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Using Knowledge Management and Visualisation Concepts to Improve Patients and Hospitals Staff Workflow

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***Abstract*—**This paper focuses on using knowledge management and visualisation concepts to improve the patients and hospitals employee's workflow. Hospitals workflow is a complex and complicated process and poor patient flow can put both patients and a hospital's reputation at risk, and can threaten the facility's financial sustainability. Healthcare leaders are under increased pressure to reduce costs while maintaining or increasing patient care standards. In this paper, a framework is proposed to help improving patient experience, staff satisfaction, and operational efficiency across hospitals by using knowledge management based visualisation concepts. This framework is using real-time visibility to track and monitor location and status of patients, staff, rooms, and medical equipment.

***Keywords*—**Knowledge management, visualisation, patients, hospitals, healthcare workers, workflow, improvements.

I. Introduction

HOSPITALS workflow is a complex and complicated process and poor patient flow can put both patients and a hospital's reputation at risk, and can threaten the facility's financial sustainability. There are two dimensions of organizational knowledge creation, epistemological and ontological dimensions. With regards to the epistemological aspect, the authors differentiate between two kinds of knowledge; namely, tacit and explicit. As elaborated, explicit knowledge described as that it is the knowledge can be written down and easily transferred from one to another. On the other hand, tacit knowledge is more difficult to segment as it often arises out of experience. Ontological dimension variety from the individuals at one end of the variety and moves from there to teams, groups, organizations and beyond that. "A spiral emerges when the interaction between tacit and explicit knowledge is elevated dynamically from a lower ontological level to higher levels". Because of these two types of knowledge; i.e. explicit and tacit, it is thus essential to share and convert these types to capture the intellectual capital of organizations. The Knowledge Conversion Model, which was introduced by, is presented as follows:

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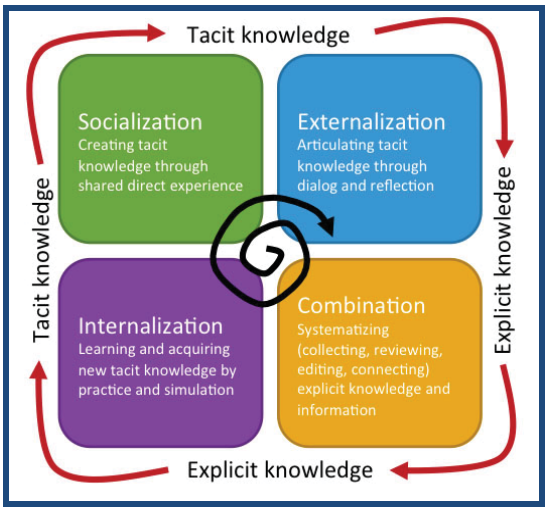

Fig. 1 "SECI" spiral model for knowledge creation [15]

II. Knowledge Management

SECI spiral model is formed by the four types of knowledge conversion according to which knowledge is converted from one knowledge type to another. As explained by [14], the four types of knowledge conversion refer to socialization (from tacit to tacit knowledge), externalization (from tacit to explicit knowledge), combination (from explicit to explicit knowledge) and internalization (from explicit to tacit knowledge). As for [8], they have tried to capture tacit knowledge of experts by developing expert systems, with the methodologies offered utilizing some appropriate methods such as interviews, protocol examination, simulation, personal construct theory, and card sorting. Knowledge management is not only limited to externalization and can assist similarly with internalization.

Problem-solving processes always involve acquired knowledge to achieve desired outcome from the current situation. According to [12], there are differences between the use of explicit and tacit knowledge in terms of solving certain issue. Where explicit knowledge is concerned, it is obvious to notice the identification of desired situation. As such, the approach adopted to deal with an issue is explicit. As for tacit knowledge, however, the approach for solving an issue is not obvious. There is some uncertainty in the route from the present situation to the desired situation and people are relying on their knowledge to deal with the issue.

