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Abstract
Manpower planning is complex and demanding task, because in establishing the factual insights of an enterprise, one is required to have the in-depth knowledge of forecasting manpower planning and practices, as well as the knowledge of macroeconomics of the particular business involved. Inconsistency information and lack of knowledge during decision-making process could generate to inaccurate decision. In addition, massive amount of information in unstructured forms need to be managed into a systematic manner. The aim of this research is to develop a generic ontology-based architecture for supporting manpower planning and proves the effectiveness of integrating information extraction from diverse source in supporting information for manpower forecasting. Ontology is built to capture and structure domain expert knowledge based on criteria and preferences for selecting manpower forecasting adjustment. Currently, the framework is under implementation as a research prototype.

Keywords
Decision support System, Ontology, Manpower planning, Labour Supply, Labour demand

1. Introduction
Manpower planning must be developed to identify the mismatch between manpower in supply and demand (Borghans & Heijke, 1996; Cörvers & Heijke, 2003). The basic rationale for making manpower planning forecasts is the long gestation lags in the production of skilled professional people. Manpower forecasts facilitate planning of education/training is the effort to ensure that manpower required and job opportunities are available at the time when they are needed (Borghans & Heijke, 1996). This is important especially for development country.

Manpower planning as part of human resource decision making process is complex and demanding task, because in establishing the factual insights of an enterprise, one is required to have the in-depth knowledge of forecasting manpower planning and practices, as well as the knowledge of macroeconomics of the particular business involved. However, with global interconnectivity, we need to deal with more heterogeneous unstructured resources consisting of a variety of digital data and stored in thousands of autonomous repositories. Large amount of unstructured information is much benefited for organizations if they are able to analyzed and used 80% of their unstructured resources especially to support decision-making process (Froelich & Ananyan, 2008).

The need to extract information on policies and macroeconomics to structure data and machine readable formats becomes more apparent as the volume of data and human-centered information accessible to decision makers continues to increase at rapid rate (Gottgtroy, Kasabov, MacDonell, & Elie, 2006; Gregg, 2008; Mohemad, Hamdan, Othman, & Noor, 2011). Furthermore the current challenges in manpower planning need the domain experts to extract the information manually from unstructured text as one of the resources (Park, Byrd, & Boguraev, 2003). Analyzing market and policy documents is complicated and demanding task which requires in depth knowledge of domain experts in macroeconomic and manpower planning. This includes knowledge relating to macro-industry indicators, labour supply, labour demand and current economic business operations. Based on that research on automated development of ontology from texts (Agichtein, 2005; Lee, Kao, Kuo, & Wang, 2007) has become increasingly important because manual construction of ontology is labor intensive and costly. Inconsistency information and lack of knowledge during decision-making process could generate to inaccurate decision.

Data availability for manpower planning is poor at the national level in developing countries (Hopkins, 2000). The data produced by existing human resource (HR) information systems is in electronic formats, however to retrieve and utilize data for decision making significant limitations still exist, where information required, lack of consistency, and not expressed in a general way for sharing between systems. One of the reason is because of the heterogeneity in the way of structuring and interpreting information causes conflicts, and makes it difficult to retrieve information from different sources (Pierra, 2003). Confusion about terminology is likely to happen and semantic integration of information does not exist: Furthermore, there are no standard understanding on the structure of knowledge for a domain for certain term in human resource (Marinoni, et al., 2007; Wache, 2004).

Traditional decision-making approach to determine the suitable scenario to do adjustment on manpower forecasting is depends on the judgments and past experiences of domain expert. Decisions behaviour can be improve depends on the capability of decision makers to use all the available and significant information (Djamasbi, 2007). However, decision-making process tends to be complex with the existence numerous of unstructured and ill-defined information. Lack of information and inability to process various capacity of information resulted organizations often consider wrong decision support solutions for their particular problem (Zack, 2007). Thus, the need to identify and organize information in terms of its content and providing semantic meaning by defining the properties of content is important to understand uncertain information in complex situation.

