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Editorial

e-Business and Knowledge Management continue to be critical and perhaps indispensable for one and all, and not just business organizations

In the ongoing knowledge era of increased digitization, e-Business and Knowledge Management continue to be critical and perhaps indispensable for one and all, and not just business organizations. Political pundits and analysts of USA attribute low online Ad –spend by Hillary Clinton as one of the reasons for the presidential candidate to be out-Googled by Barrack Obama's search savvy online campaign.(SearchEngineWatch.com). Further, statistics reveal that 34% of the large companies already have a blog and that the number of internet users is projected to almost double by 2012(JupiterSearch.com).

The synthesis of these two powerful phenomena, however, has led to business model innovations (e.g. Click & mortar, etc….) and is bound to further unleash immense value creation for enterprises in the digital era.

While e-business is providing the platform and opportunity for improvement and innovations, knowledge management is facilitating the creation and sharing of knowledge-empowering individuals, enterprises, nations and societies. The synthesis of these two powerful phenomena, however, has led to business model innovations (e.g. Click & mortar, etc….) and is bound to further unleash immense value creation for enterprises in the digital era.

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From research perspective, the concept of e-Business and Knowledge Management seems to have come of an age – having aroused research interests from a large number of intellectuals across domains. This has particularly manifested in a large pool of quality research papers received from academicians as well as practitioners. The current issue comprises of four scholarly contributions spanning topical issues in both e-business and Knowledge Management.

Manufacturing enterprises worldwide are grappling with the growing need and expectation for customized products.

Manufacturing enterprises worldwide are grappling with the growing need and expectation for customized products. They are, however, addressing this by not only focusing on core competencies but also moving towards knowledge-based manufacturing In this issue, *Harding, Lin and Choudhary* have discussed the need for 'Engineering Moderator' for distributed teams working in collaborative manufacturing projects and have ably introduced the concept of "*Moderator Technology*". They have also presented the architecture of *Universal Knowledge Moderator* – a knowledge discovery module to support collaborative e-manufacturing.

From an intensive technical insight to a more generic analysis, the second research paper by *S. Batra* revisits the concept of Knowledge Enterprise, Knowledge Economies, Knowledge Divide and Knowledge Societies – summarizing them in the form of a comprehensive conceptual framework. While delineating the concept of 'Knowledge Enterprise and Knowledge Societies' he has pointed out an interesting duality / paradox – i.e. co-existence of competition and collaboration – not just at the individual or enterprise level but also at the economy and societal level.

Finding association in database mining – also called Knowledge Discovery in databases, has been commonly adopted by successful large retail organizations. *Srivastava and Sahu* delve into the "*Market Basket Analysis*" technique of database mining – which tries to find association between customers mind, habits, and the items placed in the shopping basket. An insight into such an association is bound to facilitate retailers develop effective marketing strategies.

And finally, the last research paper by *Paniker et al*, investigates the quality and effectiveness of e-government projects (e-Seva, implemented in Andhra Pradesh, India) using sophisticated tools like GQM (Goals Questions Metrics) and BSC (Balanced Score Card). They further suggest technologies like biometrics, mobile technology etc. in increasing the effectiveness of Business Process Reengineering (BPR) initiatives in e-government projects.

Finding association in database mining – also called Knowledge Discovery in databases, has been commonly adopted by successful large retail organizations.

Last but not the least, on behalf of the editorial team, I would like to congratulate the authors-not only for their scholarly contributions but also for their perseverance exhibited during the painstaking review and publication process –which actually got delayed in our endeavor towards quality publication .We, however, hope that our readers would find the articles intellectually stimulating and look forward to their valuable feedback** and constructive suggestions.

D. P. Agrawal
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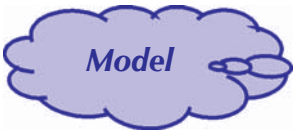

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Engineering Moderator to Universal Knowledge Moderator for Moderating Collaborative Projects

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Abstract

One of the major issues in multi-discipline collaborative projects is how to best share and simultaneously exploit different types of expertise, without duplicating efforts or inadvertently causing conflicts or loss of efficiency through misunderstanding of individual or shared goals. This research discusses the development of moderators from the initial concepts of an engineering moderator to ongoing research into universal knowledge moderator on semantic web. Moderators are knowledge based specialist intelligent software systems which support each individual of a team to perform his particular role from a position of strength, using his preferred method of working whilst understanding the need of other team members and the whole team working on a collaborative project. Current research proposes an improved framework based on semantic web and knowledge discovery for moderators to enhance globally collaborative e-manufacturing work through better interoperability and efficiency. A universal knowledge moderator prototype system consisting of an enterprise data integration module, knowledge discovery module and moderation module is developed to significantly improve the moderation activities and performance of collaborative e-manufacturing.

Keywords: collaborative, e-manufacturing, knowledge discovery, moderator, project, semantic web,

Introduction

Current market trends indicate that demand is on the increase for highly customized products with ever shortening life cycle times and this trend is expected to accelerate. Manufacturing enterprise will achieve and sustain competitive advantage by improving productivity, responsiveness and flexibility. Manufacturers are striving to meet these demands by focussing on core competencies and migrating towards knowledge-based manufacturing [1].

A manufacturing enterprise can differentiate itself from its competitors and compete efficiently and effectively, through well targeted exploitation of its knowledge and expertise. Knowledge exists in all business functions, including purchasing, marketing and design, production, maintenance and distribution, but, knowledge can be notoriously difficult to identify, capture, manage and reuse [2]. Mapping out where "knowledge" resides and identifying the conditions that foster its generation and re-use has become a necessity. The knowledge assets of an enterprise reside in many different places, e.g., knowledge bases, filing cabinets, peoples' minds and expertise, and are distributed across the enterprise. Therefore, enterprises need to know their knowledge assets and how to manage and make use of these assets to get maximum return [3]. Hence, manufacturing enterprises are faced with the following twofold knowledge challenge;

- To thoroughly understand and efficiently capture their valuable knowledge and expertise, and
- To ensure that such knowledge is effectively reused and exploited to gain the best possible competitive advantage.

In this regard, knowledge discovery, knowledge management and knowledge engineering are currently topics of importance to manufacturing researchers and managers intent on exploiting current assets.

Need for Engineering Moderators in Collaborative projects

A manufacturing system may be engineered and re-engineered for a variety of different reasons. Projects may range from partial or comprehensive overhaul of existing resources to a complete design of new manufacturing facilities and systems. Such projects are generally performed by multidisciplinary project teams. Project team members must be aware when decisions that they make may affect other team members. The strength and success of a team

depends on how well each individual can contribute the maximum benefit of their skills to a consolidated and shared vision of the total group. The different backgrounds, experiences and environments of the individuals inevitably influence their views and interpretations of the overall objectives. Hence, as soon as people from different disciplines and backgrounds try to work together on a collaborative project, there is potential for misunderstanding or lack of awareness of the needs and interdependencies of each individual contributor. This is true even in small, co-located teams where individuals meet regularly to discuss overall project requirements and progress. It is clearly a far greater problem when teams are large and physically located in different companies or even countries as shown in figure 1.

Knowledge exists in all business functions, including purchasing, marketing, design, production, maintenance and distribution, but, knowledge can be notoriously difficult to identify, capture, manage and reuse.

The type, size and context of collaborative projects varies considerably from scenario to scenario. These may represent collaborative product development, collaborative process design, supply chain design, or even manufacturing system design etc. Increasing competition in the global market pushes enterprises to strive for better product designs and more effective product development. As a result, more and more efforts are focussed on building a knowledge intensive design process that requires various globally situated domain experts to collaborate closely and share information and knowledge using Information technology. Therefore, it is necessary to raise the awareness among the project teams members to reduce or avoid the conflicts and misunderstandings that inevitably occur in collaborative projects. Moderator technology which encompasses an intelligent support system provides a possible approach to resolving these issues. Moderators also support individuals to perform their individual roles from positions of strength and improve understanding through raised awareness of the needs of other contributors. Moderators support individuals in their preferred methods of working whilst increasing understanding of the needs of both other individuals and the total team.

To date, all moderators have been designed and implemented as modular specialist software systems, consisting of a moderation module, multiple expert modules and a knowledge acquisition module. Until now, all knowledge acquisition for the prototype moderators has been done manually, based on human expertise and experience. There is however substantial potential for moderators to "learn" and update themselves from knowledge discovered in the existing operational databases

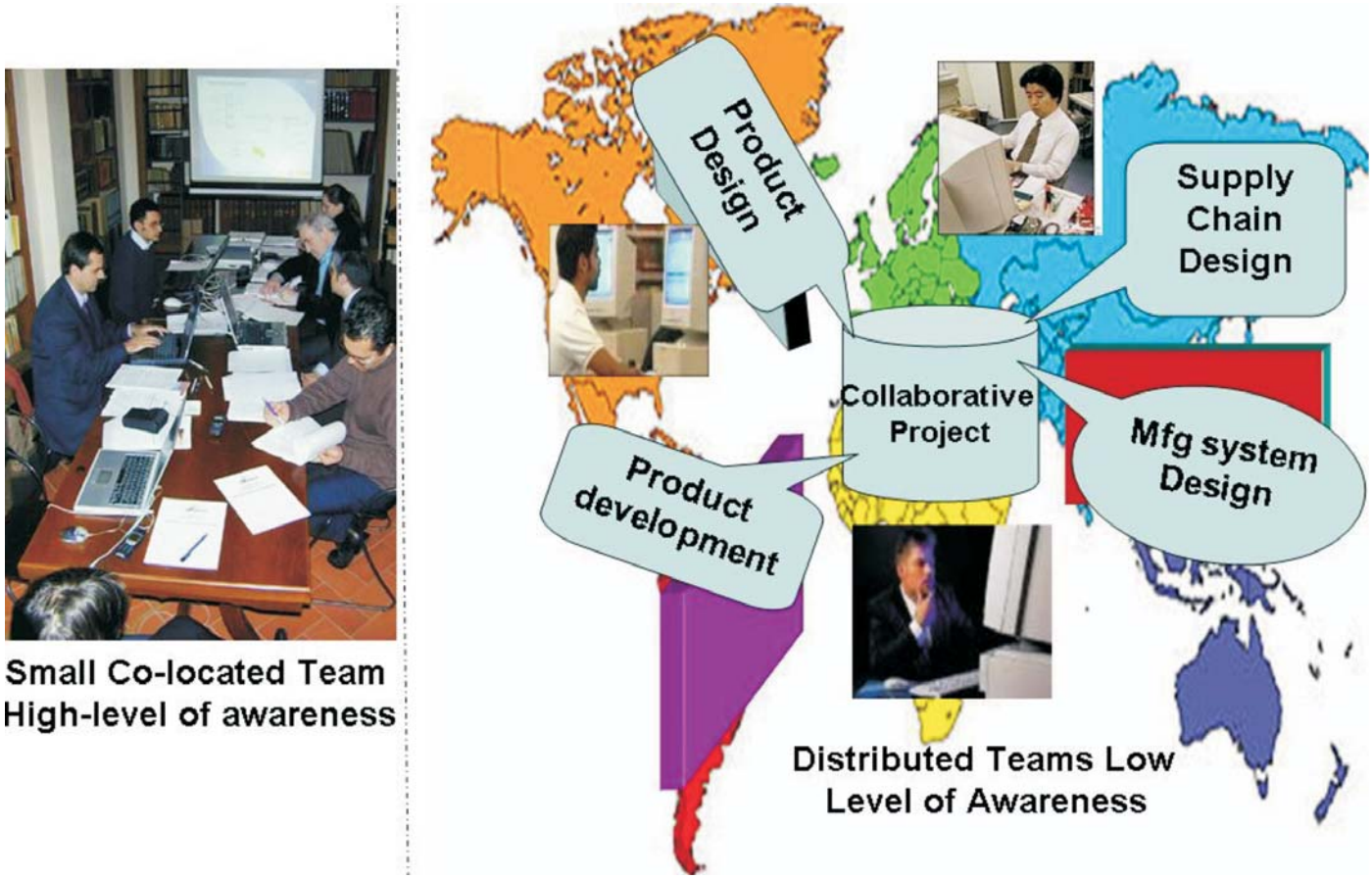

Figure 1: Awareness is Critical to Project Success [4]

of manufacturing companies. Data mining case studies have already shown that relevant knowledge for future designs and redesigns can be identified by exploring operational data collected during product manufacture [5, 6]. The objective of this research is to advance research in Moderator technology with particular emphasis on knowledge acquisition. This paper explains the current research into the development of a Universal Knowledge Moderator.