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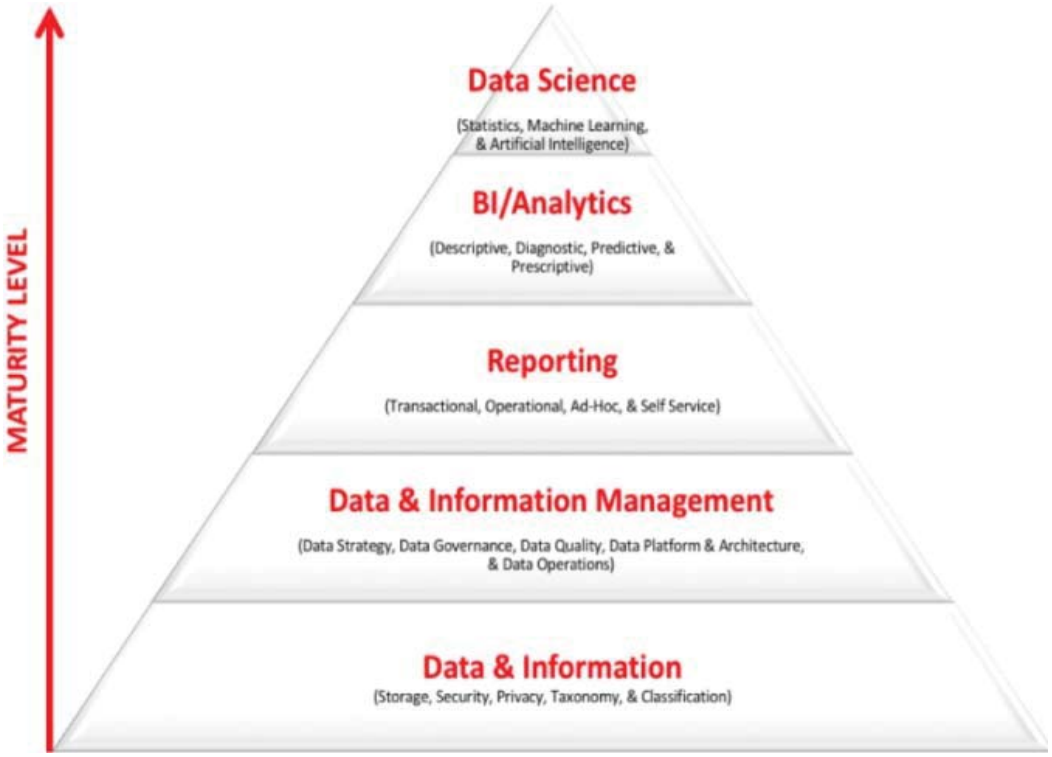

Fig. 2 "SECI" model in details for knowledge creation [15]

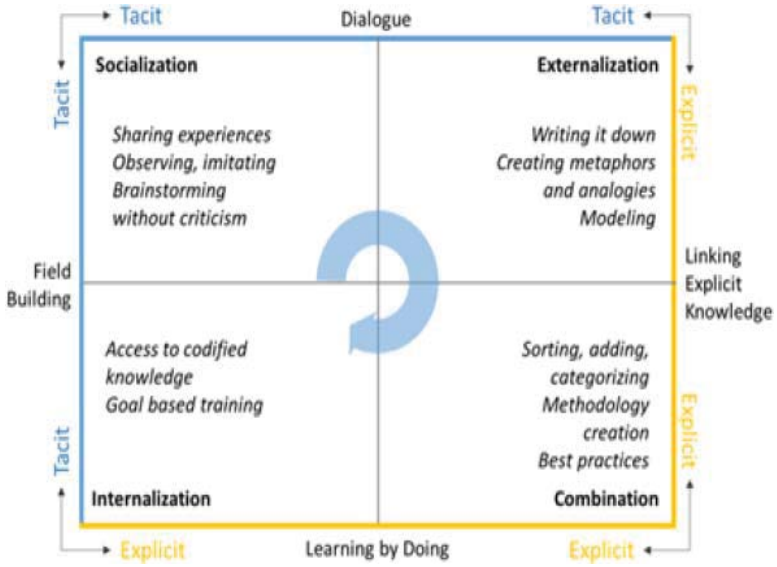

Fig. 3 Data Value Pyramid [17]

III. Information Visualisation

Visualisation refers to the study of how to effectively provide information in a visual manner [11]. Most research effort in this area is based on the production of creative graphical displays for complex datasets, as in census, systematic data, and scientific databases [4]. An issue that might present itself is to determine the presentation of the pages on a website or the files on a hard disk. According to [9], there are several visualisation methods, such as selective hiding of data, layering data, making use of 3-dimensional space, adopting scaling methods to offer more space for more significant data like Fisheye views, and benefiting from psychological principles of layout, including proximity, alignment, and common visual features like colour [10].

IV. Information Visualisation and Healthcare

There has been growing increase in the adoption of modern information technologies in the healthcare field in terms of both quantity and complexity of data available to health practitioners [3].

