Alternative Design Approach for Energy Management System

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Abstract: Energy Management System (EMS) is introduced in order to help the governing body and the utility itself to perform the most suitable decision making activities at the right time. Many EMS design approaches have been developed, though only focusing on each utility. This usually results in the fragmentation and in many cases, the duplication of the EMS, not being able to support ESI as a whole. This paper proposes an alternative design approach for an EMS based on the top-down approach. The national electricity industry framework has been developed using the application of balance scorecard. This is to define the overall required tasks within the ESI, which could then be assigned to different entities. Knowledge Engineering, especially the communication model, is then utilized to construct the knowledge and information exchange protocol between and within entity. Finally, the Common Information Model (CIM) can be developed for the EMS. In this paper, the Thai ESI was used as a case study. The results have shown that the alternative approach proposed in this research provides systematic framework for EMS design allowing the modification to the initial EMS when it is needed. Moreover, the approach can lead to the properly designed EMS with the convergence of data and information exchange among different entities which can then be effectively used by the governing body and regulator in decision making activities.

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1. Introduction

In country energy market sector, the electricity supply industry (ESI) act as an important part that affect the growth percentage of any countries. ESI can be defined as a group of partners whose is to responsible for generating, transmitting, distributing, selling and controlling the system from production point to their end user. Moreover, they need to track and balance the supply and demand of the electricity to ensure the stabilization and growth of the country. In general terms, the electricity industry can be separated into many functions for making electricity delivered to their customers. It starts with the production of electricity and then the transportation to distributers via transmission lines. After that the distributer delivers electricity to their end-users by using their distribution lines in each area. Moreover, the electricity supply industry (ESI) needs to be controlled by the system operator (SO) to secure the short-term balance, security and reliability of the system, and other associated services such as construction or maintenance. Therefore, the member in Electricity supply industry can separate in many groups which start with vertically integrated utilities who is the owner of generating plant and the utility on transmission and distribution network. The generating companies (gencos) which responsible for generating electricity by using generators and sell to their end- user. This also includes other services such as regulation, voltage control and energy reserve. The distribution companies (discos) which act as the owner and operator of distribution network, which sell energy to all consumer who connected to their network. Moreover, the supplier side who receive electricity from producer and distribute to the end user is call retailer who take responsible for buying electricity to wholesale market and sale to the authorize user, and Transmission companies (Transco) who send the electricity to their buyer by using very high voltage, electricity transmission lines. This refers to transportation over an interconnected network, which is shared by all end users. The transmission lines also call upon network externalities that benefit all interconnected parties by increasing reliability and security and reducing the cost of generation, which may result in the additional value of investment in grid augmentation being reduced by successive investment (Graham and Ellam, 2007). Meanwhile, they have member who control the business which are market operator (MO) which responsible for matching the bid and offer that buyers and sellers of electricity energy have submitted. The independent system operator (ISO) which defined as the operation controller who maintains the level of transportation services to ensure that the system operates constantly and maintains the electrical equilibrium, and the regulator who act as the government to ensuring the fair and efficient operation of the electricity sector and also responsible for managing the energy rule and policy of electricity market. The last member is related services of all the general features of the electricity system industry, the generation, transmission, distribution, end user supply and system operations are the most important features. However, the ESI was expanded widely and has a more complex structure of functions that can reduce the cost of investment and can give way to a number of different, and more specialized, market players. In order to have many players in the market, the ESI needs to find some more functions to reduce their risk. The functions, such as financial services, can provide benefits that offer a growing number of power exchanges between countries.

For the previous framework of ESI (Stoft, 2002; Harris, 2006), it start from the monopoly structure that buyer need to buy the electrical energy from the specific area that its generator was located, and the generator and the power line were owned by electricity producer. However, some economists in 1980 periods argue that market under electricity framework has limit the incentive to operate efficiency and encouraged unnecessary investment, and the burden cost of was pushed to their customer. Moreover, they argue that the electricity price can be lower and economic market can benefit from freeing the electricity from monopoly structure. By open the competition opportunity in ESI, the market can enhances the electricity efficiency; free the supply to select their own technology, which finally make the benefit to their customer.