Moderator Technology

The moderator concept was first proposed in the MOSES (Model Oriented Simultaneous Engineering System, 1992-1995) research project as a support tool for design project teams[12]. It was coordinating software for Concurrent Engineering (CE) design, to raise awareness among the inter-working cross disciplinary participants that exist and need to co-operate in modern day engineering teams. It addressed the fundamental requirements for provision of support for design team working in a concurrent engineering environment, by encouraging and facilitating communication between team members [7].

Evolution of Engineering Moderator

Generally, a concurrent engineering (CE) design project team contains specialist engineers from multiple disciplines with different types of experience and expertise. These may include, for example product development, process selection, equipment selection, project management, performance prediction (perhaps by simulation) and potentially many other types of expertise. Hence the team brings together all the skills needed to design and develop products to meet defined project and /or enterprise objectives.

Moderators are knowledge-based specialist intelligent software systems which support individuals in their preferred methods of working whilst increasing understanding of the needs of both other individuals and the total team.

In summary, the primary functions of moderators are to raise awareness, and to facilitate cooperation and coordination among engineers in design team activities. The role of a moderator is to identify the occurrence of each design conflict, and to orchestrate a dialogue between the interested design functions until the conflict is resolved. To identify and signal conflict in product design moderation within the MOSES system, the EM had to be capable of performing following operations [7].

- To promote communication and negotiation between design experts.
- To identify that a significant problem may have occurred in the design.
- To determine the course of action to follow when a significant problem is identified.
- To maintain communication between interested design experts until the conflict of interest has been resolved.

To facilitate the execution of these duties the EM must be able to use certain types of knowledge and to have access to particular types of information on which it can apply its knowledge. Therefore, the structure of the EM in the MOSES system included three main elements, Design Expert Knowledge, Knowledge Acquisition Module, and Design Moderation Module.

- *Design Expert Knowledge:* The expertise within the CE project environment comes from many different disciplines and skills. Therefore, the EM needs a mental model of each design expert or source of knowledge or expertise within the CAE system. There are three main sections in each design expert knowledge module are :

  Personal Profile Detail: to enable the EM to identify the design experts.

  Main Design Criteria: to enable the EM to decide whether the particular expert should be consulted and whether the design expert is likely to be able to identify any problems within design, resulting from the change that has been made.

  Communication methods: to enable the EM to communicate within the design experts.

- *Knowledge Acquisition Module:* This module contains the expertise to enable the engineering moderator to update its knowledge of available expertise. It must therefore retain and apply knowledge about the knowledge used by each of the design experts. The Knowledge Acquisition Module (KAM) provides the Moderator with all the knowledge that it requires to create, update and remove knowledge during the course of its operation. Part of the functionality of KAM is to add new design experts to the EM's design expert knowledge stores whenever a new team member joins the design team.

- *Design Moderation Module:* This module contains the expertise to enable the EM to moderate the current design and is comprised of several elements. To all intents and purposes, this module embodies the EM's own expertise, as this module includes the EM's knowledge of how to carryout the tasks required during the design moderation process. For example the EM could detect the design change which has been made in the shared product model database, then carryout the moderation on the design, by applying the knowledge it has about existing design experts, from its Design Expert Knowledge.

Evolution of Manufacturing System Engineering (MSE) Moderator

The next stage of development for moderators came during the Mission Research Project[8] when they were used to support collaborative team working on manufacturing system

design and improvement. Designing a manufacturing system is a complex task and such projects often require expert contributions from many different disciplines to design or modify the system successfully. It requires the application of different areas of expertise, including, for example functions such as process selection, equipment selection, facility layout, performance prediction (perhaps by simulation) and potentially many others. The primary function of the MSE Moderator was to support globally distributed Manufacturing System (MS) design and enhance the degree of awareness, cooperation and coordination between members of the concurrent engineering team within the MISSION environment. The basic functionality of the MSEM was the same as the EM.

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Additional necessary functionality for the MSE Moderator can be identified through examination of the activities in the moderation process. The content of MSE Moderator again includes Design Agent Modules (DAM), Design Moderation Module (DMM) and Knowledge Acquisition Module (KAM). The generic structure of Engineering Moderator is shown in figure 2.

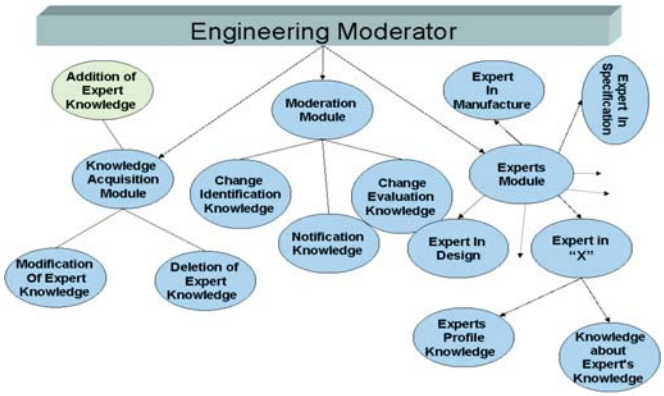

Figure 2: Structure of Manufacturing System Engineering Moderator

The third phase of work carried out determined how the existing moderator concepts might be extended or modified to make them applicable to extended enterprise, virtual enterprise and E-supply chain (E-SCM) environments. An MSE Ontology model was proposed to enable the operation of an extended enterprise MSE Moderator (EEMSEM) to provide common understanding of manufacturing related terms, and therefore to enhance the semantic interoperability and reuse of knowledge resources within globally extended manufacturing teams or E- Supply Chain Management [9-11].

Extended Enterprise MSE Moderator/ E-Supply Chain Moderator on the Semantic Web (EEMSEM)

In the era of globalization, there is a need for manufacturing systems to be designed or redesigned by extended project teams. Therefore, design takes place in an Extended Enterprise (EE) / Virtual enterprise (VE) environment that can bring about both added value and various aspects of engineering product development. The growing complexity of VE knowledge has made it increasingly difficult to share and exchange knowledge and information between companies, where inevitably the individual partners will have their own terminology and information sources. Heterogeneity of data causes a major problem in sharing and exchanging the information within a VE. The three most general heterogeneity problems among the multi database community are as mentioned below:

- Syntax: data format heterogeneity
- Structure: different data organizations, e.g. schema heterogeneity in relational databases and object oriented databases.
- Semantic heterogeneity: conceptual knowledge, where the intended interpretation or meaning of the data is specified in a special context. For example semantic heterogeneity refers to differences or similarity in the meaning of data between the different component databases.

Therefore, it is important to make design knowledge effectively accessible and sharable across virtual enterprise team members, by using an explicit and well defined terminology (Lin and Harding 2003) [11]. The adoption of "semantic web" technologies, like ontologies, content metadata and reasoning about conceptual knowledge, have been investigated by [10] to support a variety of the essential activities of evolving MSE Moderator knowledge management, including, knowledge retrieval, storage, sharing and moderation. Lin *et al.* [9] proposed an MSE Ontology to provide a common understanding of manufacturing related term and thereby enhance the semantic interoperability and reuse of knowledge resources within the global extended manufacturing teams. They used protégé (http://protege.stanford.edu/) to automate the process of building domain specific knowledge acquisition and knowledge based systems.

The main function of the EEMSEM is to coordinate expertise and support the role of concurrency within the engineering activities of the inter-enterprise environment. Two major differences that exist between the MSEM and EEMSEM are delineated as follows:

- Design information changes (including addition or deletion) are expressed in different languages and terminologies and
- Information or knowledge of what team participants consider to be important aspects of the design (e.g. key

variables or values) is expressed in different languages and terminologies.

The first difference directly affects the EEMSEM's design moderation process and the second difference affects both the design moderation process and its knowledge acquisition process. The MSE Ontology model addressed both these differences. The major goals of the EEMSEM are to:

- provide an interoperability mechanism with well defined semantic definitions of an MSE ontology model among all the participating extended project team partners to support information autonomy.
- reduce the complexity of EEMSE systems by providing a set of knowledge of the profiles and characteristics of the participants within the extended enterprise group and a communication mechanism to orchestrate dialogues between them.

The growing complexity of virtual enterprise knowledge has made it increasingly difficult to share and exchange knowledge and information between companies, where inevitably the individual partners will have their own terminology and information sources.

The EEMSE Moderator operates on an open extranet-based platform to support the execution of globally distributed MSE web applications on the WWW. It includes four major modules: Ontology Acquisition Module, Ontology Mapping Module, KAM, and Design Moderation Module. The design of KAM and Design Moderation Module are largely from the implementation of the MSE Moderator in the MISSION Project, however the descriptions of the other two modules are as follow:

- **Ontology Acquisition Module:** The first step in developing the Ontology Acquisition Module (OAM) is to acquire the common ontology and metadata created by a particular VE team group. Additionally the common ontology should be extensible so that it can be changed as necessary when the structure of project team in the VEs or supply chains environment is changed. Further details are available in (Lin 2004) [10], where the model is used to illustrate the manufacturing system domain and cover all the terminology aspects and needs for an e-SCM.
- **Ontology Mapping Module:** The Ontology Mapping Module (OMM) enables all the participants' individual terminologies to be translated to the mediating metadata created in the OAM. In order to perform the semantic match translation, the initial step of the OMM is to solve the syntactical level heterogeneity by transforming all participants' information, presented in the different data formats, into a standard ontology format.

Universal Knowledge Moderator

Ongoing research for the Universal Knowledge Moderator(UKM) is examining how the EM can be extended to include Knowledge Discovery for Globally Distributed and Collaborative E-Manufacturing on the Semantic Web. The aim of this research is to develop and establish a flexible method for knowledge discovery from semantically heterogeneous data for the moderation of design knowledge among globally cooperative e-manufacturing chains. Therefore, UKM focuses on three main aspects:

- Analysis and definition of the specification of a common manufacturing ontology for the electronic industry in an ontology server.
- Development of a suitable framework to enable WWW information exchange between partners of cooperative manufacturing chains via common mediated meta-models across all engineering design teams through semantic mapping.
- Development of a knowledge discovery/ data mining framework to enable the moderator's knowledge acquisition module to incorporate "learning", updating and reuse elements which exploit knowledge discovery techniques.

The first two of these aspects were partially covered in the earlier versions of the Moderator. Therefore, developing a knowledge discovery and data mining based framework to support the knowledge discovery module of UKM is the focus of the current research. This research proposes an architecture model in terms of the UKM for enabling semantic integration of geographically distributed knowledge discovery services on the moderator software system. It mainly consists of the following three modules as shown in figure 3 and discussed as follow:

Enterprise Metadata Integration Module

The main functionality of this module is to analyze and identify the terminology, representation and classification of the manufacturing system for UKM activities. It defines the Universal Manufacturing Enterprise Schema (UMES) and Converts the UMES into web-based ontology language, e.g. Resource Description Framework (RDF) and Web Ontology language (OWL). A set of semantic mapping rules is defined for automatic reasoning of heterogeneous document structure and data to UMES in Metadata Integration Ontology server.

Knowledge Discovery Module (KDM)

As shown in figure 3, this module incorporates features of a knowledge based methodology designed for cooperative learning, knowledge reuse and corresponding update of expert modules knowledge within UKM. The Knowledge Discovery Module will facilitate the decision making and moderation process through the use of multiple capabilities such as:

- Access to the past experience and projects to analyze the current problem and corresponding response.
- Intelligent agents to discover and filter critical information and patterns from various team members' past and current projects,

- Data Mining tools that take into account factors such as current intelligence, learning and updating the expert modules and facilitating decision making through recommendations of alternative courses of action.
- Access to team members and Moderator databases to facilitate the decision making.