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Through the provision of interactive visual representations of data and information, Information Visualisation (InfoVis) aims to offer further insights into the 'information space', contribute to maximized usage of data and information, and assist in averting overload issues. As summed up by [7], some of the aims of InfoVis systems for the healthcare field include enabling "users to explore available data at various levels of abstraction"; offering "users a greater sense of engagement with data"; providing "users a deeper understanding of data"; inspiring and incentivizing "the discovery of details and relations which would be difficult to notice otherwise"; as well as promoting "the recognition of relevant patterns by exploiting the visual recognition capabilities of users" [5]

V. Visualisation can Improve Hospitals Workflow

In the age of digitalization, the capability to navigate individuals and devices in indoor has become progressively important for a increasing number of applications [6].

To achieve process optimization in complex systems, it is necessary to continually gain data about the position of equipment and people. Indoor navigating applications and services, are work automatically to identify and track objects, people location's in real time, within indoor environments or other contained area. [17]. Most of wireless IPS tags are tagged to items or worn by people, and in most IPS, fixed reference points receive wireless signals from tags to establish where they are located [16].

Tracking vehicles using an assembly line, tracing pallets of stock in a silo, or identifying medical equipment in a hospital can be used as examples of indoor and real-time locating systems. The accurate tracking of people's location in indoor environments can be seen in several applications that vary from the medical, military and logistical fields to the entertainment world [18]. The use of indoor positioning systems is primarily to locate items or persons inside an area through radio waves, magnetic fields, and acoustic signals, [7] as well as other sensory data gathered using fixed or portable equipment [6].

To find the most appropriate technology that can improve hospital efficiency and effectiveness and meet the current needs, the performance parameters need to be matched with the user requirements [13]. The authors have formed a multidisciplinary group called Communities of Practice (CoPs). This group is meeting on a regular basis to discuss this research issues and challenged and benefit from their experiences to guide this research to achieve its purposes.

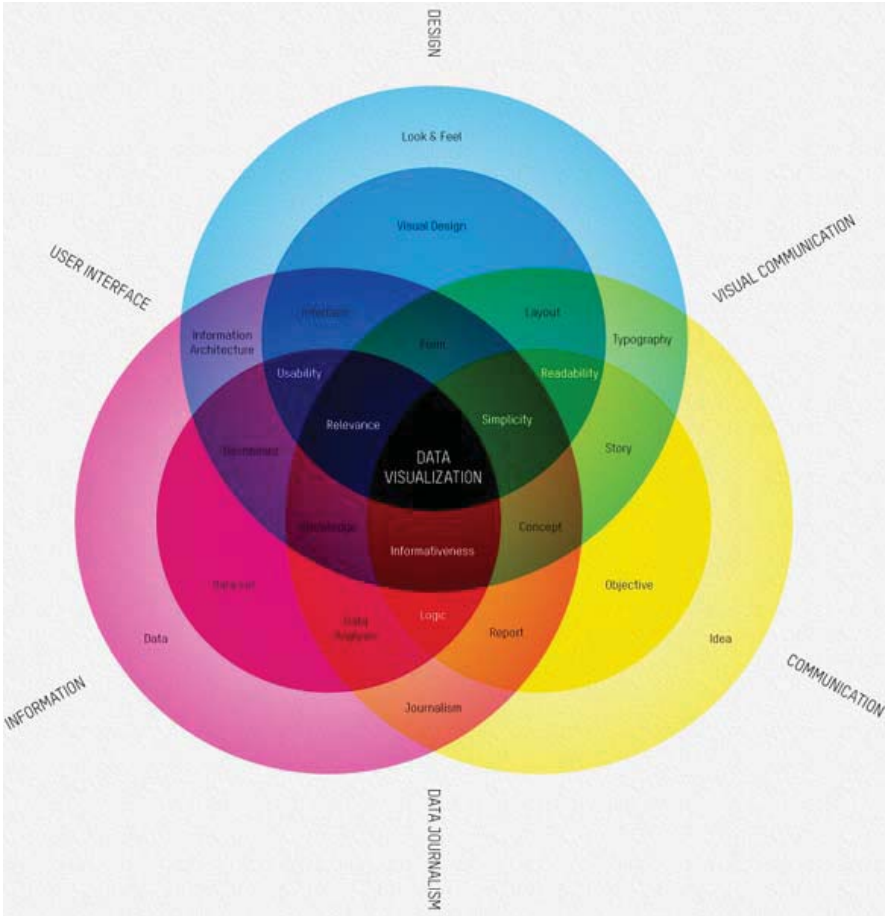

Fig. 3 Visualizing Healthcare Data [15]

