Competency-Graph Based Elearning Content Development For Halal Quality Control

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Abstract: Processing and the production of the food and dairy products is one of the most critical industrial sectors because of its direct effect on human health. On the other hand, echo-ethical concepts such as Kosher, Vegetarian and Halal terms are becoming more popular for certain communities.

The concept of Halal on food production and its importance for Muslim communities makes it a great business opportunity in all around the world with its potential of exceeding 500 billion USD. Generating standards for Halal Quality and transforming the religious rules in today's industry and implementing the Halal concept on food production with well-documented procedures require the combination of various knowledge with systems engineering practices. More effective and efficient ways have to be also developed to disseminate this knowledge. Since a universal set of standards for Certification of Halal is not established yet, Halal Accreditation Agencies in different parts of the world follow various standards to their best. This paper suggests an approach to develop elearning content in order to facilitate the training for Halal Quality Control and Certification practices. It is based on the establishment of competency-graphs according to the standards set in general guidelines of Codex Alimentarius Commission, Malaysian and Bosnian (CACMB) Standards. The suggested competency-graphs in this paper may be used as a model for designing an elearning platform in training all related parties before and during the Halal quality control and certification processes.

Key Words: Elearning, Competency-graphs, Halal Certification, Halal Standards.

Introduction

Nowadays, the meat trade is growing and passing country boundaries in a magnitude never seen before. Several issues that are always cited as the enablers of this growth are: 'super-production' by a few large exporting countries; the increase of disposable income in most importing countries; and the gradual lowering of trade barriers in many parts of the world. From 1961 to 2007, total global meat output rose from 71 million MT to about 283 million MT and the global meat trade jumped from only 3.5 million MT to 22 million MT. Poultry meat is still the largest type of traded meat. As a percentage of the total global meat production, global meat trade increased from 4.9 per cent in 1961 to 7.8 per cent in 2007 (Irfan Sungkar, 2009). Halal meat products and their use in other products have become the major driving force for global Halal trade. Due to globalization, more and more trade occurs between countries with different religious backgrounds. The existence of different communities and importance of so-called echo-ethical products such as Kosher and Halal as a major buying decision makes the Halal industry an important sector in all around the world depending on the demand in each particular region. On the other hand, the swell in demand for Halal products has given rise to fraud, where companies and exporters are labeling foods as Halal, when, in fact, this is not the case. One of the major concerns in the food market for Muslim communities is the pork which is prohibited in Islamic tradition. Due to the fact that productivity and relatively easier breeding of animal pigs producers may tend to blend meat products from these animals into other products usually improper labeling. The detection of the frauds at certain times and geographical locations make the Muslim consumers insist that the food industry comply with Halal standards during manufacturing, processing and packaging of foods.

In this new century, the food supply chain has become more complex and it involves a lot more additional processes. It is even more important now than before to ensure safety of the products manufactured, and this is done via standards and regulations imposed on food manufacturers. Although it may be interpreted as a trade barrier, at the end of the day, it is essential for food manufacturers/ exporters to gain consumers' satisfaction and trust. Most of the countries usually have strict regulations regarding especially meat and its derivatives. The BSE or Mad Cow Disease crisis and other food crises within the European Union (EU) proved that it is very important that at all times the origin of food products can be traced. The new regulations also include provisions for the traceability of food in the food chain (Irfan Sungkar, 2009). The requirements apply to food and feed businesses located in the EU (including importers). They are obliged to:

a) Know and document from whom they have bought their food (ingredients)
b) Know and document to whom they supply their products
c) Label their products so that they can establish traceability in case of a food safety problem

All these requirements regarding the food safety regulations set by authorities and demand by the communities need a systems engineering approach to the problem of Halal Certification. A Halal certificate is a document issued by an organization (known as certification agency) certifying that the products listed on it meet Islamic dietary guidelines, as defined by that certifying agency. Halal Certification practices similar to the other practices such as ISO and HACCP involve training of the stakeholders in the food production chain. External accountability principles require an external body which does not have an affiliation or interest in the company for certifying the compliance. It involves experts knowledgeble in food chain analysis. Furthermore, a religious authority is needed and often it is also separate from this expert body. Certification may be based on the compliance for the manufacturing site or specifically for certain products in the production chain. Duration of certificate depends on the manufacturing and product types.

Complexity of certification may be overcome by training people in the food chain. Training is usually the most cumbersome part of the process and training needs may change from one agency to another. Competency-graphs were developed herein to model and achieve the knowledge management regarding the training needs related to the whole certification process. For Halal Quality Certification, general guidelines of Codex Alimentarius Commission (GL 24-19971), Malaysian Standards (MS 1500 2004) and Bosnian Standards (BAS 1049-2007) were taken as basis for constructing the whole model which will be named throughout this paper as CACMB. The paper briefly describes the competency graphs known also as Conceptual Prerequisite Maps (CPM) and then outlines the competency graphs for a Halal Certification Processes. It also gives an example knowledge pathway through the competency graph for training in a sample domain within Halal Certification chain.