It uses knowledge discovery and data mining tools to resolve the challenges of identifying and incorporating new knowledge with the existing expert modules in the UKM. In the proposed framework, the KDM mainly consists of four component as follow:

- *Knowledge Miners*: The main functionality of a knowledge miner is to find patterns, relationships and rules within data associated with the expertise of each team member. It mainly consists of three components; a knowledge interface, functional facilities and a knowledge base relating to current project team members (and including details of previous updates to knowledge that have been made using the KDM). The knowledge interface manages the communication between the knowledge manager and the knowledge miner. The mining tasks are carried out using the current project team member knowledge base. Knowledge about the project team members, domain knowledge and the main data mining engine are part of this component. The mining engine is given a mining objective, and then it tries to discover special patterns of data by forming the data into clusters that share some common properties, finding associations among the data, and discovering If Then Else rules. Overall, the knowledge miner plays a vital role in extracting the information, discovering hidden relationships, dependencies, patterns, etc., relating to particular team members specified within the knowledge base. After completing the mining task, the results are sent to the Knowledge Manager for further processing and queries.
- *Knowledge Manager*: The Knowledge Manager acts as a mediator and communicator between different knowledge miners, miner interface, expert modules, and the repository for knowledge sharing. It also makes the decisions to create or delete expert modules based on the extracted information, recommendations from the various constituent elements, and information about changes being made to the project team. The Knowledge Manager mainly consists of four components; miner interface, manager interface, functional facility, and the manager knowledge base. The Knowledge Manager checks what special types of knowledge are relevant to specific expert modules and consequently which types of databases and files are appropriate to mine in order to update the knowledge content of the particular expert module. When mining and update tasks have been completed, it stores the knowledge of these activities in the repository for possible future use and transfers the relevant new or updated knowledge into the expert modules through the expert module assistant. The updated expert modules can then be enabled, so that they can be used again in the ongoing moderation processes.

The growing complexity of virtual enterprise knowledge has made it increasingly difficult to share and exchange knowledge and information between companies, where inevitably the individual partners will have their own terminology and information sources.

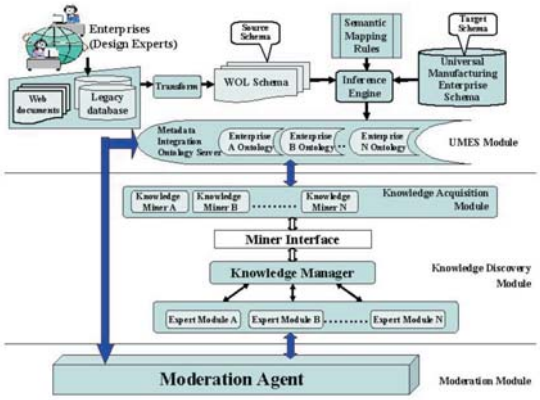

Figure 3: The Architecture of Universal Knowledge Moderator (UKM)

- *Repository :* The repository stores the knowledge for future reuse. It stores mining results and helps the Knowledge Manager, if a similar situation arises in future during the project. When the Knowledge Manager receives the mining request for information, it first queries the repository to see if relevant knowledge pertaining to the request has already been discovered. If it is not found then the Knowledge Manager initiates the Knowledge Miner(s) to mine the appropriate knowledge/ data bases. In addition, the repository provides the mechanisms for using a common vocabulary. As the different members of the project team work on the same problem domain and communicate with a set of valid message objects, it is essential for all the components of the knowledge acquisition module to share a common vocabulary. Furthermore, meta knowledge stored in the repository, such as system configuration, (e.g. various mining parameters for the knowledge miner), design consideration of data mining framework such as generic software and knowledge can be shared and reused by other project teams in future.
- *Information Manager*: In the present context, the main functionality of the information manager is to share and access the shared data and knowledge bases of project teams. It also notifies the knowledge manager about particular changes desired by particular project team members. The information manager also maintains its original functions during the moderation process as it signals the UKM whenever a change in the project is recorded in the project database. However this does not affect the knowledge acquisition process, so will not be

considered further here. The information manager must also assist the Knowledge Manager in deciding when to create, delete or update a particular expert module. This will happens whenever new project team members join a project or when existing contributors are changed in any way, or when new knowledge or experience is identified within the enterprise which may influence how a contributor to project will make his or her project decisions.

Moderation Module

The major function of the Moderation Module is to identify the potential project conflicts and to perform moderation activities. The moderation process is activated whenever a project decision is made and this is identified by a change being made to the project information within the shared database. Project decision change information is identified by the Moderator polling and asking the information manager for details of any changes that have taken place. When the Moderator has been notified of a change, it is connected to its object oriented knowledge database, which contains memories from knowledge miner and knowledge manager. The moderation of the current change is stopped or moves to the next change, if no team members are interested in that change. However, if the Moderator finds that one or more team members does have interest in the current type of change, a conflict has been identified. To resolve the conflict, the interested team members are contacted by the UKM and it remains in dialogue with these team members until conflicts are resolved.

Conclusion

This research discusses the development phases and ongoing research on Moderator technology. These includes: Engineering moderator for product design, Manufacturing system engineering moderator for manufacturing system design, extended enterprise manufacturing system engineering moderator to enhance the semantic interoperability and reuse of knowledge resources within globally extended manufacturing teams. Current research focuses on the development of universal knowledge moderator based on semantic web and knowledge discovery technology to enhance the knowledge generation and reuse in globally collaborative e manufacturing work. A framework for a UKM and a detailed description of the knowledge discovery module is presented to support the collaborative e- manufacturing.

Our current phase of work also focuses on enhancing support of the networked enterprise in the successful, timely creation of, and participation in collaborative Virtual Organizations by providing an infrastructure and services to discover, capture, deliver and apply knowledge relevant to collaboration creation and operation. Therefore in conclusion future research plans include:-

(a) to provide semantic ontology-based modelling of knowledge structures on collaborative working; and

(b) to develop the service-oriented self-adaptive holistic solution for knowledge-based collaboration services.

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Framework

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Knowledge Enterprises, Knowledge Economies, Knowledge Divide and Knowledge Societies: A Conceptual Framework

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Abstract

The terms knowledge, knowledge enterprise and knowledge management have been in vogue for the last decade or so in the context of corporate sector as means for gaining competitive advantage. However, the term knowledge has a variety of interpretations and can mean different things to different people in different contexts. At a macro-level, knowledge economy and knowledge-based economy are widely used terms to signify economies in which the production, distribution and use of knowledge are the main drivers of growth, wealth creation and employment. The social sciences literature refers to knowledge societies as distinct from knowledge economies. Reference is also made in the economic and social science literature, particularly in the documentation generated by international development agencies, on issues such as knowledge divide among people and among nations. A need has been felt to develop a conceptual framework in order to clarify various related concepts mentioned above and show their inter-relationships in a seamless micro- and macro- context. Using this framework, models of knowledge management at country level can be evaluated.

Keywords: knowledge consumers, knowledge divide, knowledge economy, knowledge enterprise, knowledge human resources, knowledge management.

Introduction

Extensive literature has been published over the last decade on knowledge enterprises, knowledge economies, knowledge divide and knowledge societies. This Paper aims at developing a conceptual framework which synthesizes these vital concepts. This is an intermittent step with a purpose to develop a coherent framework using which models of knowledge management at country level can be evaluated.

Various Dimensions of Knowledge

The concepts of Knowledge Enterprises, Knowledge Economies and Knowledge Societies are founded on the basic concept of "Knowledge". However, the term knowledge has so many different interpretations in different contexts that very often the use of this term as well as the derived terms of knowledge enterprises, knowledge economies and knowledge societies degenerates into clichés or fashion statements.

Some of the interpretations of the term "knowledge" in various contexts are briefly summarized below. Figure 1 schematically shows these interpretations of knowledge.

Knowledge as "Actionable Information"

The Knowledge Management literature which has essentially developed in the context of corporate sector views knowledge as an entity related to the business strategy and objectives of the organization which if properly leveraged will provide a competitive advantage to the organization. A simple definition of knowledge as proposed by Tiwana (2002) for instance is that knowledge is "Actionable Information". This interpretation of knowledge, however, places this entity in the same cluster as data, information, databases, information systems etc.

Knowledge as Subject Matter Domain

Some definitions of knowledge view it as an entity related to a specific discipline. For example, any scientific subject such as physics or chemistry or any engineering subject such as telecommunication technology has its own body of knowledge. Different terms are used to describe this interpretation of knowledge. One such commonly used term is "Declarative Knowledge". Two other term used by OECD (1996), which can be collectively seen as belonging to this interpretation of knowledge are "Know-What" and "Know-Why".

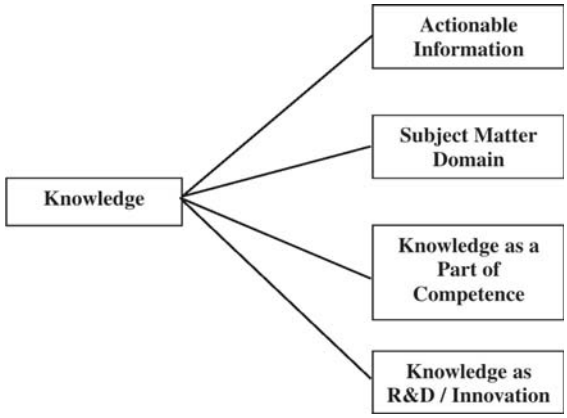

Figure 1: Interpretations of Knowledge

Knowledge as Part of Competence

The literature on training and development views knowledge, skills and attitudes as a triad defining the competence of an individual or the group of human resources in an organization. The first component of this triad essentially refers to the cognitive part of learning which people acquire through education and thus relates to what one can elicit from study of subject matter domains. The second component of this triad, namely, skills, is also considered as a type of knowledge in the knowledge management literature. A common term used to describe this entity is "procedural knowledge". The OECD categorization of knowledge terms this as "Know-How". The third component of the triad, called, Attitudes, is also seen as some kind of skills. Some call it as soft skills, while some others call this as behavioural skills. The important thing about all skills (both "How-to" type and soft-skills) is that they can be acquired through training. Availability of guides, procedure manuals and instructional materials can help in acquiring these kinds of knowledge to some extent, but more importantly, these skills are learnt through observation, simulation and guided on-the-job learning.

The term knowledge has so many different interpretations in different contexts that very often the use of this term as well as the derived terms of knowledge enterprises, knowledge economies and knowledge societies degenerates into clichés or fashion statements

Knowledge as R&D/ Innovation

Another interpretation of knowledge relates to creating its new forms, which enable the organizations to offer new products and services or some other differentiating factor for providing it a competitive advantage. The creation of new knowledge is of course dependent upon the competence of the persons engaged in R&D. It is also influenced by the enabling learning environment in the organization which fosters knowledge sharing amongst individuals.

Characteristics of a Knowledge Enterprise

A knowledge enterprise can be viewed as an enterprise which acquires knowledge inputs in various forms and delivers knowledge outputs for its customers and thereby derives economic value. Figure 2 schematically represents a "Knowledge Enterprise".

Knowledge Inputs

The inputs to a knowledge enterprise include, among others:

a. Knowledge embedded in its Human Resources

b. Knowledge embedded in its Process Technology

c. Knowledge embedded in its Products Design

d. Knowledge Management Systems

Though these inputs are obvious, some explanation/ elaboration would be apt at this stage.

Knowledge embedded in its Human Resources

The employees of the enterprise are endowed with certain qualifications and skills at the time of joining, which represents their initial knowledge stock. They progressively enhance their knowledge stock by acquiring new knowledge and skills through learning on-the-job and through specific training programmes or educational inputs. Much of the knowledge acquired by them is contextual knowledge about the affairs of the organization, its customers and its suppliers, which is vital for them to perform their day to day operations in the organization. Predominant form of new knowledge acquired by them is tacit knowledge. Generally speaking, the more number of years a person has been working in an organization, greater would be the value of this tacit knowledge to the organization. Additionally, some employees may acquire special skills or highly specialized domain knowledge in a particular field, which renders them unique value contributors to the organization because of their knowledge assets.

Knowledge embedded in its Process Technology

Depending upon the nature of products and/or services offered by a company, it sets up elaborate processes for production and delivery of such products and services. These are typically dominated by technology, which embodies the knowledge (of Know-How type) of production/ service creation. For example, the manufacturing plant of a chemical industry embodies the knowledge of its manufacturing process, optimized to produce the chemicals with high productivity, high quality, low wastage and low costs, and in accordance with the customers' delivery requirements. Further innovations may take place in the process technology over time with experience gained, changes in customer requirements or new technologies being developed in the industry, which may necessitate replacement of the existing technology at some stage.