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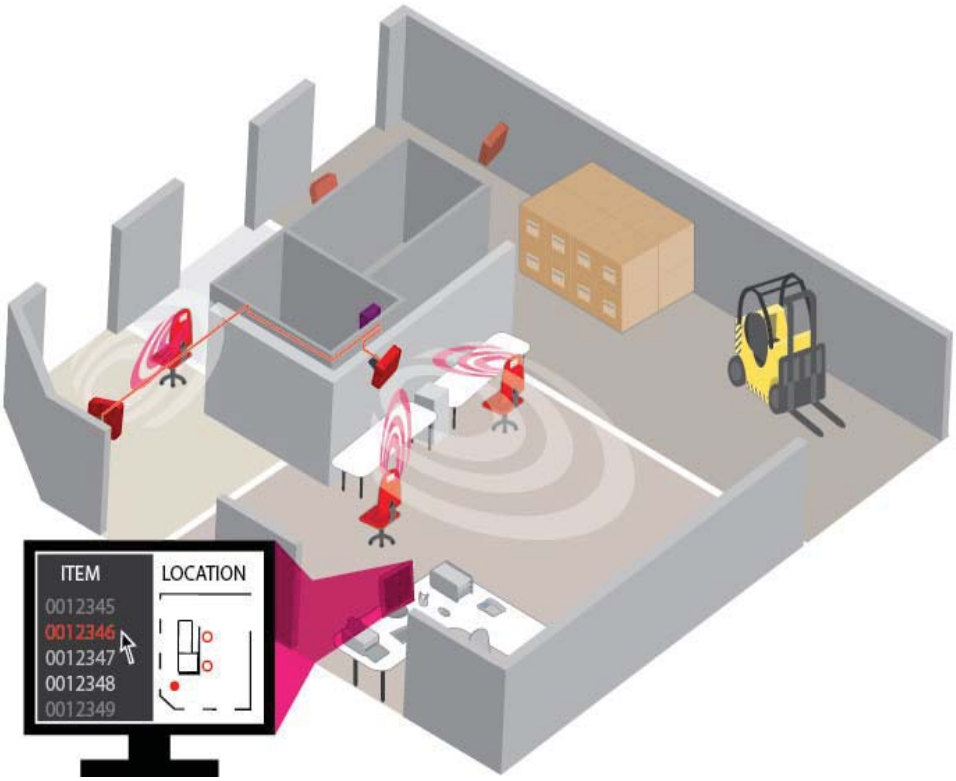

Fig. 4 Indoor Positioning System [7]

Regarding evaluating and selecting an appropriate system, CoPs have done the following:

1. Discussed the potential benefits and expected challenges of adopting a RTLS in hospital.
2. Identified hospital areas where RTLS is required and beneficial.
3. Reviewed the current RTLS technologies and applications and their advantages and disadvantages.
4. Identified the most important user requirements.
5. Assessed and compare different indoor tracking and monitoring technologies.
6. Then, choosing the appropriate technologies which meets the hospital needs, standards and expect to achieve setting goals.

Based on that, the CoPs has agreed that the RFID and ZigBee combination is most appropriate technologies to fulfil the project purposes. RFID and ZigBee are technologies that can be used for track objects: RFID will deliver a faster, speed scanning for large numbers of tags, and ZigBee can provide a huge network scale with low output power, which is a substantial benefit for health care applications especially when tracking or monitoring in an environment including people [1].

Using such non-contact and non-intervention sensor technologies which automatically scan for tracking objects, users can receive real-time data and visualization objects such patients, staff and equipment and its locations throughout hospital HIS which will improve the information systems management and provide more effective systems for better decision [2]. Moreover, those technologies are cost-effective in comparison to other technologies.