Conceptual Prerequisite Maps (CPM) or Competency Graphs

Throughout the later part of the twentieth century, significant research efforts have been devoted into the area of intelligent tutoring system. While small-scale implementations of various systems have achieved successes, no system to-date has been able to achieve large-scale deployment. While the advance of networking and hypertext technologies in recent decades have seemingly introduced new hopes and promises, developments and advances in computer assisted learning have been weighted heavily on content management, organization and standardization. Competency graphs were suggested to answer some of the challenges encountered by developers of intelligence tutoring systems (Louis Shun, Vincent Ng). To allow intuitive creation of concepts by subject matter experts, and to ensure maximum adaptability of the algorithms to be investigated, a competency graph may be utilized to model knowledge base on a basic form as directed acyclic graphs (DAG) named *Conceptual Prerequisite Maps (CPM)*. Only two elements are presented in a CPM. The nodes of the CPM represent knowledge or concepts, while the arcs present "is prerequisite of" relations of one concept to another. The formal definition of a CPM is as follows ((Louis Shun, Vincent Ng):

A Conceptual Prerequisite Map (CPM) or Competency Graph (CG) is a directed acyclic graph (DAG) represented as $G(C,P,f)$ where C is a set of concepts represented as vertices, P a set of "is prerequisite of" relationships represented as edges, and f being an ordered mapping $f: P \rightarrow C \times C$. Figure 1 shows an example CPM with 10 concepts in the knowledge domain.
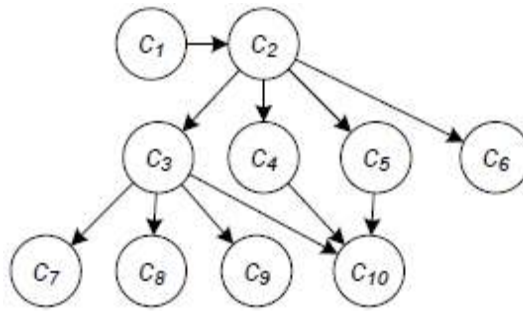
Figure 1. CPM of 10 concepts

All the competencies are represented as nodes in the graph and the dependencies between them are identified and specified. CPM can be used to model a learner's level of mastery of the concepts in a specific knowledge domain. Some measurements may be associated with individual concepts representing the learner's level of competency in the domain. With the expansion and abundance of information, it is important to model and to analyze knowledge in an organizational level. The availability of an organizational knowledge model would allow an organization to specify organizational needs of knowledge related to its essential operations in a more systematic way.