Knowledge embedded in Products Design

The products or services which are eventually delivered by a company are expected to satisfy customer needs through incorporation of desired product/ service features with the help of technology. Two types of knowledge are embedded in product design. One is obviously the technical knowledge of the conceptual design of the product which reflects the innovative thinking of the design personnel. The second is the customer-related knowledge, which is explicitly or implicitly made available to the design team by the marketing personnel, and which greatly influences the design decisions. The knowledge of competitor products and policies is another important ingredient of knowledge which is considered by the design team while designing new products/ services. Strategic considerations of aligning knowledge with business strategy so that the product related decisions serve to fulfill the strategic requirements of the

enterprise are vital in this. The knowledge of strategy (and the related meta-systemic aspects such as policy planning, which fall into the domain of top management) are also important knowledge contributors.

Knowledge Management (KM) Systems

This refers to the systems specifically developed and instituted by an enterprise for acquiring, storing, distributing and sharing knowledge in the organization. A large part of the domain of KM systems is to explicate tacit knowledge, place it on knowledge repositories and portals, provide organization-wide (and often including customers and vendors) connectivity and collaborative technology for sharing of this knowledge. These KM systems are directly concerned with making sure that the knowledge of individual employees is explicated to the extent possible and shared by all others in the organization. Various themes describing the philosophy behind the KM systems of companies make interesting reading and reflect the intent of such KM systems. For example, "Learn once, use anywhere" is a theme of KM systems at M/s Infosys Technologies Ltd., a leading global software development company headquartered in India.

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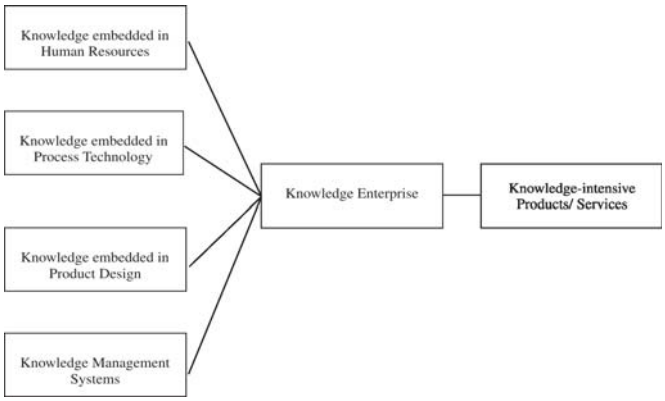

Figure 2: Schematic of a Knowledge Enterprise

Outputs of a Knowledge Enterprise

The direct output of a knowledge enterprise is obviously the products and services that it offers to its customers. The distinction between the products and services of the knowledge enterprise genre of enterprises (in contrast with a traditional enterprise) would be the knowledge-intensity of these products and services. Knowledge intensity essentially implies that a higher level of intellect is required on the part of the user/ consumer of knowledge products and services in satisfying his/her demand through the product/services being offered. For example, a Microsoft office product presupposes that the user has the basic knowledge of working with computer systems and is educated enough to grasp the instructions given through installation procedures and through the Help menus.

The rationale for a knowledge enterprise to offer knowledge-intensive products and services is that the knowledge economy increasingly generates more demand for such products and services. The new products/ services reflect the transformation of innovative and creative thinking of its R&D and other personnel into knowledge products which have current demand. The gradual and planned obsolescence of the older products so that the enterprise is continually attuned to the emerging customer needs is also reflective of the strategic knowledge within the company. Thus, higher percentage of new products/ services being offered by a company is an indicator of its being more knowledge-intensive.

Without yet defining a knowledge economy, it is argued here, for the sake of simplicity, that in a knowledge economy, various knowledge enterprises co-exist, with each one having a cascading effect on the other. Thus, one knowledge enterprise may need knowledgeable human resources, technology or products/services in a specific domain and thereby generate demand for such knowledge-based entities (human resources, technology or products/services). Another knowledge enterprise must produce such technology or product/services, and the economy must prepare human resources equipped with the knowledge in demand. Conversely, the output of a knowledge enterprise would fulfill such demand from other enterprises.

This cascading phenomenon of co-existing knowledge enterprises results in new forms of demand generation and fulfillment. These include: (a) high export demand for knowledge-intensive products/services; (b) process outsourcing of knowledge-intensive services; (c) emigration of skilled human resources; and (d) emergence of knowledge consumers. These are briefly discussed below.

High Export Demand for Knowledge-intensive Products/ Services

There may be high export demand for the knowledge-intensive products and services being produced by a knowledge enterprise. A higher volume of exports by a firm indicates that its products and services are endowed with attributes which have a global demand (or at least high demand in the global niche markets of that firm for a specified product or service).

Process Outsourcing of Knowledge-intensive Services

Instead of the knowledge products being physically exported, the knowledge-intensive services may be offered through the process outsourcing route. The increasing incidence of knowledge process outsourcing reflects this situation. This

output of knowledge enterprises is specifically relevant to enterprise operations concerned with satisfying the needs of off-shore customers by providing remote services on the basis of direct skills of the enterprise personnel at other end. It is known that the traditional call centres relied on the voice skills as well as the contextual knowledge of specific geographical locations acquired through education and training by the call centre operators. However, in the upmarket KPO operations, higher level knowledge skills are critical. For example, a legal process outsourcing activity would require an elaborate knowledge of the legal system of the client organisation.

Emigration of skilled human resources

There may be an off-shore demand for knowledge and skills embedded in human resources. Emigration of skilled professionals fulfills this kind of demand. Traditionally international migration has been related to both unskilled and low skilled labour as well as higher knowledge and skills. However, the demand for persons with higher levels of knowledge is increasing world-over, as this demand can't be fulfilled through local population alone due to a variety of factors. Higher knowledge intensity of products and services further reinforces demand for persons with higher knowledge and skills from overseas.

Emergence of knowledge consumers

As a consequence of the combination of knowledge-intensive products and services and increasingly knowledgeable and skilled human resources required in the economy, a new category of consumers called knowledge consumers has emerged. The knowledge consumers possess the basic qualification and skills to understand and gain proficiency with the features of the new knowledge products and services being offered. The knowledge consumers are not created out of vacuum. A symbiotic relationship exists between evolution of knowledge products and acquisition of new knowledge by the consumers to handle new features of such products. The increasing sophistication of Microsoft office products and operating systems provides a classical example of the steady evolution of knowledge consumers.

Figure 3 depicts these cascading effects in a schematic form.

Characteristics of a Knowledge Economy

OECD Report (1996) defines knowledge-based economy[1] as one in which the production, distribution and use of knowledge are main drivers of growth, wealth creation and employment for all industries. Though this definition doesn't refer to the term, "knowledge enterprise", it is evident that the production, distribution and use of knowledge for growth and employment would require co-existence of multiple knowledge enterprises which fulfill demand for knowledge-intensive products and services as described above.

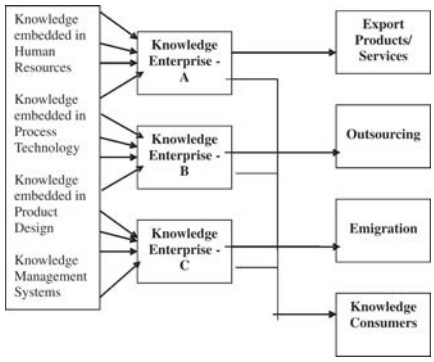

Figure 3: Cascading Effect of Co-existing Knowledge Enterprises

Figure 4 schematically depicts the concept of a knowledge economy. As can be seen, knowledge enterprises form a key component of knowledge economies because the creation of products and services by the enterprises and their procurement / utilization by the intended customers is crucial for a knowledge economy to survive. Additionally, a knowledge economy requires:

Knowledge intensity essentially implies that a higher level of intellect is required on the part of the user/ consumer of knowledge products and services in satisfying his/her demand through the product/services being offered…. The rationale for a knowledge enterprise to offer knowledge-intensive products and services is that the knowledge economy increasingly generates more demand for such products and services.

a A network of educational and training institutions which serve to impart knowledge (both cognitive knowledge and skills) to the human resources of the economy.

b R&D centres which generate new knowledge through creating new technologies and innovations, which can be commercially acquired and adapted by the knowledge enterprises. This is however not to say that knowledge creation is not in the in-house domain of knowledge enterprises; but creation of new knowledge as a commercial entity for public domain is a valuable output of the R&D centres in any knowledge economy.

c Govt. policy environment which eventually decides whether the interface between knowledge enterprises, educational & training institutions and R&D centres is harmonious enough and conducive to the growth of the knowledge economy and its ability to meet the competitive challenges from other knowledge economies.

d Connectivity and collaborative facilities which ensure that information & communication technology (ICT) is effectively utilized to promote dynamic interfaces among

[1] The term used by OECD Report is "Knowledge-based economy". It is considered here that the term "knowledge-based economy" is synonymous with the term, "knowledge economy".

all the above said actors/ stakeholders of the knowledge economy.

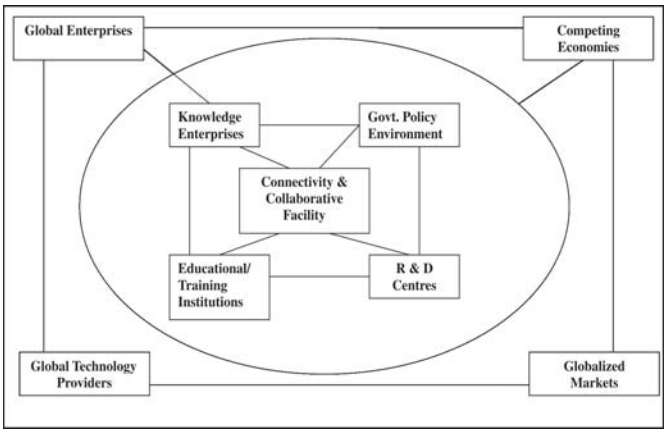

Figure 4: Concept of a Knowledge Economy

This model of knowledge economy also presupposes that various knowledge enterprises within its boundaries are simultaneously competing and collaborating with each other. While competition amongst them is important to ensure that excellence is rewarded and those who best align their knowledge and business strategy gain the upper hand, collaboration in certain respects is equally essential to ensure that the economy as a whole has a greater knowledge leverage vis-à-vis the competing economies.

The competing economies in this context are obviously the economies of other countries, if a view is taken that a knowledge economy broadly superimposes itself on the national boundaries of any country. However, this is only a partial (though most predominant) view of a knowledge economy. Conceptually, the domain of a knowledge economy may be widened to cover a region (for e.g., SAARC or ASEAN countries) or conversely it may be narrowed down to smaller geographical but more modular domains such as cities. The concept of Knowledge City revolves around the assumption that the city rather than a country as a whole can be taken to represent a unit of analysis, as it may fulfill the criterion of having all the five components of a knowledge economy mentioned above. (Carrillo, 2006)

In a knowledge economy, various knowledge enterprises co-exist, with each one having a cascading effect on the other…. This cascading phenomenon of co-existing knowledge enterprises results in new forms of demand generation and fulfillment. These include high export demand for knowledge-intensive products/services; process outsourcing of knowledge-intensive services; emigration of skilled human resources; and emergence of knowledge consumers.

A particularly significant feature of knowledge economies is that they represent open systems, implying their having a dynamic interface with the external environment. The external environment of a knowledge economy also possesses newer characteristics, fueled by globalization and technology. Thus, globalized markets, global enterprises and global technology providers are essential components of the knowledge-intensive external environment of a knowledge economy.

Leaders and Laggards of Knowledge Economy

Having laid down the basic conceptual framework of a knowledge economy, it is easy to identify the characteristics of economies which can be considered leaders and those which can be considered laggards.

Knowledge Leaders

A leader amongst knowledge economies would be distinguished through the following unique features:

Focus on Competence Building

A leading knowledge economy has a focus on competence building. All the components of the economy are geared towards enriching the human resources with cognitive knowledge, skills and attitudes which are in demand. There is a strong emphasis on tertiary education because all progress in R&D is crucially dependent on the higher education levels, particularly scientific knowledge. Equally important is the emphasis on building basic literacy and primary education since that is the very foundation of higher education attainments. Both these are simultaneous targets for a knowledge economy, though both are targeted on different sections of the population. One doesn't view these demands for primary and tertiary education as competing candidates for resource allocation; both demands have to be satisfied and a critical mass of competencies attained for the economy to get into a self-sustaining mode.