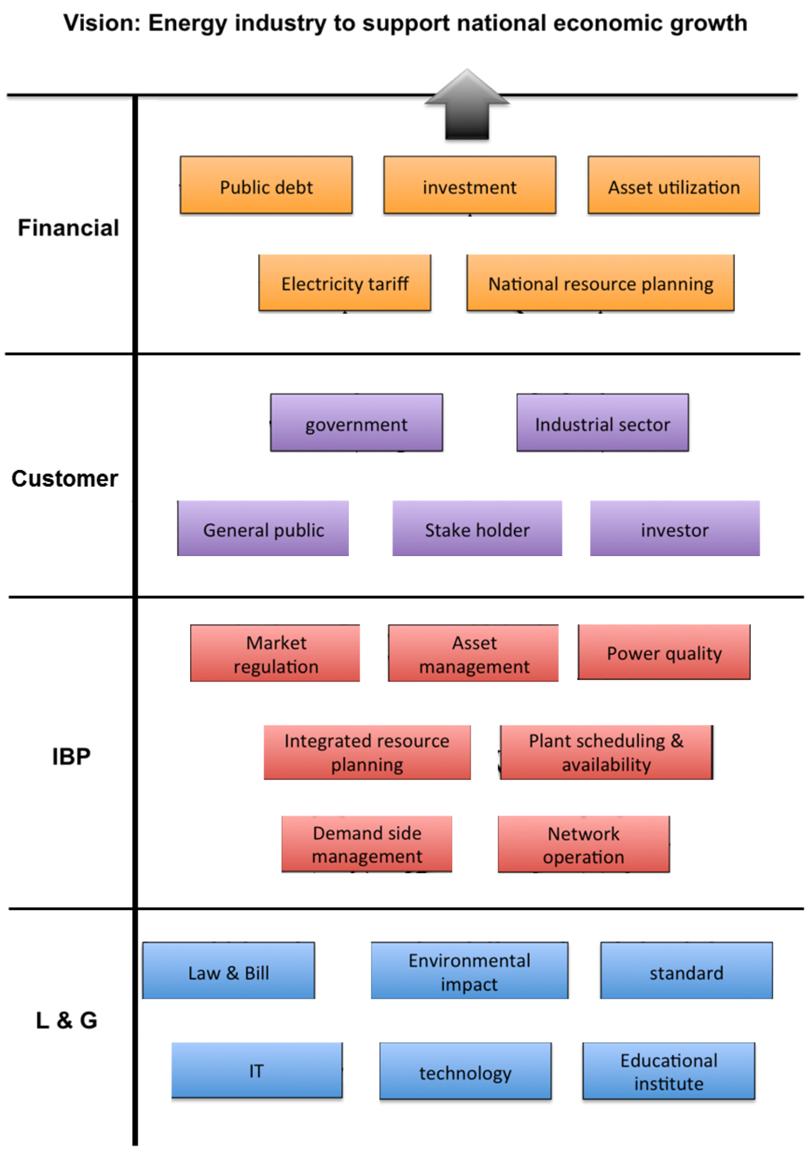

Figure 1. Shows the ideal BSC for National Electricity Framework

The ESI structure starts out as a monopoly which each utility company has its own power generation, transmission, and distribution system integrated within their organization to provide electricity to their customer in difference geographic areas. The market then opens up and private power generators called Independent Power Plant (IPP) begin to connect their capacity to the network. With this emergence, the utility company has no longer owned the whole generation capacity and needed to purchase energy from IPPs. This introduces the competition between generators that create the investment cost sharing which affect the cost of electricity. The latest structure development of the ESI is the fully competition market which the consumer are free to purchase electricity from any supplier. In this market, the retail price are no longer regulated as the consumer have their power to choose their own retailer according to the price offered and, as a results, an energy price is set though market interaction. Based on an ideal of national electricity framework in ESI, it identifies the measurement from strategic objective and task of each agent by using balance scorecard methodology.

After the ideal balance scorecard was derived, researchers use it as a starting point to identify the strategic objective, its' target and measurement indicator, and put it in OMTI table. The OMTI table also describes the responsibility of every partner who relates with national electricity framework. The result of that paper show that OMIT table can identify the responsibility of each partner on each strategic theme. Therefore, this paper has the objective to continue working on that area, which using the task and measurement indicator from OMTI table to create the task template, communication plan, and communication worksheet CM-1 and CM-2 to identify the information transaction between two agents in Electricity Supply Industry (ESI).

Knowledge Engineering Aproach for Ems Design

In the Electricity Supply Industry (ESI), the data the decision makers use to support their decision comes from many sources, in different formats and at different times, so people have to focus research on the power system exchange data to help decision makers. In order to manage the task and information that transfer between each task and agents, this paper refer to the use of knowledge engineering methodology concept that showed below. The commonKADS model was established under the objective of capturing the knowledge from experts while they perform their work and transforming it into the computerized database, which general people could understand. In order to capture the knowledge from one task, commonKADS has been separated into two main parts. These are, task templates used to classify the characteristic of the task, and communication models, which are used to identify the information transaction between any agents who are involved in the task (Schreiber, 2000; Gobin, 2012; Sutton, 2009). To make business successful, many organizations manage their strategy by using many techniques such as balance scorecards, which identify the organizations strategic approach and its attributes related to four main factors, finance, customers, internal business processes and learning and growth. The balance scorecards can also present the key performance indicator (KPI) of each attributes that affects the way organizations complete their strategic objective. However, balance scorecards only present the relationship of each factor and do not include the internal communications in terms of the transferring knowledge within organization. Therefore people, adopt Knowledge Engineering, involving the science of knowledge capture processing, and will bring the Common KADS theory using Knowledge Engineering, from time to time. Common KADS Theory can be explained as the process of capturing, extracting or mining of the hidden techniques of specialists or expert parties to create a human knowledge model. Then, the overall solutions that have been gathered from the experts will be analyzed and presented in the way of a general concept that ordinary people can understand. The CommonKADS is concerned with answering three questions, which are: (Annica & Hook, 1993; Adrian, 2011).

- Why?: It is used to understand the organization context and its environment to answer the question like "Why Knowledge systems help to create the greater solution"? Or "Which organization impact does it have"?
- What?: It provides answers for selecting the structure of knowledge and communication involved in the task.
- How?: It presents the way to transform knowledge to a computerized system model.