Ontology are being developed to facilitate knowledge sharing, representing domain knowledge in a meaningful way and reuse where formal implies that the ontology should be machine-readable and shared that it is accepted by a group or community (Gómez-Pérez, Ramírez, &

Villazón-Terrazas, 2007). Ontology-based method is a new and promising approach to manage knowledge in HR, integrate multiple data resources, and facilitate the consideration of the complex relations among concepts and slots in decision making (Chang & Terpenny, 2009). Several applications of human resource ontology (HR-ontology) have been created a by integrating some existing widespread standards and classifications (Popescu & Popescu, 2010). However, to the best of our knowledge there is no development of domain ontology for storing semantic knowledge in order to solve manpower planning at macro level. This study presents a generic ontology-based architecture to assist decision-making process by modeling domain expert knowledge and preferences demand on manpower planning generally and supporting manpower forecasting adjustment at macro level specifically. Further, appropriate inference rules are generated to represent operational knowledge of particular criteria. The reasoning capabilities allow end users to retrieve, interpret knowledge.

The organization of this paper is as follows. Related researches on current practices in human resources or manpower planning are discussed in Section 2. Meanwhile, Section 3 presents the proposed Ontological-based extraction model for supporting manpower forecasting. . Discussion of the proposed researched is detailed out in Section 4. Finally, Section 5 concludes with a summary of this paper.

2. Related Works

Knowledge based automation in the domain of human resource (HR) faces some particularly daunting challenges. Information technology scientists and practitioners involved in the HR domain have to quantify and qualify the common knowledge that underlies meaningful conversations about human resources. Various standardisation efforts also support capturing the combination of tasks and responsibilities that make up a typical job description or job vacancy. The examples of existing ontology in HR has been built as : ProPer Ontology (Hepp, Bachlechner, & Siorpaes, 2006) on skills management, KOWIEN Ontology (Dittmann & Zelewski, 2004) on competence and skills management, LIP Ontology (Schmidt, 2008) on-demand learning support, TOVE (TOronto Virtual Enterprise Ontologies) integrated ontologies for the modelling of commercial and public enterprises, and COKE (Gualtieri & Ruffolo, 2005) a three-level ontology containing a top-level HR ontology. In summary, there are several approaches to elaborating ontologies in the HR domain, each of them with a different focus.

2.1 Ontological-based Information Extraction

The massive amount of information available to business analysts makes information extraction (IE) and other natural language processing tools key enablers for the acquisition and use of that semantic information. Extraction and representing knowledge in structure form could perform reasoning or provide valuable information to support decision-making process. It is impractical and time consuming for decision makers to manually process the ill-defined information since the standard tools available designed for structured data analysis (Mohemad, Hamdan, Ali Othman, & Mohamad Noor, 2010). Valuable information in the knowledge based can perform reasoning or provide valuable information to decision maker. It motivates to devising an intelligent and processes this kind of information and makes them recognizable for manpower forecasts.

In order to address this issue, General Architecture for Text engineering (GATE) (Cunningham, 2002) is used to enable the ontology-based semantic annotation of documents, policy document, news, and website. Analysis of unrestricted text to extract from the text instances of concepts in the ontologies will be performs. Instances in the text are linked with concepts in the ontology. Once the information has been gathered from different sources, the ontology has to be populated with all mentions found in text refer to the same entity in the forecasting made. The semantic information from the extraction is used as valuable information for decision maker or applied to statistical models of decision making. Besides ratio analysis or trend analysis, the accuracy of projecting manpower development is dependent variable of the economic growth of particular entity. Thus, domain expert are required to verify the extraction results for perfect output and providing adjustment suggestions to identify dependent variable or support parameter adjustments.

3. Research Approach

The proposed framework of ontological-based extraction model for manpower planning is depicted in Figure 1. This framework is made up of ontological-based model, HRD-based model (Human Resources Development modelling), and ontological-based extraction model. Collection of unstructured documents, policies, market analysis and data retrieved from extraction process will be stored on database and knowledge base holds expert knowledge to support decision-making processes. It encompasses facts and rules for guiding knowledge acquisition in particular ontology domain. The ontology will be used to do interpretation and information extract from document resources for the development of its knowledge structure. The knowledge produced from ontology will be used as an input to HRD-based Model. The model base module is the core of the system; it consists of Labour supply, Labour demand, balancing of labour supply and labour demand (HBFand system control of input and outputs (HSC).