Tight Linkages among Stakeholders

A leading knowledge economy has a focus on tight linkages or coupling between the Government, knowledge enterprises, knowledge creating systems (R&D) and knowledge imparting systems (education & training institutions). This tight linkage is crucial for the economy to respond to continuing changes in the external environment, necessitating continual infusion of new knowledge inputs in the knowledge enterprises.

Diversity of Human Resources

A leader among knowledge economies not only tolerates inter-mixing of nationalities and cultures, it actively encourages such inter-mixing. The intermixing is in itself an effective source of knowledge sharing and through that, creating new knowledge. Each member of a multi-cultural and multi-nationality team enriches the group perspective. Intermixing is also a barometer of the gravitational pull of a knowledge enterprise and a knowledge economy to attract knowledge workers from different places across the world.

High Extent of Pervasion of ICT

A leader among knowledge economies has a high extent of

pervasion of Information & Communication Technologies (ICT). The added value of pervasive ICT is that the connectivity among various constituents of the economy is greatly facilitated, thereby enabling dramatic reduction in response time, and smoothening the inefficiencies of the overall system.

Larger Export Markets and High Technology Products

Another characteristic of the leaders among knowledge economies is that they have a high percentage of export of products and services in their national income. This is reflective of the unique global positioning acquired by them through better leveraging of their knowledge assets. Yet another similar characteristic is that high technology products constitute a much higher percentage of the products and services made available by them to the global market.

Knowledge Laggards

Conversely, the laggards among knowledge economies exhibit opposite properties, or may not move forward to achieve the characteristics described above at the right pace. For example, they may have low literacy levels, low level of tertiary education, and may find more comfort in isolationist and protectionist policies. The human resources in a laggard economy may find that competence and merit is not rewarded, that internal conflicts resulting in friction and dissipation of energy are the order of the day and little incentive exists for collaboration. Connectivity may take a back seat on the reasoning that this is too expensive or that it is unlikely to make a significant dent.

Knowledge Divide: Fall-out of Knowledge Economies

In the conceptual description of knowledge economies given above, the ethos is that of developing and utilizing knowledge human resources (KHR) in economic activities of generating knowledge-intensive goods and services so that economic growth is achieved, and as a byproduct, knowledge consumers are developed. The knowledge consumers are also KHRs for the economy by virtue of their higher cognition and skills in specialized domains. However, a category of persons, who may be described as Knowledge Have-nots (KHN) may also co-exist which only marginally contribute to the knowledge economy, and may emerge out again as KHN only because of their marginal participation in the growth generating activities of the knowledge economy. Consequently, the gap in the knowledge content of KHRs and KHNs increases since the KHRs would have undergone significant increase in their knowledge content in the economy. This gap in the knowledge content of KHRs and KHNs, termed as "Knowledge Divide" is typically an adverse fall-out of knowledge economies, and is continually perpetuating. Figure 5 schematically depicts the knowledge divide.

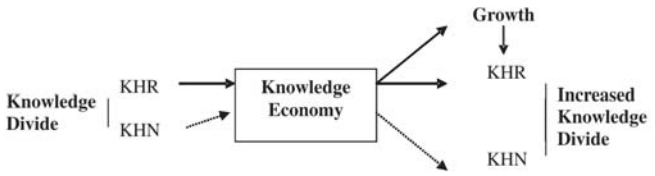

Figure 5: Widening Knowledge Divide

However, the knowledge divide is not confined to the boundaries of a knowledge economy. It can also be conceived as knowledge gap amongst economies. As seen in Figure 6, the knowledge divide between knowledge leaders and knowledge laggards described earlier may also increase simultaneously with global economic growth, due to lesser extent of participation of knowledge laggard economies in global economic activities.

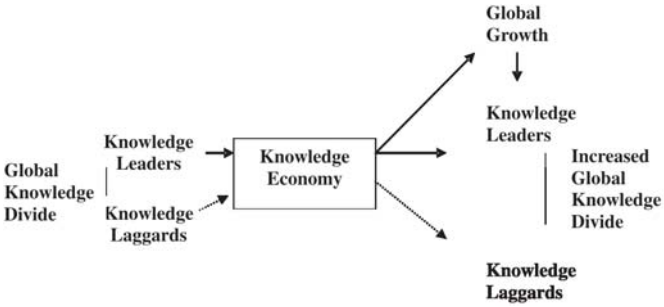

Figure 6: Knowledge Divide among Economies

This model of knowledge economy also presupposes that various knowledge enterprises within its boundaries are simultaneously competing and collaborating with each other. While competition amongst them is important to ensure that excellence is rewarded and those who best align their knowledge and business strategy gain the upper hand, collaboration in certain respects is equally essential to ensure that the economy as a whole has a greater knowledge leverage vis-à-vis the competing economies.

Knowledge Societies

While the concept of knowledge economy can be seen as leveraging knowledge for competitiveness, the concept of a knowledge society is "inclusive". A UNESCO Publication (2005) describing knowledge societies, observes that:

> *"… A knowledge society must foster knowledge-sharing among people. It should be able to integrate all its members and promote new forms of solidarity involving both present and future generations. Nobody should be excluded from knowledge societies, where knowledge is a public good, available to each and every individual. The cornerstone of true knowledge societies would be whether we now have the means to achieve equal and universal access to knowledge, and genuine sharing of knowledge."*

Typical attributes of a knowledge society may be described as follows:

a. A knowledge society fosters collaboration rather than competition among economies.

b) It promotes sharing rather than shielding if knowledge.

c) It targets at the collective well-being of the society as a whole and not merely generating economic output.

d) The concept of knowledge society views educational attainment not only as a means of economic output, but also as an end result in its own right.

e) It values self-actualization as well as the ability of individuals to make their own choices based on informed decisions.

This model of knowledge economy also presupposes that various knowledge enterprises within its boundaries are simultaneously competing and collaborating with each other. While competition amongst them is important to ensure that excellence is rewarded and those who best align their knowledge and business strategy gain the upper hand, collaboration in certain respects is equally essential to ensure that the economy as a whole has a greater knowledge leverage vis-à-vis the competing economies.

Figure 7 schematically describes the concept of a knowledge society. As can be seen, the two pivots of knowledge societies are existence of suitable knowledge sharing mechanisms at local and global level. Both the knowledge sharing mechanisms are fostered by a combination of Govt. policy initiatives and international development agency support. Availability of effective ICT facilitates these knowledge sharing mechanisms. Additionally, establishment of knowledge management systems, both at local and global levels, are instrumental in strengthening these mechanisms. In this context, the World Bank has taken a pioneering role in installing and implementing knowledge management systems, which has been emulated by several international financial institutions and development agencies such as Asian Development Bank, UNESCO and UNDP, as well as bilateral agencies such as Swiss Agency for Development and Cooperation (SDC).

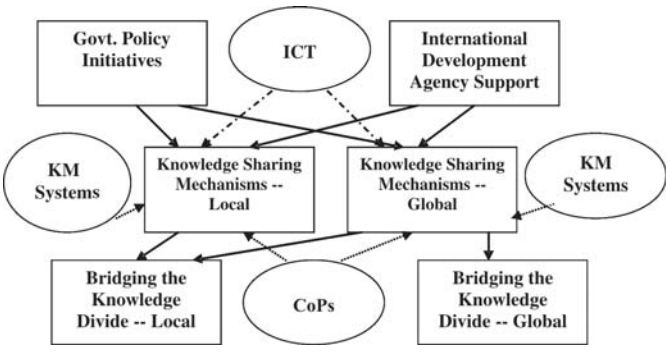

Figure 7: Concept of a Knowledge Society

The above said international development agencies have a crucial role to play in assimilating knowledge from different sources and disseminating it amongst the needy nations through collaborative developmental activities. Through the knowledge management systems established by these agencies, the prescriptive and descriptive expert knowledge contents, available in an explicit form, are shared. Additionally, even the tacit knowledge of local communities and the tacit contextual knowledge of the local environment where knowledge is to be applied are attempted to be captured (Batra: Dec. 2006). Several Communities of Practice (CoPs) on specific knowledge domains, geographical regions or problem clusters exist through cooperation among various international development agencies and other interested parties/ NGOs etc. which further strengthen these knowledge sharing mechanisms. The desired end result of all these initiatives is to bridge the knowledge divide, both at local level (within a knowledge economy) and global level (among knowledge economies) is bridged. This is, however, a continual endeavour – a never-ending exercise.

Co-existence of Knowledge Economies and Knowledge Societies

A knowledge economy can function in a perpetuating mode as long as the outputs of the knowledge enterprise can be geared to generate KHRs, which feed other economic enterprises. However, this process may not be self-perpetuating, and Govt. support and policy initiatives would be necessary to focus on KHR generation according to the changing knowledge needs of the economy. Additionally, Govt. support and policy initiatives have to invariably emphasize bridging the knowledge divide, and ensuring that the KHNs have greater opportunity of access to education & training and transforming into KHRs. Thus, in practice a Knowledge Economy requires support from the knowledge sharing philosophy of a knowledge society, and it is difficult to conceive of a knowledge economy without the values of a knowledge society to supplement.

Conversely, a knowledge society also can't exist without the embracing support provided by the knowledge economy. The generation of economic surplus at the local level is the key driver of Government initiatives in building knowledge sharing mechanisms and investing into ICTs in the public domain. Similarly, the generation of economic surplus by various global knowledge economies/ nations is crucial for sourcing the funding requirement of international development agencies. Therefore, it is not possible to realize the vision of knowledge society to any satisfactory level in real terms without first realizing the vision of a knowledge economy.

However, the UNESCO Publication (2006) referred above also sounds a note of caution by observing:

> *The notion of knowledge societies holds out fresh possibilities for human and sustainable development. However, one important stumbling block in the growth of knowledge-societies is the risk of*

promoting a single model, based exclusively on the requirements of the knowledge economy. This model of knowledge economy would widen the existing divides and lead to the emergence of new forms of exclusion, not only between the most developed countries and the rest, but also within each country.

Conclusions

This Paper has aimed at developing a conceptual framework of knowledge, knowledge enterprises, knowledge economies and knowledge societies. It has illustrated the inter-linkages among these vital concepts. It also refers to the notion of knowledge consumers, which have an important role to play in a knowledge economy, and the notion of knowledge divide, both within and among knowledge economies.

The simultaneous emphasis on knowledge economies and knowledge societies reiterates the duality between competition and collaboration mentioned earlier in the context of knowledge enterprises. This duality of simultaneous competition and collaboration among human beings appears to be a fundamental trait of humanity and extends to the levels of economies and societies.

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Efficient Association Rule Mining for Market Basket Analysis

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Abstract

Data mining is an attitude that business actions should be based on learning, that informed decisions are better than uninformed decisions, and that measuring results is beneficial to the business. Data mining is also a process and a methodology for applying the tools and techniques. Association rule mining is also one among the most commonly used techniques in Data mining. A typical and the most running example of association rule mining is market basket analysis. This process analyzes customer buying habits by finding associations between the different items that customers place in their "shopping baskets". The discovery of such associations can help retailers develop marketing strategies by gaining insight into which items are frequently purchased together by customer and which items bring them better profits when placed with in close proximity.

The algorithms for single dimensional association rule mining, such as apriori and the FP-tree developed are in a greater use today. However, candidate set generation in apriori is still costly, especially when there exists a large number of patterns and/or long patterns. And both these algorithms prune the itemsets based on their frequencies (i.e., if their frequencies exceed minimum support threshold then they term them as frequent and the rest of them as infrequent). But this pruning technique is insufficient to help market analyst to make decisions such as planning the supermarket's shelf space, changing the layout new store layouts, new product assortments, which products to put on promotion so as to improve their marketing profits. So the focus of this paper is to enhance these algorithms in a way that it provides frequent profitable patterns which help market analyst to make the best informed decisions for improving their business.

Keywords: efficient association, market basket analysis, rule mining.

Introduction

Database mining is motivated by decision support problem faced by most large retail organizations (Agrawal *et al.*, 1993b). Progress in bar code technology has made it possible for retail organizations to collect and store massive amounts of sales data, referred to as basket data. A record in such data typically consists of the transaction date and items bought in the transaction. Successful organizations view such databases as important pieces of the marketing infrastructure. They are interested in instituting information-driven marketing processes, managed by database technology, which enables marketers to develop and implement customized marketing programs and strategies (Michalski *et al.,* 1992).