The three questions above are used to develop aspect models, which are shown in the figure below:

From Figures 1 and 2, CommonKADS can present the model divided into six types (Giuseppe and Scarpetta, 2000):

- Organization model: it presents the organization features to discover the problems, opportunities and impact on the organization of intended knowledge actions.
- Task model: it presents the characteristic of the task layout for input, processing and output task, as well as needed resources and competences.
- Agent model: it presents the characteristics of any elements that participate within the task. Agents can be a human, information systems or any entity.

- Knowledge model: its purpose is to the detail the type and structure of the knowledge used in performing a task.
- Communication model: it shows the model of communication transactions of every agent involved in the task.
- Design model: it uses the implementation of every model above as a requirement in order to create the technical system specification in terms of architecture, implementation platforms, software modules, representational constructs and computational mechanisms.

This research focuses on the two main parts for the model, which are the “Knowledge Model” and “Communication Model”. Knowledge models specify the knowledge and reasoning requirement of the perspective system, and communication models specify the needs and desires with respect to the interface with other agents.

In order to classify and transform the knowledge into a computerized model, the knowledge engineer (KE) mostly uses general models—to describe the characteristic of the task, called “Task templates” (Annika and Hook, 1993). It is defined as the common type of a reusable combination of model elements, and is uses the KE for solving problems of a particular type. Moreover, the task template specifies a typical domain schematic that would be required from the task point of view. Task templates can be separated into two main groups of task, not only the analytical tasks that are used to classify the object of any task type, but also the synthetic tasks that show the design of a system task to be constructed for some physical artifact. For analysis tasks, the characteristics of each type can be seen in the Table 1.

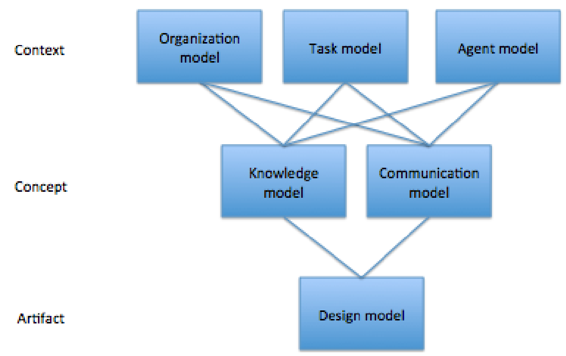

Figure 2. Schematic diagram of the CommonKADS model suit

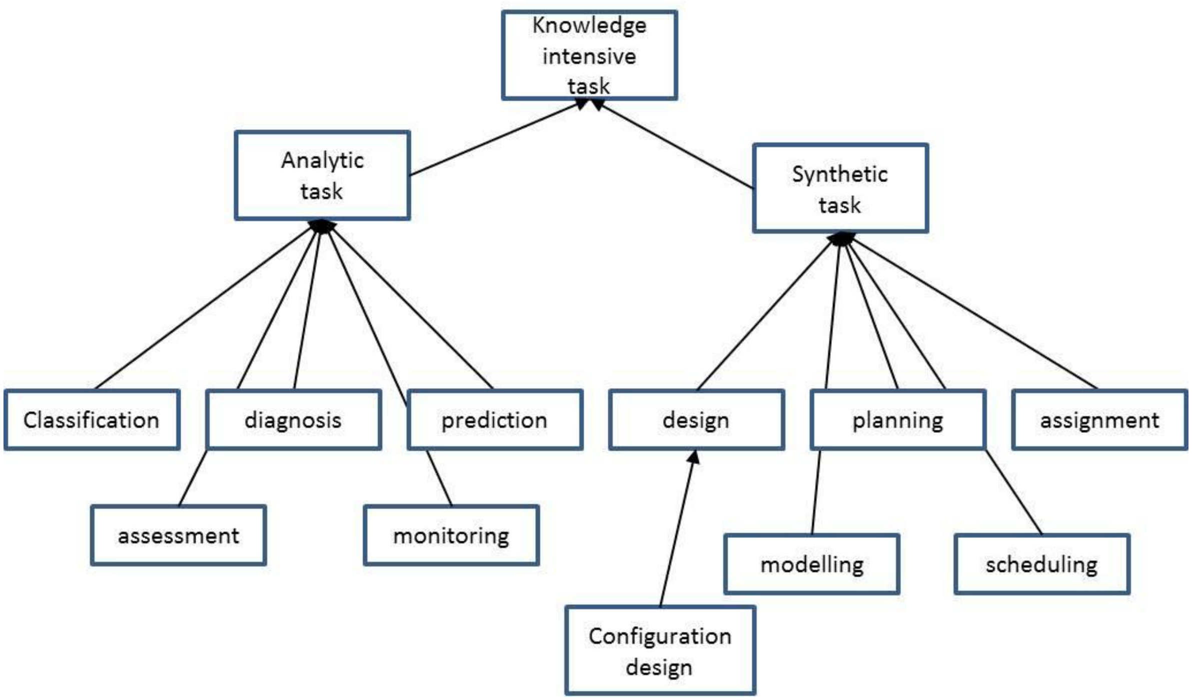

Figure 3: Schematic diagram of hierarchy of knowledge-intensive task types based on the type of problem being solve

Table 1. Overview of analytic task type

Task type	input	output	knowledge	features
analysis	System observations	System characterization	System model	System description is given
Classification	Object features	Object class	Feature-class assisocations	Set of classes is predefined
Diagnosis	Synptoms/ complaints	Fault category	Model of system behavior	From output varies (causal chain, stat, component) and depends on use made of it (troubleshooting)
Assessment	Case description	Decision class	Criteria, norms	Assess,emt is performed at one particular point in time (cf. monitoring)
Monitoring	System data	Discrepency class	Normal system behavior	System changes over time task is carried out sepeatedly
Prediction	System data	System state	Model of system behavior	Output state is a system descriptio at some future point in time