3.1 HRD-based Model

HRD-based model consists of Labour Supply Model, Labour Demand Model, HRD System Control (HSC), HDF Balancing Facility (HBF) and link with market and policy. The details of HRD-based model for manpower planning illustrated as in Figure 2. Labour Supply Model consists of three components, (i) A demographic model (HDM), is used to project the population by age group and gender, (ii) An educational attainment model (HEM), is used to project the labour force by educational attainment and (iii) an occupational supply model (HOSM). HOSM converts the projection from HEM of the labour force by educational attainment to a projection of the labour force by occupation. Meanwhile Forecast Labour Demand Model consists of two components: (i) Macro-models (HMM) are used to project labour demand by industries, following the industry classification used in the national accounts and later will constructed to initially project labour demand by industries, and (ii) Occupational demand model (HODM) is used to convert the forecasts of labour demand by industry to labour demand by occupation.

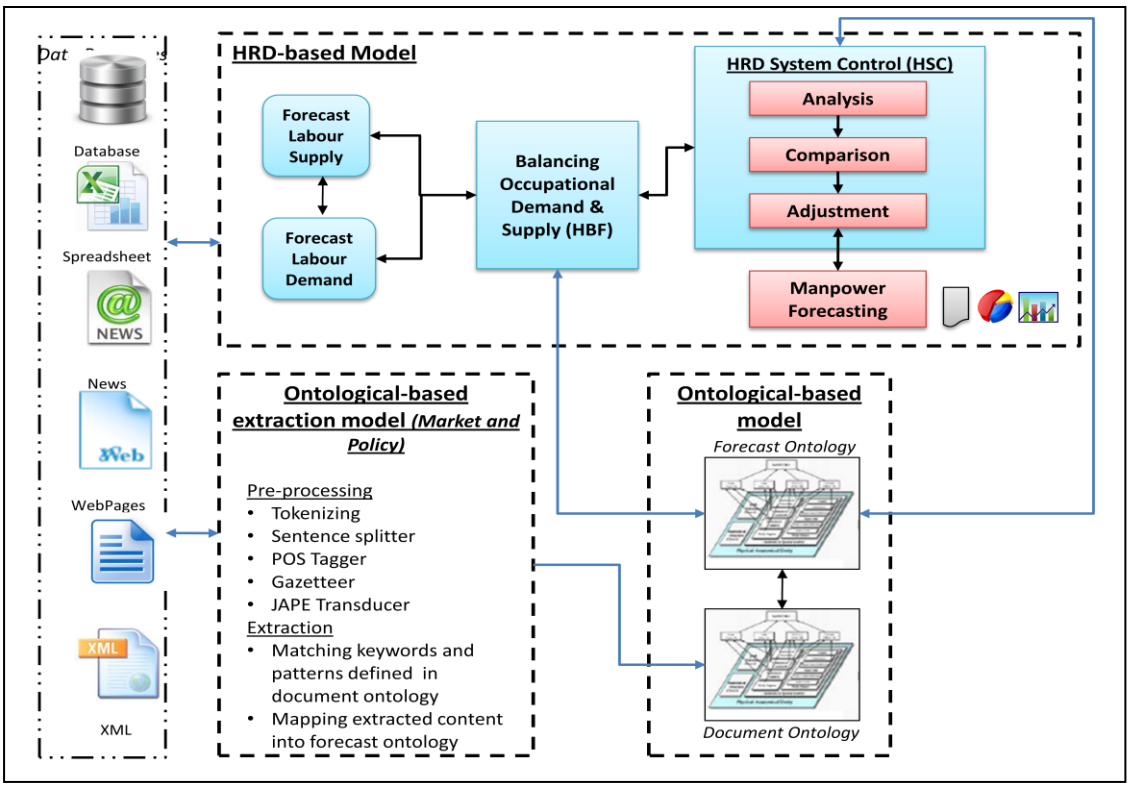

Figure 1: Proposed framework of ontological-based extraction model for manpower planning