The problem of mining association rules over basket data was introduced by Agrawal *et al.*1993a. An example of such a rule might be that 98% of customers those who purchase tires and auto accessories also get automotive services done. Finding all such rules is valuable for cross-marketing and attached mailing applications. Other applications include catalog design, add-on sales, store layout, and customer segmentation based on buying patterns. The databases involved in these applications are very large. It is imperative, therefore, to have fast and algorithms for this task.

The problem of finding association rules falls within the purview of database mining (Agrawal *et al.*, 1993; Michalski *et al.,* 1992; Han *et al.,* 1992), also called Knowledge Discovery in databases (Lubinsky, 1989). Related but not directly applicable, work includes the induction of classification rules. The other works in the machine learning literature is the KID3 algorithm presented in (Mannila and Raiha, 1987). If used for finding associations this algorithm will make as many passes over the data as the number of combinations of items in the antecedent, which is exponentially large. Related work in the database literature is the work on inferring functional dependencies from data (Mannila and Toivonen, 1994).

This paper identifies the limitations of both the apriori developed by Agrawal and Srikant, 1994, and the FP-tree developed by Han *et al*. (2000) and then propose an algorithm, Frequent Profitable Pattern Tree algorithm, to identify frequent profitable patterns that help a market analyst to take informed decisions to improve business.

The remainder of this paper is organized as follows: Section 2 presents the literature survey of single dimensional association rule mining algorithms, the proposed FPP-Tree algorithm in Section 3, the followed by experimental results and comparison in Section 4, and followed by conclusion and future work in Section 5.

Literature Survey – Single Dimensional Association Rule Mining Algorithms

There are two main algorithms that are in common use: i) The Apriori Algorithm: mining frequent itemsets using candidate generation (Agrawal & Srikant, 1994) and ii) The FP-Growth Algorithm: mining frequent itemsets without candidate generation. (Han *et al.,* 2000)

The Apriori Algorithm

The apriori-gen function takes as argument L_{k-1} the set of all large (k-1) itemsets. It returns a superset of the set of all large k-itemsets. The function works in two steps. These two steps are similar to the join and prune steps respectively. However, in general, first step produce a superset of the candidates produced by the join step. The major drawbacks of this approach are:

Association Rules are derived from transactional data. They considerable item-sets which occur together often. Market Basket Analysis is a technique to solve Association Rule Mining Problems. It assists managers to exploit product associations and consumer's behavior to enhance sales.

1. Generating large number of frequent itemsets is expensive: 10^6 frequent 1-itemsets require testing of 5*10^11 candidate 2-itemsets.
2. Not good for long patterns: A frequent itemset of size 100 requires testing of $2^{100} \approx 10^{30}$ smaller candidate itemsets.
3. Repeated scans of database are expensive.
4. The main bottleneck is the candidate generation mechanism.

Mining Frequent Itemsets without Candidate Generation using FP-Tree

"Can we design a method that mines the complete set of frequent itemsets without candidate generation?" An interesting method in this attempt is called **frequent pattern growth** or simply **FP-growth,** which adopts a divide-and-conquer strategy as follows: compress the database representing frequent items into **frequent-pattern tree** or **FP-tree**, but retain the itemset association information, and then divide such a compressed database into a set of conditional databases (a special kind of projected database), each associated with frequent item, and mine each such database separately.

The FP-tree construction takes exactly two scans of the transaction database: The first scan collects the set of frequent items, and the second scan constructs the FP-tree. The cost of inserting a transaction *Trans* into the FP-tree is $O(|freq(Trans)|)$, where *freq*(*Trans*) is the set of frequent items in *Trans*. We will show that the FP-tree contains the complete information for frequent-pattern mining.

Why FP-tree is better over Apriori Algorithm?

Frequent pattern tree (FP-tree) is novel data structure, for storing compressed, crucial information about frequent patterns, and developed a pattern growth method, *FP-growth*, for efficient mining of frequent patterns in large databases. There are several advantages of *FP-growth* over other approaches:

1. It constructs a highly compact FP-tree, which is usually substantially smaller than the original database and thus saves the costly database scans in the subsequent mining processes.
2. It applies a pattern growth method which avoids costly candidate generation and test by successively concatenating frequent 1-itemset found in the (conditional) FP-trees. This ensures that it never generates any combinations of new candidate sets which are not in the database because the itemset in any transaction is always encoded in the corresponding path of the FP-trees. In this context, mining is not *Apriori*-like (*restricted*) *generation-and-test* but *frequent pattern* (*fragment*) *growth only*. The major operations of mining are count accumulation and prefix path count adjustment, which are much less costlier than candidate generation and pattern matching operations performed in most *Apriori*-like algorithms.
3. It applies a partitioning-based divide-and-conquer method which dramatically reduces the size of the subsequent conditional pattern bases and conditional FP-tree.

Common Limitations of Apriori and FP-Tree Algorithms

Both of the above algorithms are really efficient in mining association rules. These algorithms prune the itemsets based on their frequencies (i.e., if their frequencies exceed minimum support they term them as frequent and the rest as infrequent). But this pruning based on frequencies, alone, cannot really help the market analyst to make decisions such as planning the supermarket's shelf space, changing the layout new store layouts, new product assortments, which products to put on promotion so as to improve their sales and marketing profits. For this we need to give the specific concern over profitable frequent patterns. These give a quick idea of which associations give them profit and which do not. And in some cases it may happen that, frequent patterns which are generated by the above algorithms may not be as profitable as a pruned-out pattern.

This may happen like, if a pattern a $\rightarrow$ b $\rightarrow$ c which is pruned-out as infrequent by both apriori and FP-tree, is giving a better profit than a frequent pattern such as b $\rightarrow$ c $\rightarrow$ f. And thus by taking into an account this result, the market analyst may commit mistake in arranging b, c, and f in one shelf (in close proximity) instead of arranging a, b, and c (which are actually profitable) into one.

Frequent Profitable Pattern Tree Without Candidate Generation

This algorithm mines two databases, one is a transactions

database D shown in Table 2, and the other is a profits database P which holds the profits of all the items as shown in the Table 1. The first scan of the database D is the same as Apriori, which derives the set of frequent items (1-itemsets) and their support counts (frequencies). Let the minimum support count be 2. The items whose supports are greater than minimum support are selected as frequent. The set of frequent items is sorted in the order of descending support count. This resulting set or list is denoted by L. Thus, we have L=⟨c:4, f:4, a:3, b:3, m:3, p:3⟩ from the Table 3. A tree is constructed as follows. First create the root of the tree labeled with "null". Scan the database D second time. The items in each transaction are processed in L order (i.e., sorted according to the descending support count) and a branch is created for each transaction.

Table 1: The Profit Database

itm_name	Itm_profit
A	4
B	3
C	5
D	2
E	4
F	3
G	3
H	2
I	5
J	3
K	4
L	6
m	3
N	2
O	5
P	3
S	2

Table 2: The Transaction Database

TID	item1	item2	item3	item4	item5	item6	item7	item8
1	f	a	c	d	g	i	m	p
2	a	b	c	f	l	m	o	
3	b	f	h	j	o	w		
4	b	c	k	s	p			
5	a	f	c	e	l	p	m	n

For example, the scan of the first transaction," TID: c, f, a, m, p" which contains five items in L order, leads to the construction of the first branch of the tree with five nodes: ⟨⟨c:4⟩ ⟨f:3⟩ ⟨a:3⟩ ⟨m:2⟩ ⟨p:2⟩⟩, where c is linked as a child of the root, 'f' is linked to c, 'a' is linked to 'f', m is linked to 'a', and 'p' is linked to 'm'. However, this branch would share a common prefix ⟨c⟩, with the existing path for TID 100. Therefore, we instead increment the count of 'c' by 1, and create a new node (f: 3), which is linked as a child of (c:4). In general when considering the branch to be added for a transaction, the count of each node along a common prefix is incremented by 1, and the nodes of the prefix for the next match sequentially either till the leaf nose of until there are no matches, for each match increment the count value by 1. And still if there are any items in the transaction that are to be added into the tree, start inserting from the end node of the search. Now scan the profit database, which has the list of item-profits P⟨a:4, b:3,c:5,……⟩ and assign the individual profit to each node in the tree correspondingly, then calculate the joint-profits of each node in the tree by using the formula,

*Joint-profit of item X_i = count of Xi * (profit (Xi) + profit (parent (Xi) + Σ profit (ancestors (Xi)).*

For example for the branch ⟨c, f, a, m, p⟩,

Joint–profit of c = 4*(5+0) =20. (Since profit of root is 0.)

Joint–profit of f= 3*(3+5+0) =24.

The main concept behind doing this is if 'f' is purchased by customers for three times, then it also implies that 'c' is purchased by those customers for same number of times. So their joint-profit is calculated, since the profit acquired by selling f three times automatically includes the profit of selling 'c' for three times.

Similarly the joint profits of all nodes are calculated. The constructed tree is shown in the Figure 1. Now scan the tree for all the profitable-frequent patterns, whose joint-profit is more than the minimum joint profit (threshold given by the user). This gives the items which are profitable and also frequent for each prefix node (direct child to the root node). Now the market analyst can arrange the items in a more profitable way.

The FPP-Tree Algorithm Design

Let $I = \{a_1, a_2, \ldots, a_m\}$ be a set of items, a *transaction database* $D=\langle T_1, T_2, \ldots, T_n\rangle$ where T_i (i " $[1 \ldots n]$) is a transaction which contains a set of items in I, and $P=\langle p_1, p_2, p_3, \ldots.\rangle$. The *support* (or occurrence frequency) of a *pattern* A, where A is a set of items, is the number of transactions containing A in D. A pattern A is *frequent* if A's support is no less than a predefined *minimum support threshold*, ξ.

Given a transaction database *DB,* a profit database P which give the items profits, minimum joint profit threshold min-joint-profit ψ, and a minimum support threshold ξ , then we need to find *the complete set of profitable frequent patterns* using the algorithm given below.

Association Rule Mining is essential to extract rules to assists reading the customers' behavior, shelving of goods, and designing cross-selling strategies to enhance sales/profit.

Algorithm

Input: A Transaction database D, Profit database P, minimum support threshold, minimum joint profit.

Output: The complete set of profitable frequent patterns.

Method

The Profitable Frequent Pattern Tree is constructed in the following steps.

1. Scan the transaction database D once. Collect the set of frequent itemsets F, their corresponding supports.

2. Sort F in the descending order as L, the list of frequent items.

3. Create the root of a profitable-frequent-pattern tree, and label it as "null". For each transaction Trans in D do the following:

   a. Select and sort the frequent items in Trans according to the order of L.

   b. Start inserting the sorted frequent items to the tree. If the item is the first item in the transaction, then search the direct children (i.e., children at the first next level) of the root node for the item you are inserting.

      o If the item is found then, increment the count of that node by 1, and traverse the successive nodes of that node, searching for the next succeeding items in the Trans one by ne, until either no match is found or till the leaf node is reached. In this search, for each match increment the matched node count value by 1.And if there are any unmatched elements in the same transaction, start inserting from the node where the search is stopped. And while inserting increment the count value by 1.

      o If the item is not found then, insert the items one by one following the node-link right from the root node. And for every new node increment the value of count by one

4. After constructing the tree assign the profits to each node by accessing the profit database P accordingly.

5. Now calculate the joint-profit for each node by using the formula,

Joint-profit of item X_i = count of Xi * (profit (Xi) + profit (parent (Xi) + Σ *profit (ancestors (Xi))*.