Table 2. Overview of syntetic task type

Task type	input	output	knowledge	Feature
synthesis	Requirement	System structure	Element, constraints, preferences	System description need to be generate.
Design	Requirement	Artifact description	Components, constraints, preferences	May include creative design of components.
Configurati on design	Requirement	Artifact description	Components, skeletal designs, constraints, preferences	Subtype of design in which all components are predefined.
Assignment	Two object aets, requirement	Mapping set 1 to set 2	constraints, preferences	Mapping need not be one-to-one
planning	Goals, requirement	Action plan	actions constraints, preferences	Actions are (partially) ordered in time
Scheduling	Job activities, resources, time slot, requirement	Schedule = activities allocate to tome slots of resources	constraints, preferences	Time-oriented character distinguishes it from assignment.
modelling	Requirement	model	Model element, Template models, constraints, preferences	May include creative "synthesis".

Meanwhile, synthesis tasks also contain many task types. The first task is the *design* task type that constructs some physical artifact, and generally includes the creative designs of components. The next task type is *assignment*, which is consistent with constraints as well as conforming to preferences. *Planning* task type is similar with design but the main difference is the system being constructed and that it is concerned with activities and their time dependencies. Next is the *scheduling* task type, which is used to allocate the activities of resources during certain time intervals, and focuses on the time-oriented character of scheduling. The last task type, *synthesis* task, is modeling that constructs an abstract description of a system in order to explain or predict certain system properties or phenomena. The characteristics of synthesis tasks are shown in the Tables 2-4. The above table shows the characteristics of each task type in the analytical task (Siorpaes, 2010; Muhammad, 2013). The first one is the well-known analytical task type *Classification* that characterizes the object in terms of class, and each class has constraints on the values of the object features. The *Diagnosis* is different from classification because its underlying knowledge typically contains knowledge about system behavior, and its output can take in many forms, such as faulty components, a faulty state or a causal chain. The next task type is *Assessment*, which is often found in the financial and community service domain. It is used to characterize a case in terms of a decision class. For the *monitoring* task type, it looks similar to the assessment task but the main difference is that the output is simply a discrepancy instead of a decision class. The last task type of *analytic* tasks is a *prediction*, which presents the system behavior to construct a description of the system state at some future point in time. This task is often found in knowledge-intensive modules of teaching systems. After completing the design of the knowledge model, concerns turn to the other important model, the “Communication model”, which is used to specify the information exchange producers use to realize the knowledge transfer between agents. The overview of a communication model and the relationship with other CommonKADS models can be seen in the Figure 4.