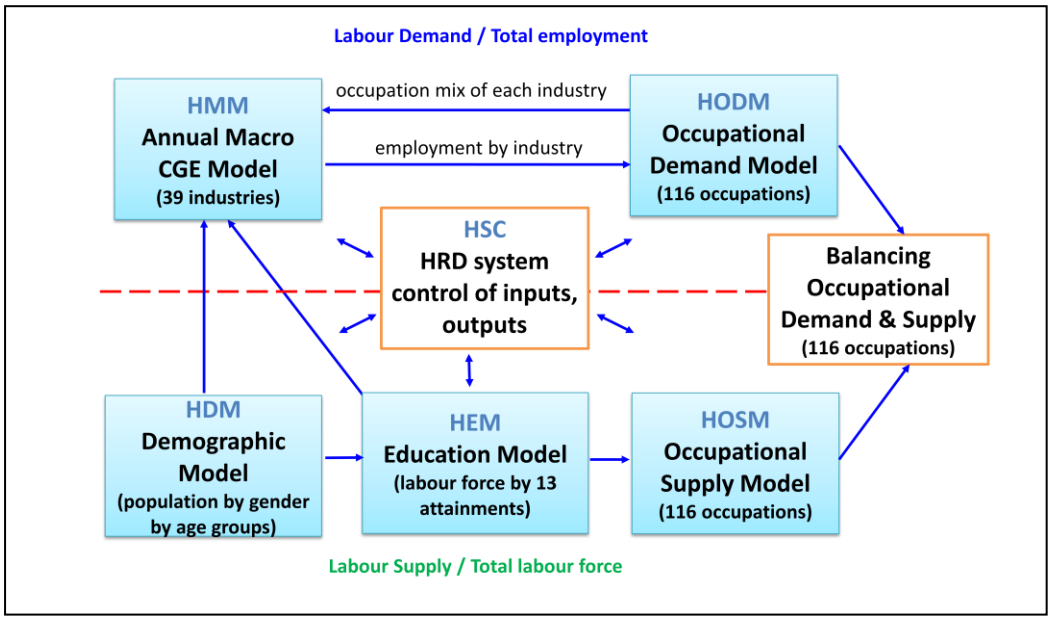

Figure 2: HRD-based model for manpower planning

The final step in the HRD-based model System is the HRD Balancing Facility (HBF). The HBF takes the labour demand and supply predictions from the HODM and HOSM models

respectively and identifies any structural shortages and surpluses for labour markets in Malaysia. Figure 1 also shows the HRD system control (HSC). It is in this model control centre where scenario inputs are provided to the five models and scenario outputs are collected from the ontology. The HSC is where this study will can first introduce and examine the effects of alternative policies. The HSC then collects the results for these alternative policy scenarios and compares them with the baseline scenario.

3.2 Ontological-based Model

In this research, the ontology will be used to demonstrate the analysis of the domain knowledge and the development of its knowledge structure from the output from HRD-based model and to store semantic knowledge on the structure of construction market and policy document domain based on domain expert knowledge. It also models the keywords as the main sources to extract relevant information. The development of domain knowledge for supply ontology and demand ontology will be use Topbraid. An ontology model containing relationships between inputs of forecast supply model depicted in Figure 3.