Example taken from Table 2:

Table 3: Header Table

Item	Support	Profit
c	4	5
f	4	3
a	3	4
b	3	3
m	3	3
p	3	3

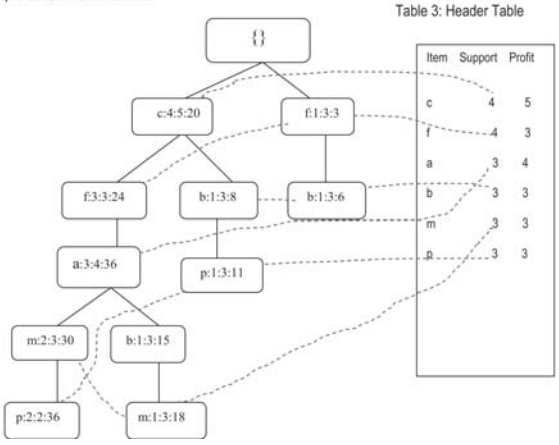

Figure.1: Frequent Profitable Pattern-Tree

6. Scan and print out all the frequent items whose joint-profits are greater than min-joint- profit ψ for each prefix path.

(**Syntax of a node:** *item-name: count: individual-profit: joint-profit)*

The paper uses the database having the transactions table and item profits table, to predict the outcomes using the apriori, fp-tree and our proposed algorithm. It has been proved that our approach performs better results than the rest. It is observed that both apriori, and FP-tree algorithms gave only the frequent patterns as their outcomes (f, c, a), but the proposed algorithm gave frequent profitable patterns (f, c, a, m, p) as shown in the Table 4. The proposed algorithm says that m and p are giving profits which are comparatively same as f, c, and a. And from the obtained results, we may say that frequent items which are pruned out (i.e., like m, and p) while generating frequent patterns are profitable. Based on this idea our proposed algorithm gives profitable frequent patterns. So that we never prune out the profitable items in pruning stage of association rule mining while giving frequent profitable patterns as outcome. Note these values may change based on the minimum support threshold value, given by the user.

Table 4: Results from FTTP vis-à-vis Apriori and FP-Tree

Algorithm	Apriori	FP-Tree	FTTP
Results	*f, c, a*	*f, c, a*	*f, c, a, m, p*

Association Rule Mining is essential to extract rules to assists reading the customers' behavior, shelving of goods, and designing cross-selling strategies to enhance sales/profit.

Conclusion

One appeal of association rules is the clarity and utility of the results, which are in the form of rules about groups of products. There is an intuitive appeal to an association rule because it expresses how tangible products and services group together. A rule like, "*if a customer purchases three-way calling, then that customer will also purchase call waiting,*" is clear. Even better, it might suggest a specific course of action, such as bundling three-way calling with call waiting into a single service package. Keeping this in mind our proposed algorithm has given profitable frequent patterns with out generating any candidate itemsets. The proposed algorithm efficiently makes use of the knowledge acquired from both the "apriori" developed by Agrawal and Srikanth, 1994 and "FP-tree" by Han *et al.*, 2000.

The Frequent Profitable Pattern Tree constructed in the section 3 gives the *frequent profitable patterns* which help the market analyst to arrange the shelf space in a more profitable way, which improves their business. And since this FPP-tree is also being constructed without candidate generation, it inherits all the advantages of FP-tree, such as: i. it constructs a highly compact FPP-tree, which is usually substantially smaller than the original database and thus saves the costly database scans in the subsequent mining

processes, and ii. it doesn't generate any candidate itemsets, so the calculation and tree building process speeds up.

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Empirical Study

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Business Process Re-Engineering (BPR) and Technology Interception - The Continuum in the E-Government Application Cauldron

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Abstract

This paper discusses the quality and effectiveness of service delivered through the Integrated Citizen Service Centre (ICSC), eSeva, in Andhra Pradesh (A.P). The Authors have used Goals Question Metrics (GQM) and Balanced Score Card (BSC) to make their observations. The focus of the paper is on Business Process Re-engineering a major Strategic initiative in e-government applications. Biometric-based recognition because of inherent features such as reliability, speed and cost and the different possible uses can have a profound influence on the way government conduct its business. With newer technology like iris scan already being used in the issue of ration cards in Andhra Pradesh, other e-government applications necessitating authentication of identity of citizens, the same database can used hence inevitably BPR will assume greater significance. The authors in a limited sense also examine the possible role of usage of mobile technology in health applications opening up a possibility of extending eSeva services to health sector.

Keywords: balanced score card (bsc), biometrics, business process re-engineering (bpr), general packet radio service (gprs) mobile, goals question metrics (gqm) and integrated citizen service centre (icsc).

Introduction

The tenth five year plan, formed the basis of India's major thrust in developing e-government applications in the last five years outlined "Re-engineering of existing government process and procedures as essential to bring about transparency in working, reducing bureaucratic control, increasing efficiency and productivity, reducing cost of service delivery etc. Integration of Projects across various departments to provide a single point of contact for citizens for delivery of services electronically is essential". [1]

The literature reviews on BPR in the manufacturing sector adapted for e-government suggest:

- The fundamental rethinking and radical redesign of business process to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed. [2]
- The analysis and redesign of business and manufacturing processes is to eliminate that which needs no value. [3]
- A radically new process of organizational change that many companies are using renews their commitment to customer service. [4]

At the state administrative level convergence of utility and citizen services at a single point was piloted by Mr. R Chandrasekhar, I.A.S and followed up by Mr. J Satyanarayana, I.A.S during their tenure as Secretary IT&C, Govt. of Andhra Pradesh. Mr. Satyanarayana reveals that BPR government contributes about 35% towards the e-government projects. [5]

In Andhra Pradesh the administrative function was backed by the Political wisdom which recognized the need and led to the state emerging as a leader in e-government application. The Vision statement articulating the acronym SMART [6] reflected the thrust in e-government in the State.

This paper is divided into three parts 1) The authors

describes the GQM method and Balanced Score Card Method to understand the impact of BPR, report the results of the analysis of the data gathered over the last two years at time intervals of every quarter the 2) Study of newer Technology introduction 3) Experiment with future technology in improving Health Services in Urban and Rural India.

Importance of GQM and BSC In Understanding Impact of Bpr for Stakeholders

Let us begin with understanding the Goals that eSeva set for itself

Goals of e-Seva

1. Providing a one-stop services to the citizens through a chain of Integrated Citizen Service Centers (ICSC)
2. All the counters should provide all the services at all the ICSC.
3. The architecture adopted should be scalable and secure.
4. The service time per transaction should be less than three minutes.
5. Minimize the queue formation at the centers
6. The cost of transacting with the government should be reduced
7. Selected services should be available over the Internet 24 x 7

The Importance of Measuring the Impact of BPR on the stakeholders

(The services that do not involve an inspection or attestation should be offered over the Internet also to facilitate the citizen to avail them from Home / office).

There is a strong relationship between BPR and organizational change management procedures during a BPR project, which must have a high degree of top management support. In the case of e-government it must come from both the bureaucratic and the political leadership which was forthcoming in Andhra Pradesh. Jih et al [7] suggested that management must take a more holistic approach to the redesign of business processes and their relationship with information technology. The need to integrate techniques for organizational design and incorporate the same during the BPR exercise was necessitated and carried out by the state.

There has been some confusion regarding the use of terms like reengineering, process improvement and redesign. Valiris et al [8] in their literature suggest that reengineering is synonymous to radical change and process improvement to incremental change and that both, reengineering and process improvement are included in the definition of redesign. In this paper we adopt the same view. Therefore, synonymously and interchangeably we refer the topic 'business process redesign' since the term that has the broadest acceptance in the industry.

Dangers of Excess Business Process Re-Engineering

In most of the cases the officials are ambitious and introduce Business Process Re-Engineering (BPR), more than a common user can accept, in to the Project. BPR should change the existing functionality to an optimal level only. To achieve success a set of metrics to control and monitor BPR for e-Government implementation Projects is required in order to help Project managers / Project Directors.

According to Guha et al.[9] "Although there is the recognition of the needs to control and monitor a redesigned process and link it to continuous improvement programs, many methods studied did not reflect the recognition of these needs". The use of BPR at the local authority [10] level referring to the level of re-engineering, with the suitability of processes to undergo re-engineering[11] and the level of dependence on Information & communication Technology (ICT).

Any e-governance Project having BPR as central to its objectives need to create an impact on the stakeholders. The authors feel that the Project may have the following goals i) Overall e-government goal ii) Process goals iii) Activity Goals iv) Related Metrics for measurement as depicted in Figure 1.

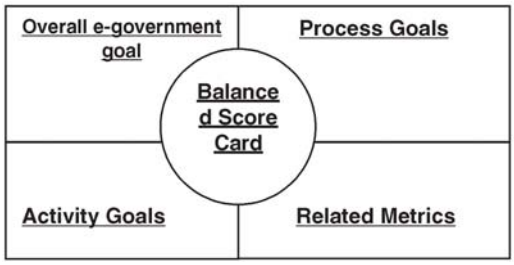

Figure 1: Project Goals

GQM Method Overview

The GQM approach is a mechanism that provides a framework for developing a metrics program. It was developed at the University of Maryland as a mechanism for formalizing the tasks of characterization, planning, construction, analysis, learning and feedback.

GQM does not provide specific goals but rather a framework for stating the goals measurement and refining goals into questions to provide a specification for the data needed to help achieve the goals.

The GQM method was originally developed by V. Basili[12] and D. Weiss, and expanded with many other concepts by D. Rombach. The GQM method contains four phases: planning phase, definition phase, data collection phase and interpretation phase. The GQM top-down approach assists Project Managers / Program Directors and application developers not only in knowing what data to collect but also in understanding the analysis method needed when the data is available. [13]

Description of Metrics

In this section the team shows the definition of each metric and the relationship between the questions defined and the metrics (see table 1) for the eSeva. We also represented graphically the relationships (see figure 2) The graphic represents the three levels: measurement goals, questions, and metrics. Metrics can help answer more than one question

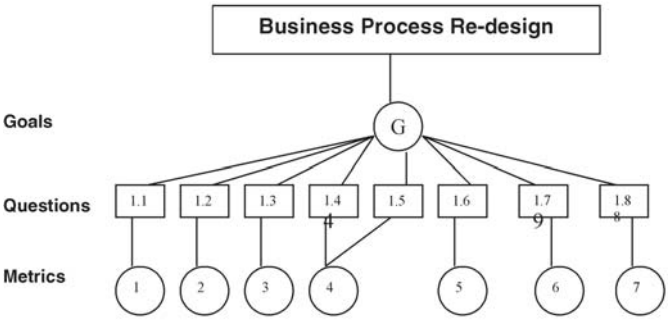

Figure 2: Graphical representation of the GQM preliminary Plan

For each metric we defined the following aspects: what they measure, when they must be measured, what possible values they could have, and the metric scale, who will measure it, what medium is used for data collection. Most of the metrics proposed are direct measurements except the metrics showing percentages.

Table 1: Definition of Metrics and relationship with Questions

	Goal	Question	Metrics – Description of Result
Q1	Magnitude of Re-design	Magnitude of redesign that is necessary for each business process	Low for each process
Q2	Users Involved	Number of users involved in the redesign	Citizens - Stakeholders
Q3	Business Process Redesigned	Number of business process that need to be redesigned	IT Architecture - Search pattern is now changed to owners name instead of survey number
Q4	Business Process affected	Number of business process that need change due to redesign of other process	Nil
Q5	BPR effort	It comprises of total number of departments involved, number of processes redesigned and people involved in each phase.	Continuous addition of new services since inception
Q8	Duration of Business process redesign	Estimated time necessary to redesign each business process	Three man months
Q9	Cost	Cost involved in adapting the redesigned process	New approach adopted PPP Model

Interpretation of Metrics

In relation to the magnitude of redesign metric, Guha et al. had developed a "project radicalness planning worksheet" in order to assess the BPR project radicalness. This worksheet includes eleven factors related with BPR project planning: strategic centrality, feasibility of IT to change process, process breadth, Senior management commitment, performance measurement criteria, process functionality, project functionality, project resource availability, structural flexibility, cultural capacity for change, management's willingness to impact people and value chain target.

Each factor is measured in a Likert scale (1-5 scores). However, their view is not for each business process but for the project as a whole. We think that this method is very useful not only at the beginning of the BPR project to define the BPR plan and allocate the adequate resources but will sustain till the Project closure. This Plan also provides for establishing management commitment and support. Higher radicalness implies more commitment and lower radicalness implies more analysis of existing processes in order to improve them.

Based on the magnitude and the scale of effort involved in a BPR approach, Bancroft et al proposed a matrix of magnitude versus scale of effort. BPR effort is quite similar to the complexity of each business process. The more departments and people involved in the change, the greater the scale and therefore complexity of the BPR effort.