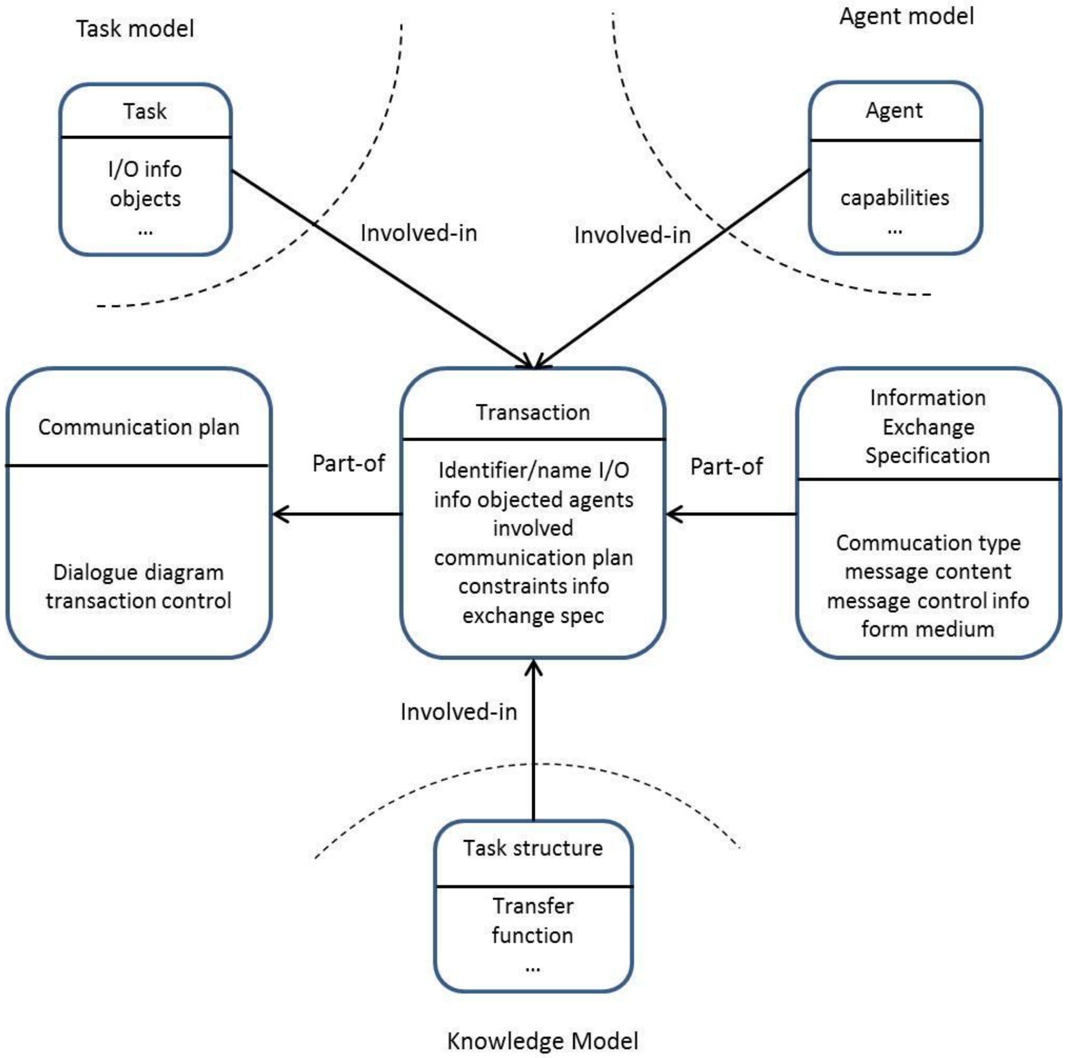

Figure 4. The overview of the communication model and how it relates to the other CommonKADS models

Table 3. Worksheet cm-1

Communication model	Transaction description worksheet CM-1
Transaction identifier/name	A transaction is to be defined for each information object that is output from some leaf task in the task model or in the knowledge model, and that must be communicated to another agent for use in its own tasks. The name must reflect, in a user-understandeble way, what is doe with this information object by the transaction. In addition to the name, give a brief explanation here of the purpose of the transaction.
Information object	Indicate the (core) information object, and between which two task it is to be transmitted.
Agents involved	Indicate the agent that is sender of the information boject, and the agent that is receiving it.
Communication plan	Indicate the comunication plan of whichthis transaction is a component.
Constraints	Specify the requirements and (pre)conditions that must be fulfilled so that the transaction can be carried out. Sometime, it is also useful to state post conditions that are assumed to be valid after the transaction.
Information Exchange specification	Transactions can have an internal structure, in that they consist of several messages of different type, and/or handle additional supporting information objects such as explanation or help items, this is aetailed in worksheet CM-2. at the point, only reference or pointer needs to be given to a later info exchange spec.

Table 4. Worksheet cm-2

Communication model	Information Exchange Specification worksheet CM-2
Transaction	Give the transaction identifier and the name of which this information exchange specification is a part
Agents involved	1. Sender: agent sending the information item 2. Receiver: agent receiving the information item
Information item	List all information items that are to be transmitted in this transaction. This includes the ('core') information object the transfer of which is the purpose of the transaction. However, it may contain other, supporting, information items, that, for example, provide help or explanation. For each information item, describe the following: 1. Role: weather it is a core object, or a support item 2. Form: the syntactic form in which it transmitted to another agent, e.g., data string canned text, a certain type of diagram, 2D or 3D plot. 3. Medium: the medium through which it is handled in the agent-agent interaction, e.g., a pop-up window
Message specifications	Describe all message that make up the transaction. For each individual message describe: 1. Communication type: the communication type of the message describing its intention. 2. Content: the statement or proposition contained in the message 3. Reference: in certain cases, it may be useful to add a reference to, for example. What domain knowledge model or agent capability is requiref to be able to send or process the message.
Control over message	Give, if necessary, a control specification over the message within the transaction. This can be done in pseudo code format or in a state transition diagram. Similar to how the control over transaction within the communication plan is specified.

After *C. Applied Communication Model ensue in BSC for ESI*

Figure 4 shows the key that every agent uses for describing a communication act, which is called a *transaction* and it uses this to tell the information objects exchanged between the agent and the task. Transactions present the building blocks for the full dialogue between two agents and predefine the communication type and pattern. The transaction can describe the communication plan by using a computerized system form such as a UML diagram. This diagram can identify the elements of each task from the first to the last step. Moreover, Knowledge Engineering describes the transaction by using the transaction description (worksheet CM-1), shown in the table below, specifying the transaction name, objective, agent involved, communication plan name and the constraints of each transaction (McMorran, 2007; Schwarz, 2004; Batarseh, 2009; Monica, 2005). Meanwhile, each transaction description also uses information exchange specification (worksheet CM-2). In this worksheet is seen the transaction name and agent involved, identifying the sender and receiver of this transaction. Moreover, it also describes the information item that classifies the layer of each part of the information, separating core and support information, and the message specification, which describes the communication message type that makes up the transaction of each individual message. In order to analyses the responsibility area and the information possess by one agent, the worksheet CM-1 and CM-2 have been used to identify the information description and agent involve of each task. The result for applying the CM-1 and CM-2 is show in the case study in part IV.