VI. The Proposed Framework

Develop a visualisation tools which based on sharing the acquired and analyzed knowledge and data to improve patient flow, reduce the long patient waiting time and empower decision making strategies. Visualisation tools and processes will be used to identify the efficient model for best patients routing through the healthcare facility and determine the needed resources for staffing [1]. In addition to this, the simulation will highlight primary factors affecting patient care and notify the concerned personnel. This tool can also use the historical data and current activity to accurately forecast the performance of the operation for forecasting the future needs. Also, it can be used as a training environment for current and new employees. Moreover, developing a Smart Healthcare tracking and monitoring system to visualize people and medical's assets operational efficiency, and other activities. There are many benefits of this tools including but not limited to:

1. Notifications of potential delays and schedule deviation and adherence.
2. Amend provider locations based on levels of needs, transports, equipment utilization, etc.
3. Security breaches and unauthorized access notifications.
4. Detailed monitoring of equipment status and downtime.

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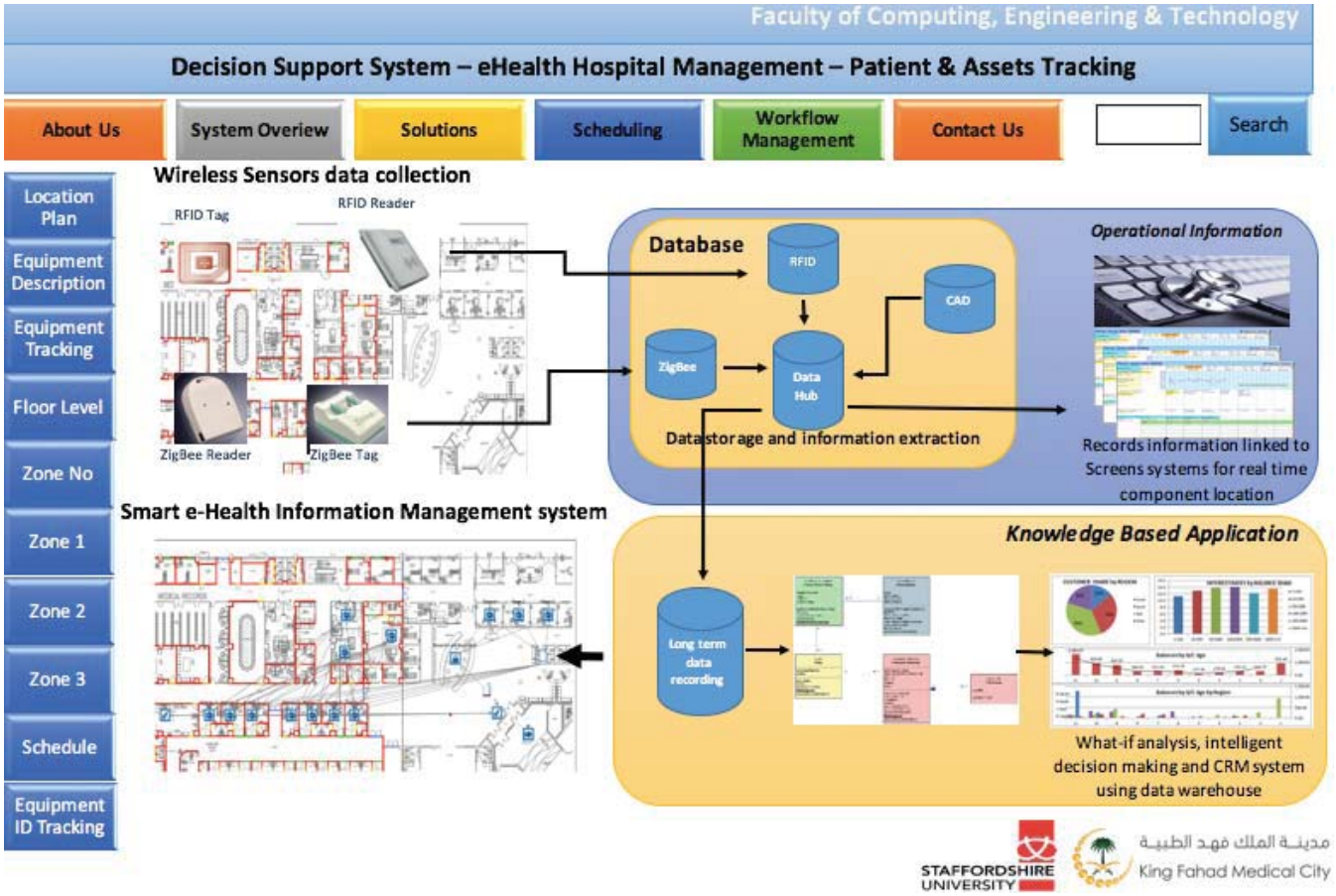

Fig. 6 The proposed framework

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