Competency Graphs for Knowledge Management in Halal Quality Control

Conceptual Prerequisite Maps or Competency Graphs are suggested herein for modeling knowledge, content, learners' as well as organizational knowledge needs for Halal Quality Control process. Figure 2 shows the competency graph developed for the certification process. There are three different symbols used in the graph. Conceptual knowledge shown by ellipses represents the theoretical knowledge, general understanding of a concept (see the 'Halal Quality Control H1000'). Procedural knowledge is shown by boxes and means practical knowledge of the way a procedure is performed. It may be also defined an activity or set of activities to perform (see the 'Evaluation of Products P1000'). External knowledge is the knowledge that should be known and being available externally (see the 'Islamic Concepts C1000'). The direction of arrows shows the prerequisite relationship between two entities. In the competency graph given, the concept H1000 requires the P1000 and P1100 whereas P1000 and P1100 are required by H1000. The external entity C1000 (Islamic Concepts) is required by both 'Audit Team P1500' and 'Education Team P2100'. Individual competency cards are developed for all these three items namely conceptual knowledge, procedural knowledge (aka actvities), and external knowledge.
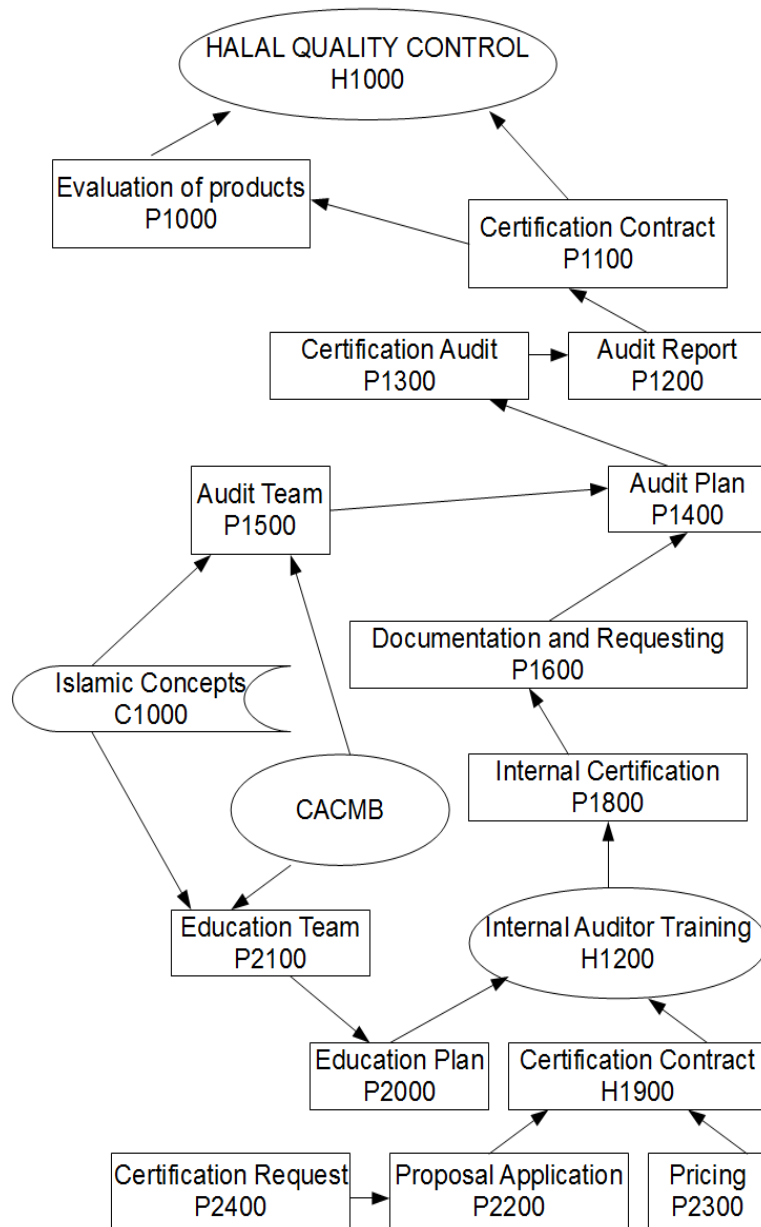
Figure 2. Competency Graph for Halal Certification Process

Competency Name	Evaluation of products
Competency Code	P1000
Description	This competency constitutes the knowledge of the announced and unannounced occasional inspections to Applicant Company and analysis of company's random samples from the market.
Competency Type	Activity
Required by Competencies	H1000
Requires Competencies	P1100
Explanatory Supplements	Refer to CACMB, Procedure for Halal Quality Certification, Section heading *Evaluation of product validity*.

Figure 3. Competency Card for Evaluation of Products (P1000)

The competency cards may be utilized to quickly refer to the related competency (see Figure 3). Each competency card has the description fields as Competency Name, Competency Code, Description, Competency Type, Required by Competencies, Requires Competencies, and Explanatory Supplements. The competency card in Figure 3 is related to the activity 'Evaluation of products P1000'.

Furthermore, a competency table is developed as in Table 1. The competency table includes 14 Activities, 3 Conceptual Knowledge Maps, and 1 External Knowledge Map.

Knowledge Pathways in Competency Graphs

Competency Graphs provide the designers of elearning system developers with the knowledge paths which are useful for conditional activities style of learning resources. Competency graphs are used for developing the knowledge pathways. Any branch of three elements (activity, knowledge and external entity) in a competency graph may be starting point depending on the learning needs of the required user. The following section gives a brief case study as an example to the knowledge pathway required for a Halal Expert.

Case Study: Knowledge Pathway for Halal Expert

We assume a case herein where Certification authority wants to expand the number of Halal Experts and Official Auditors to rapidly satisfy increasing Halal Certification demand in the region. Authority receives some applications and makes a selection among the candidates. 30 candidates are elected for the position. Before they start working they must be trained and given the concept of Halal Quality Control. The competency graph given in Figure 2 is utilized for this purpose.

To implement the idea of creating the knowledge path, the related branches first need to be identified in the competency graph. Halal Experts can play two roles in the certification process. They may be either a member of education team (P2100) or audit team (P1500). We see that for a person in both positions, the knowledge of CACMB (H1100) and Islamic Concepts (C1000) competencies are required (see Figure 2). Starting with H1100 which is the CACMB standards for Halal certification, the Halal expert requires knowledge of certain competeny paths based on the competency graphs developed for CACMB (H1100). A competency graph was also developed for this project. However, due to the space constraint in this paper, only related parts in the competency graph of H1100 is given.