3. Common Information Modeling (Cim) Design for Ems

The Energy Management System (EMS) was an important tool used in the electricity market because it obtained data and used it to produce the trend analysis and annual consumption forecasts, which is shown in Figure 5. However, each EMS has developed by their own programming language to serve its individual objective, so IEEE, a well-known computer application standard, has established the first power system exchange data in the year 1968 called Common Format (McMorran, 2007). It represented the line-based format for grouping the content of the lines into sections and gave headers to each section, with data items entered in each column. However, this standard did not allow blank items in the columns, which were replaced by a zero. With the expansion of ESI, it needed to exchange power data between companies that used different computer based systems connected via web technology. The common format cannot support those technologies because the data was not self-describing and could only to be understood by experts. Therefore, the Common information model (CIM) was developed by the Electric Power Institute as a platform independent model for describing the power system, and was adopted as an IEC standard (IEC 61970) in November 2003 (Kingston, 1994; Schwarz, 2004; Quynh-Nhu, 2005). The CIM represents all major objects normally used within electricity utility enterprise in the structure of a UML based Rational Rose^{TM} model that is represented as classes having attributes and shows relationships to the other classes.

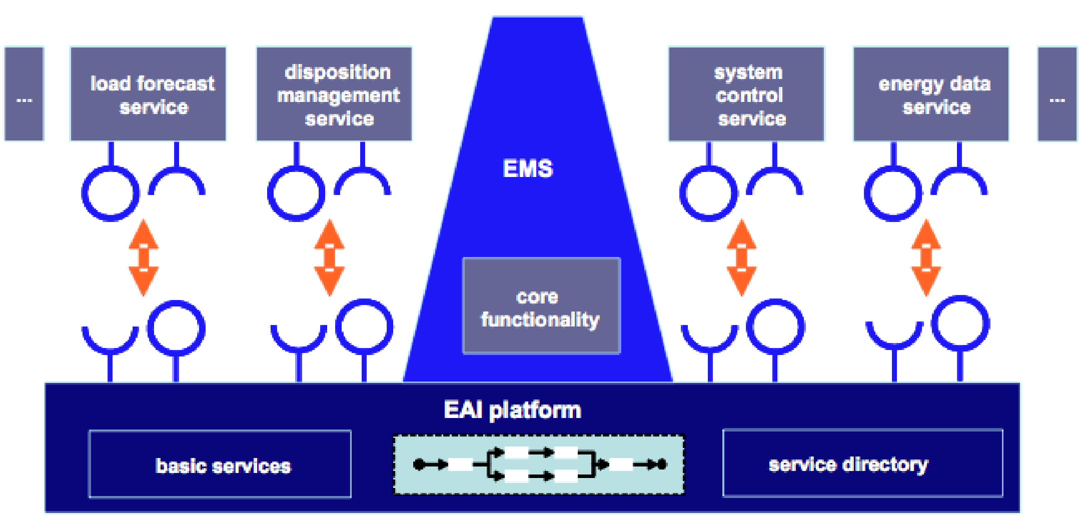

Figure 5. Schematic diagram of Energy Management System (EMS) framework

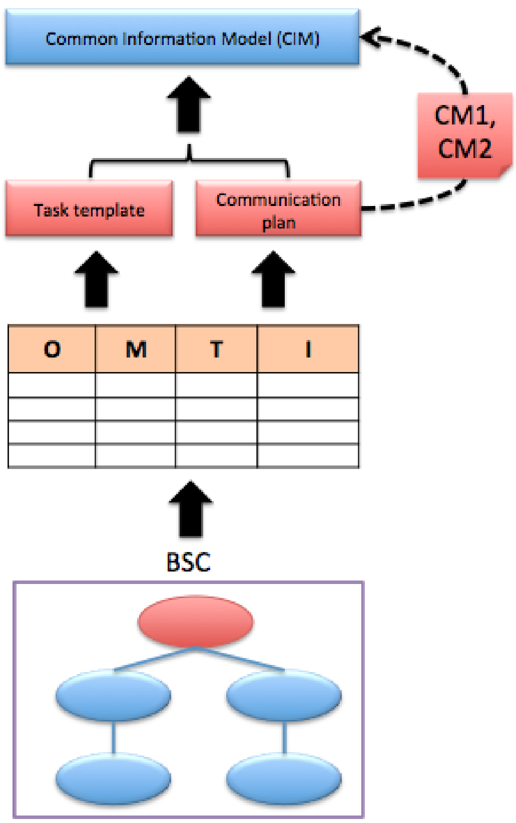

Figure 6. Schematic diagram of research methodology to create CIM for Thailand's national energy framework

Figure 6 shows an example of applying CIM for integrating EMS with many service-oriented subsystems (Stephen, 2004; Studer, 1998). A communication and nitration platform can be used to provide communication and data exchange between the different subsystems, which apply CIM for providing the numerous options to support communication between systems and provide their internal data such as power grid topology to the EMS. Based on the research that show the methodology to apply Balance scorecard (BSC) to manage the strategic map of Electricity Supply Industry (ESI), and create the ideal BSC and OMTI table which show the strategic theme include the task and sub-task which responsibility for every partner on Electricity Supply Industry (ESI) which show the process in a table below: Based on the table above, researcher uses the task which list in OMTI table and match with the task template from commonKADS technique in order to specify the template, and identify its factors in communication plan for every partner. The task template and communication plan of each ESI's partner, which got from OMTI table can be used to create the communication model form, CM1 and CM2, which identify the information description, characteristic of the data that transfer between the partner, and the agent who involve to communicate in that task (Sachin, 2012). Finally, the information in CM1 and CM2 of every task are used to create the Common Information Modeling (CIM) that show the linkage of information framework and data structure transfer between two or more agent in ESI.