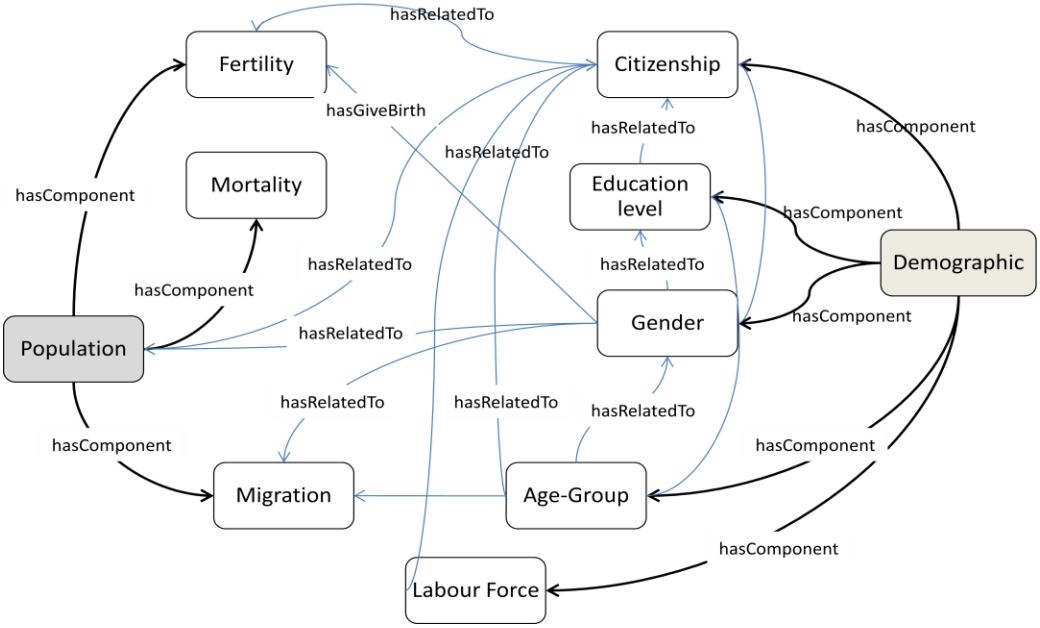

Figure 3: An ontology model of labour supply model

4. Discussions

Information system and technology are integral part of organizational decision-making and management processes. Managers are constantly required to make critical technical and business decisions in order to improve their organizational processes. Efficient and effective decisions are largely supported with sufficient and relevant rich data. However, unstructured documents either in hard copy or digital forms could not be disregarded in daily business

processes. The use of free textual documents remain important for auditing, authentication and recording purposes even though there is an effort to integrate and transform the whole traditional paper-based into electronic or digital form by using Web-based technology. It is necessary to have a mechanism to automate analysis of unstructured information and transform them into structured forms to improve decision-making processes. Thus, an ontological-based extraction for manpower planning has been proposed in this research.

The ontological-based extraction model is constructed based on framework in which it concentrates on ontology modeling, information extraction and forecasting model. The enrichment of information extraction certainly has lead to the use of ontology as the guide to identify and extract relevant parts from textual documents. Ontology structures and represents expert knowledge into machine readable format for a particular domain. Meanwhile HSC model is applied to formulate an adjustment to manpower forecasting based on information provided by domain expert or decision maker.

The implementation of framework for ontological-based extraction for manpower forecast is based on manpower planning at macro level or National level. The role of this prototype is used to assist manpower planner or other chief decision makers in selecting the adjustment figure suggested in forecast manpower balancing based on the information extracted from relevant document. There are only a few application domain ontology of supply and demand chain on product has been constructed as proposed by Chandra and Tumanyan (Chandra & Tumanyan, 2004) and Grubic and Fun (Grubic & Fan, 2010). However, they are not designed specifically for storing knowledge on supply and demand of manpower at National level.

5. Conclusion

The successful forecasting of the required human capital is heavily impacted by making the right decision during projected/targeted growth of future business development or even at the national macro level manpower planning. Managing manpower is very complex and uncertain involving coordination of business analysts to gather, merge, and analyse considerable amounts of information in multiple formats and from heterogeneous sources. Typical manpower planning helps decision makers by providing possible suggestions for decision-making according to the analysis of quantitative data on several criteria for specific problem. Current existing manpower forecasts focus on quantitative data processing where the systems specifically analyse accurate values. However, quantitative system could not directly study exact problem structure from text. Ontological-based approach is employed to personalize balancing criteria is expected to improve degree of automation in balancing process where decision makers do not have to screening policy and economic information manually in order to identify relevant information for decision analysis. The need for automated computerized tool is paramount with respect to improve decision-making processes. Ontological-based extraction for manpower planning is expected to automate process in acquiring relevant information for making decision.

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