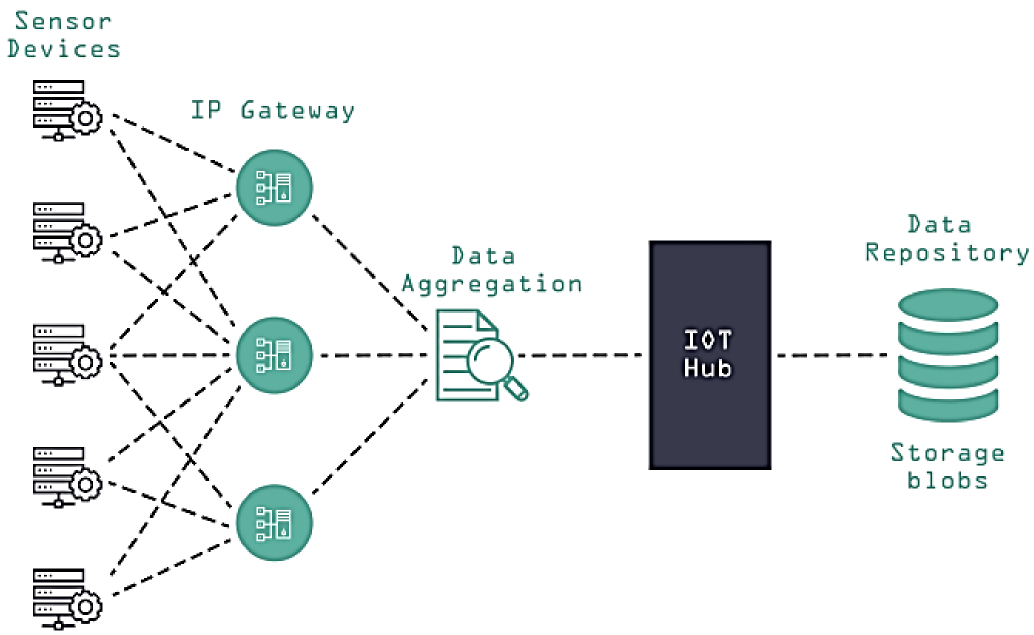

Figure 5: Structure of the module that is responsible for collecting sensor data (SDC).

The sensor data collecting (SDC) module is one method that can be utilized to acquire a comprehensive understanding of a sensor network structure. As soon as the wireless sensor network (WSN) is put into place, it will be able to supply precise environmental data, which will include information on soil moisture, crop production, leaf index, and the development of vegetables. The transfer of data from the gateway to the Internet of Things hub (for example, Azure IoT4, Google Cloud5, Apache Kafka6) is accomplished through the utilization of a particular communication medium. This medium is often based on the 6LoWPAN protocol, which enables the transmission of compressed IPv6 packets across IEEE 802.15.4 networks.

CONCLUSION

Ecosystems' abilities to provide goods and services have been weakened, and natural resources have suffered permanent damage, as a result of the present approach and rate of growth. In addition, new forms of use behaviors, which are frequently exploitative, have been spreading across many ethnic and cultural groups as a way of life. The uninformed attempts to mainstream individuals have accelerated homogenization, making our systems more susceptible to abuse and degradation. Despite the fact that indigenous knowledge has developed in harmony with natural surroundings and climate disturbances, and is typically founded on the ideals of cohabitation and communitarianism, conservation planning and management have a tendency to overlook and dismiss indigenous knowledge. The knowledge, methods, and instruments of indigenous peoples have the potential to impart valuable lessons to the rest of the world and serve as a model for biodiversity policies. Research has demonstrated that participatory approaches are essential in order to ensure that different knowledge systems, particularly scientific and traditional knowledge, are represented in a manner that is accurate and fair. It is important to properly recognize the achievements of IKS during times of closed economies and high levels of interdependence by incorporating their expertise into mainstream practices and investigating opportunities for expanding it up. This middleware updates the processing, representation, and distribution of drought forecasting data from the current Web 2.0 to the Web 3.0 in order to provide efficient environmental monitoring and forecasting within the domain of this cutting-edge technology. This is done in order to provide efficient environmental monitoring and forecasting. At the moment, the entire middleware system is running in test mode, but it is partially functional. Our long-term goals include drawing in semantic application developers so they may reap the benefits of the middleware architecture and conducting usability, acceptance, and feasibility tests. There is room for improvement in our suggested model that would allow it to offer higher degrees of compatibility with diverse environmental data sources.

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