4. Case Study

To justify the ideal national energy framework, researcher start by studying in AEDP 2012 -2021, and found that this plan was mainly focus on the improvement of renewable energy in Thailand electricity industrial sector. This plan presents the important cause for develop the energy plan of Thailand. It shows the energy ratio between domestic production and imports from foreign country, and the way to promote renewable energy to reduce the dependency ratio of imported energy. Moreover, this plan also focus on the environmental problem especially for global warming problem and the goal to low cost carbon society, then this plan present the issue of agricultural resource and some area in Thailand that have wide and solar resource which show the latency in order to use that resource in to produce the electricity. Therefore, the mainly topic of this research is focus on present the ideal of Thailand national energy framework with use as a guideline for design the Energy Management System in the future. After researcher put the information in OMTI form by analyst from AEDP plan 2012 – 2021 found that these information used for create not only for the task template but also its communication model with CM1 and CM2 form. In order to create the task template and communication model, researcher has designed based on the responsibility of regulator that present in the five main topics are as follow:

- Electricity tariff: it show the information relates to the tariff calculation in Electricity Supply Industry (ESI)
- Electricity operation: it present the information that indicate and used to measure the level of operation on ESI
- Investigate suspected case: it presents the information that relates with conflict case between two or more agent in ESI, and regulator need to make the final decision to resolve that conflict.
- Customer protection: regulator uses that information to protect their customer from electricity pricing and unfair policy on their operation of electricity supply industry to avoid the incidence of operation debt.
- Electricity rule: regulator uses the information to support the electricity rule, standard and policy creation procedure.

For this case, researcher focus on the responsibility of regulator to make the decision on electricity tariff because this strategic theme has mainly affected with both operate agent and their consumer.

Based on responsibility objective of regulator, electricity tariff show as an important objective that regulator need to concern while their find the problem solution. Moreover, information from many agents that sent to regulator is sensitive information and may need to filter by Independent System Operator (ISO) or Market Operator (MO) before submitted to regulator. The agents who involve on this strategic theme can be shown in the Figure 7.

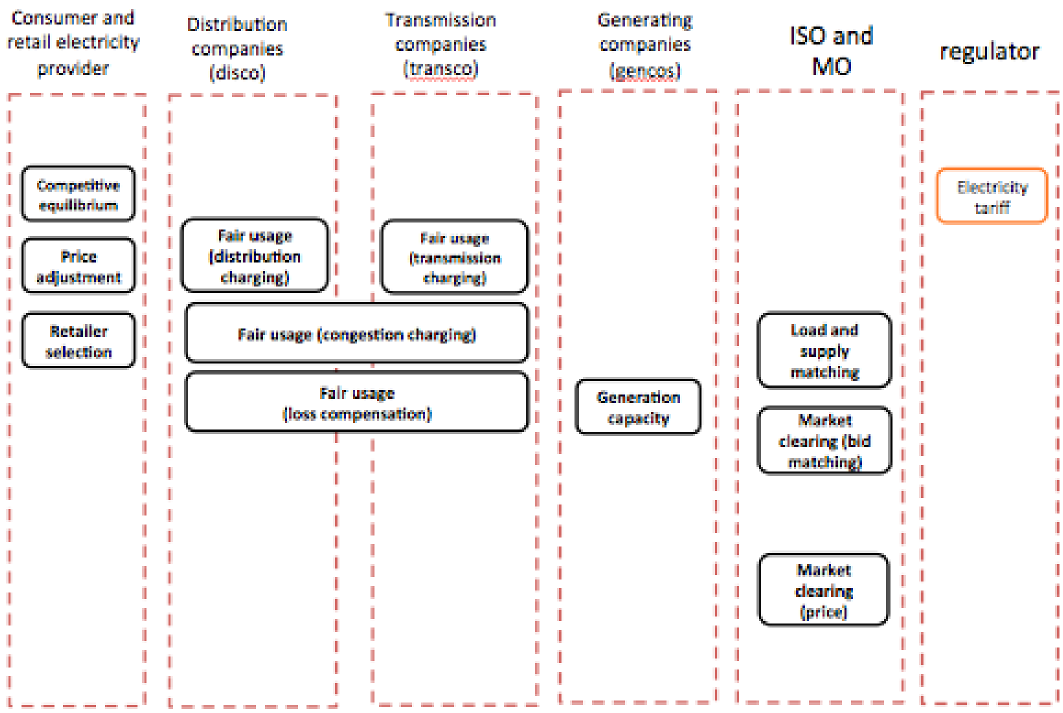

Figure 7. The diagram of task that relate with electricity tariff

From Figure 7, it presents the agent who involve with the electricity tariff solution to show the specific information from that agent. It shows that Independent System Operator (ISO) and Market Operator (MO) has sent the information not only for loading and supply matching but also the market clearing, while other agents which are genco, Transco, disco and retail electricity provider sends support information to ISO, MO and regulator. Therefore, the communication plan for electricity tariff can be shown is as follow:

Figure 7 shows the loading and supplying matching receive support information, which are competitive equilibrium, generation capacity and loss compensation, from genco, Transco, disco and retail electricity provider. Meanwhile, market clearing on bid matching receives information, which is competitive equilibrium and generation capacity from genco and retail electricity provider. Temporarily, the last task is market clearing on electricity pricing has received information from disco, Transco and retail electricity provider to support the price adjustment on both electricity operation and electricity selling.