Name	Code	Type	Required By	Requires
Halal Quality Control	H1000	Knowledge	P1000	P1100
Evaluation of products	P1000	Activity	H1000	P1100
Contract of Certification and Trademark use	P1100	Activity	H1000	P1000, P1200
Audit Report	P1200	Activity	P1100	P1300
Certification Audit	P1300	Activity	P1200	P1400
Audit Plan	P1400	Activity	P1300	P1500
Audit Team	P1500	Activity	P1400	C1000, H1100
Documentation and Requesting	P1600	Activity	P1400	P1800
Internal Auditor Certification	P1800	Activity	P1600	P1700, H1200
Certification Contract	P1900	Activity	H1200	P2200, P2300
Education Plan	P2000	Activity	H1200	P2100
Education Team	P2100	Activity	P2000	C1000, H1100
Proposal Application	P2200	Activity	P1900	P2400
Price Orientation	P2300	Activity	P1900	
Certification Request	P2400	Activity	P2200	
Islamic Concepts	C1000	External	P2100	P1500

Internal Auditor Training	H1200	Knowledge	P1800	P1900
CACMB	H1100	Knowledge	P2100	P1500, H1110, H1120, H1130, H1140, H1150, H1160, H1170

Table 1 Competency Table for Halal Quality Control (Main Competencies)

A Halal Expert needs pathways from H1100 as Area of Implementation (H110), Reference to other standards (H1120), Terms and Definitions (H1130), Halal Food Requiements (H1140), Labeling (H1150), Halal Certificate (H1160) and Additions (H1170) to reach the overall knowledge for Halal Standards requirements and measures for Halal Quality. Terms and Definitions (H1130) require some other knowledge required namely Halal Quality (H1131), Halal Product (H1132), Haram Product (H1133), Mashbooh Product (H1134), HAS (H1135), Halal Products Administration (H1136), and HrCCP (H1137). The knowledge of Halal Food Requirements (H1140) needs the knowledge of Haram Food (H1141), Halal Food (H1142), Additional Requirements (H1143), and Halal Meat and Halal Slaughtering of Animals (H1144). Haram Food (H1141) requires the knowledge elements of Food of Animal Origin (H1145), Food of Herbal Origin (H1146), Beverages (H1147), and Additives (H1148). Additions (H1170) needs the elements Procedure for Halal Quality Certification (H1171), Rulebook on Audit for Halal Quality (H1172), Rulebook on Halal Logo of Halal Quality Appearance and Use (H1173), Rulebook on Halal Slaughtering (H1174), and Rulebook on Halal Status of Additives (H1175). So after having all the knowledge in the path, the trainee gains the competency of CACMB (H1100). The knowledge pathway to H1100 is shown in Figure 4.
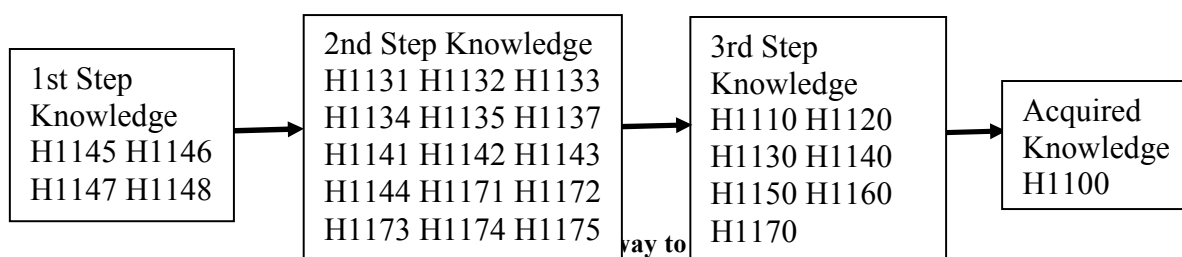
Besides the knowledge path explained, a Halal Expert candidate must also have the knowledge of Islamic concepts (C1000). This is an external knowledge requirement including religious knowledge of related verses and hadith on Halal subjects. A Halal Expert Candidate needs to acquire the knowledge of H1100 and C1000 in order to participate in an audit team or an education team. There are also some other competencies which are needed for an expert in those positions. Those are ability to prepare an audit plan P1400, education plan P2000, to train internal auditors H1200, making a certification audit P1300, and preparing an audit report P1200. Indeed rules and guidelines of these competencies are included in the CACMB (H1100) but they are changeable in respect to structure applicant organization and the type of the application itself. So they have a procedural hierarchy with a dynamic pathway. Minimum requirement for being a Halal Expert is embedded in this knowledge pathway. However, it is also recommended for Halal Expert to acquire overall competency for Halal Quality control to work with the whole Picture of Halal Concept.

Conclusions

This paper suggests an approach to develop elearning content in order to facilitate the training for Halal Quality Control and Certification practices. The approach is based on the establishment of competency-graphs according to the standards set according to combination of three standards. The suggested competency-graphs in this paper may be used as a model for designing an elearning platform in training all related parties before and during the Halal quality control and certification processes. This is a unique approach in this business which is growing very fast. Within a decade, the business volume is expected to be more than a trillion dollars worth.

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