The Balanced Score Card

The balanced scorecard suggests that we view the organization from four perspectives, and to develop metrics, collect data and analyze it relative to each of these perspectives:

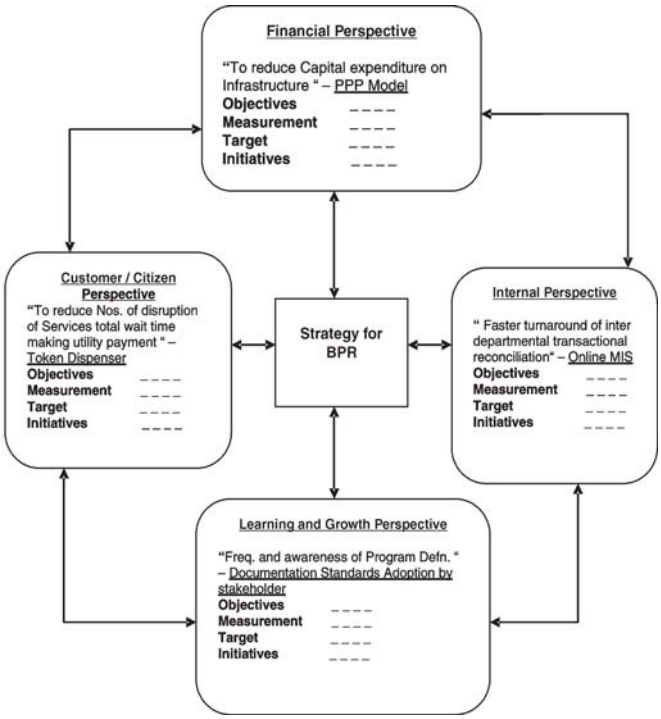

Figure 3: The Balanced Score Card

The balanced scorecard is a *management system* (not only a measurement system) that enables organizations to clarify their vision and strategy and translate them into action. It provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results. When fully deployed, the balanced scorecard transforms strategic planning from an academic exercise into the nerve center of an enterprise. This method was developed by Dr. Robert Kaplan and Dr. David Norton. [14]

(Scale 1 – Nil , 2 – Low, 3 – Medium, 4 – Average, 5 – High)

Table 2: Impact Measurement Matrix for Achieving eSeva Goals

	Factors	Rating as per GQM (2005)	Rating as per GQM (2007)	Adapted Avg. Composite measure for BSC (2005)	Adapted Avg. Composite measure for BSC (2007)
1	BPR effort	2.0	0.2	2.1	0.1
2	Replicable ICT Architecture	5.0	5.0	4.9	4.9
3	Scalability of ICT Architecture to add newer application	5.0	5.0	5.0	5.5
4	Stakeholders acceptability	5.0	4.1	5.0	4.0
5	Cost model Replicable	4.3	4	4.3	4.0
6	Growth of transaction (month wise)	5.0	3.8	4.9	3.6
7	Cross functional Team necessity	3.0	1.8	2.8	0.8
8	ICT skills necessary for stakeholders	2.0	1.95	2.0	0.9
9	Project Management Skills	3.0	1.2	5.0	1.1
10	Governance Transparency	3.8	1.3	3.75	1.08
11	Continuity of Project Director	4.6	3.3	4.6	3.3
	Success Rate Citizen Acceptability (Weighted Avg.)	**4.65**	**4.1**	**4.5**	**3.85**

Observations by the Authors

1. Large Scale Capital intensive Projects saw adoption of PPP model.
2. Importance of e-government applications growth.
3. Replicable e-government applications are achievable if in the Software Development Life Cycle thrust and importance is given to parameterization. Bangalore One is the replication of eSeva in Hyderabad.
4. Drop in transaction rate was due to discouragement of transaction by certain departments which is reflected in drop of transparency in Governance. Sales Tax payment, Bus pass issue, Passport form sale and application acceptance took a major drop. Touts in the system are back and the overall citizen acceptability rate therefore took a plunge. In a separate survey with respect to drop in applications of Passport in a survey conducted by the authors (Sample N=10) it was observed that 20 % of the respondents applying for new passports were Govt. servants or family member (immediate family) who preferred going to Passport Agents in December 2006 and the figure rose to 40% in June 2007. The ICSC centre had no feedback mechanism loop to respond to the applicant the reason for delay. Touts outside Passport office at Secunderabad were promising residential verification within one week. Surprisingly the passport office has a separate window at passport office for accepting passport application from passport agents. The official website of the Government of India or the Regional passport office does not mention about acceptance at eSeva Centers. Document Verification Services the cost at eSeva is Rs. 50 (Around 1US$), whereas using tout service result in expenses of 100US$ for the citizen.
5. Disjoint independent silos continue to grow and co-exists as can be observed in the case of passport application submission. The Government of India web site http://passport.gov.nic.in through the Rights to Information Act and Vigilance module seem to encourage transparency, but however visibility of this attempt is very poor as an overwhelming 95% of the respondents coming to Secunderabad came form far flung districts in the state. ESeva centers do not find mention for receiving application form. With only one Regional passport office at Hyderabad and two application receiving centers at Vijaywada and Tirupathi respectively in the state of Andhra Pradesh and catering to population of over eight million citizens in the state, the primary stakeholder the citizen is inconvenienced through expenditure incurred, costs for efforts in follow up and ending up in the hands of touts. The study however did examine the expenditure that the state government has to incur for police verification per applicant for identity, criminal record and residence verification or the revenue share mechanism between the Central Government and State Government for carrying out the same. Discontinuance of filing of Income Tax return filing at post offices is another case of reduction of easier access to stakeholders. In both cases, the reason given by Income Tax Department and Regional Passport office was the applications received at the collection centers, namely eSeva and post office never reached them.

New Technology Interception Adaptation for e-governance

6. The table below lists the initiatives started vis-à-vis Benefit that started accruing with each BSC perspective

Table 3: Balanced Score Card Initiatives

BSC Perspective	Initiative Started	Benefit
Financial	PPP Model in e-government applications	Reduction of Financial burden on State Exchequer
Citizen	Introduction of Token Dispenser	Eradication of Mob mentality at service counter
Internal	Online MIS	Better Treasury Management
Learning and Growth	Documentation Standard	External Vendor Management- Only CMM Level 5 companies in Bid participation. Ensuring Service Quality.

Technology Introduction - Iris Recognition for Issue of Ration Cards in A.P

In July 2005 to September 2006, the Government of Andhra Pradesh State Government introduced 'iris' technology cameras intended to speed up the process of issuing ration cards. Totally 1,800 cameras through Designated Photography Location (DPL) were deployed statewide to enable an average 15,000 ration cards could be distributed throughout the State in a day. In India the ration card is recognized legally as valid proof in all Government and commercial transaction. [15]

The Technology introduction program would have ensured 20 million individuals enrolled in the first phase. When the program concludes, the user base was targeted to cover 80 million persons. This undoubtedly was the largest iris recognition program ever done, even though in 1996 Malaysia was the world's first country to use biometrics based recognition for issue of passports to citizens. [16]

Biometric recognition, or simply biometrics, refers to the automatic recognition of individuals based on their

physiological and/or behavioral characteristics. [17] To understand in brief, any human physiological and/or behavioral characteristic can be used as a biometric characteristic as long as it satisfies the following requirements: [18]

1. *Universality: ea*ch person should have the characteristic. *2) Distinctiveness:* any two persons should be sufficiently different in terms of the characteristic *3) Permanence:* the characteristic should be sufficiently invariant (with respect to the matching criterion) over a period of time. *4) Collectability:* the characteristic can be measured quantitatively. *5)* ***Performance:*** refers to the achievable recognition accuracy and speed, the resources required to achieve the desired recognition accuracy and speed, as well as the operational and environmental factors that affect the accuracy and speed. *6) Acceptability:* indicates the extent to which people are willing to accept the use of a particular biometric identifier (characteristic) in their daily lives *7) Circumvention:* indicates how easily the system can be fooled using fraudulent methods.

The applications of biometrics in e-Government applications can be

1. National ID card / Voter 's Card 2) Ration Card 3) Driver's license, 4) Social security, welfare-disbursement 5) Passport control 6) Criminal investigation 7) Terrorist tracking mechanism perhaps necessitating convergence of applications.
2. The skill-sets identified as being necessary for handling programme / project level issues are Business Process Reengineering, Change Management, Financial Management and Technology Management [19]

In Andhra Pradesh the Government has started using the same database gathered in this phase to provide health insurance to citizen living below poverty line, leading to build up of an effective social security welfare disbursement for the economically backward (Citizen's Living Below Poverty Line (BPL)) and bringing in interdepartmental collaboration. [20]

The table below gives the comparisons of various biometric technologies based on the perception of the authors, High (H), Medium (M), Low (L)

(Legends used 1) Universality, 2) Distinctiveness, 3) Permanence, 4) Collectability, 5) Performance 6) Acceptability, 7) Circumvention)

Mobile Technology in Health Services

Mobile Technology could be extended for bridging the existing gap in health care services.

In the event of early diagnosis in cases of acute myocardial infarction (AMI) when patients under clinical observation in a limited trial by Wifin Technologies Pte. Ltd., with a Chennai based private hospital has proven to have improved Patient Management leading to decrease in adverse event / mortality. We envisage that in a network of community / public hospitals which can be technologically upgraded, in real time specialist advice is available in Cardiac Care. Our aim is to use a combination of teaching and decision support technology involving Cardiac Specialist to ensure that all patients with AMI and other Cardiac related ailments have the opportunity to access timely and appropriate Health Care in the Rural sector

Table 4: Perception of Various Biometric Identifiers

Biometric Identifier	1	2	3	4	5	6	7
DNA	H	H	H	L	H	L	L
Ear	M	M	H	M	M	H	L
Face	H	L	M	H	L	H	H
Facial Thermogram	H	H	L	H	M	H	L
Gait	M	L	L	H	L	H	M
Finger Printing	M	H	H	M	H	M	M
Hand Geometry	M	M	M	H	L	M	L
Hand vein	M	M	M	L	M	M	L
Keystroke	L	L	L	M	L	L	M
Odor	H	H	H	L	L	M	L
Palm print	M	H	H	M	H	H	M
Retina	H	H	M	L	H	L	L
Signature	L	L	L	H	L	H	H
Voice	M	L	L	M	L	H	H

Mobile Technology for Patient Management and Hospital preparedness

The early detection of cardiac ischemia and arrhythmia with an ability to record a professional-quality, 3-lead electrocardiogram (ECG) based on leads I, II, and V2; derive the missing leads of the standard 12-lead ECG, the patient risk factors and clinical data; different levels of alarms can be generated and forwarded along with Public electronic Health record (PHR) onto a standard Bluetooth-enabled, GPRS-compatible mobile phone as an alarm.

Smart devices together with the advances of wireless technologies such as Bluetooth, ZigBee, GPRS, or WIFI will allow the citizens to access and/or transmit their health data anywhere and anytime and to act as consumers responsible of their own health. This concept is called pervasive computing, where e-Health represents only one of the numerous application areas.

Figure 4: ECG Visualization on Mobile Phone

According to medical data Irreversible damage happens to myocardial tissues occurs at about 240 minutes from first symptom. Our aim is work on reducing the 180 min and

the 80 minutes by 50% to facilitate better patient Management

The work was initiated based on reference data in developed countries [21]

Conclusion - The Road Ahead

The Parameterization, Visibility, access to information, Right To Information (RTI Act), need for transparency leads to BPR. Technology is an enabler for Re-engineering.

- The BPR should be optimum and should be a requirement of the process but not the requirement of technology.
- BPR is not a one time activity, it is a continuous process associated with People, Process and Technologies to create efficient , effective working environment.

The finding of the measurement of Impact using GQM and BSC methods, its adaptability, the importance of BPR Strategy is depicted below to facilitate improved implementation in the of e-government application cauldron.

Note:

1. The Judicial wrangling over IPR rights between LG Electronics and 4G Systems in the award of contracts and its implementation being delayed backed with another historical event in the delay of implementation of 1000 school project and the judicial verdict coming mid school year puts a lot of strain on the stakeholders. The Court in both cases ruled in favour of the bid winners and complimented the government in ensuring transparency.
2. Newer technology intervention like mobile for health will also necessitate in future the judicial system to gear up on challenges such as non response liability claims by patients etc.

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