After finish the design of the communication plan of each task, it use that plan to create CM1 and CM2 forms as shown in Tables 5-7. From example, the CM1 of supply bid matching has include information are generation capacity and competitive equilibrium which show the agents involve are generation company (genco) and retail electricity provider which both send information to regulator and Market Operator (MO). On the other hand, market operator also sends the information to ISO which ISO can use that information to compare with their plan and submit the result to regulator in order to use for make final decision. The CM1 form can be shown in the Tables 5.

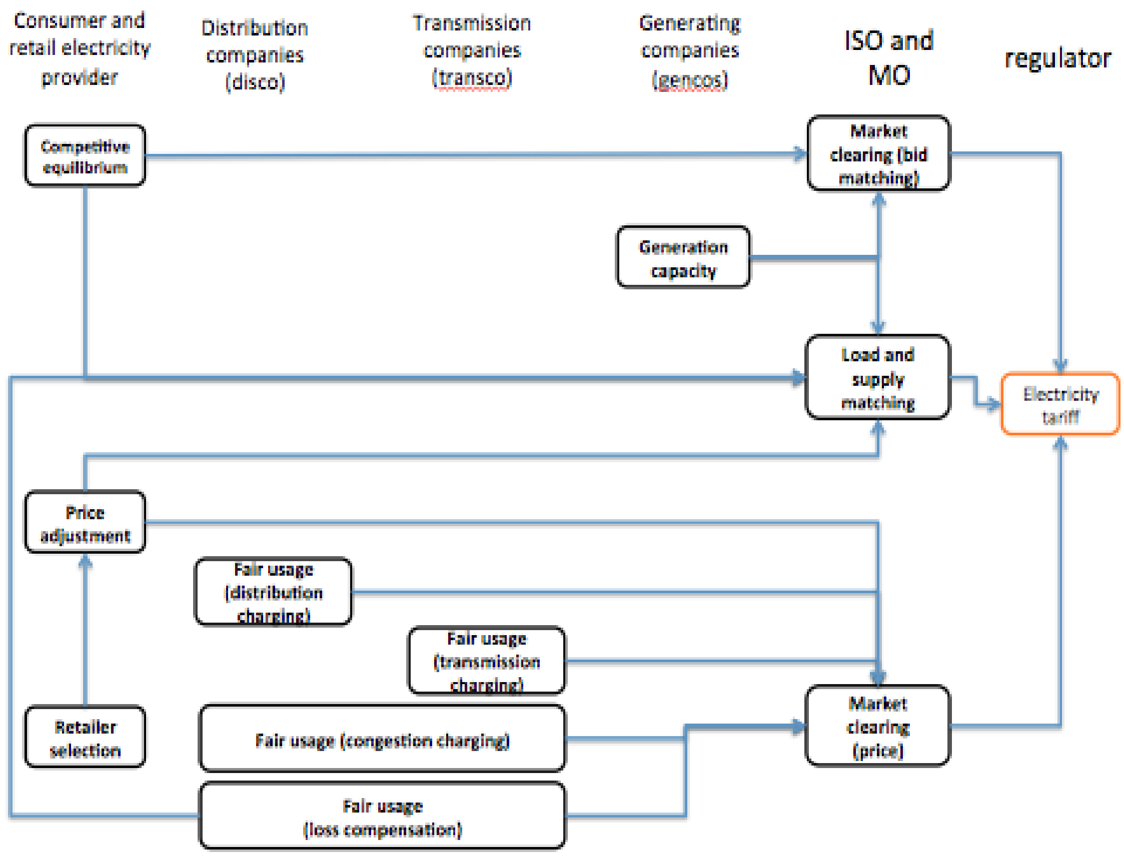

Figure 8. Diagram of the relationship between each task that relate with electricity tariff

Table 5. Worksheet cm-1 from supply and load matching

communication model	transaction description worksheet CM-1
transaction identifier/name	**Supply bid matching (market clearing)**
information object	Information receive task : ① Generation capacity ② Competitive equilibrium
Agents involved	**Generating company (gencos)**: send information to regulator **Retail electricity provider**: send information to regulator **Market operator (MO)**: receive information from gencos and retail electricity provider **Market operator (MO)**: send information to ISO **Independent system operator (ISO)**: send information to regulator **regulator**: receive information from ISO
Communication Plan	Electricity Tariff
Constraints	
Information Exchange Specification	

Table 6. Worksheet cm-2 present competitive equilibrium from load and supply matching task

communication model	Information Exchange Specification worksheet CM-2
Transaction	**Competitive equilibrium**
Agent Involved	1. Sender (retail electricity provider): retailer info., competitive level Receiver (MO): retailer info., competitive level
Information Items	MO request information from retail electricity provider 1. Role: competitive level act as a core object, while retailer info. is the support object 2. Form: - competitive level present in both data string and chart - retailer info. present in the form of canned text and chart 3. Medium : command line interface
Message Specification	
PRESENT-MESSAGE	Type : REPORT Content : present previous operation result Reference : N/A From : retail electricity provider To : MO
RECEIVE-MESSAGE	Type : REQUIRE Content : get information Reference : N/A From : MO To : retail electricity provider
MORE-INFORMATION-MESSAGE	Type : REQUEST Content : request more information Reference : Committee order From : MO To : retail electricity provider
Control over message	

Table 7. Worksheet cm-2 present generation capacities from load and supply matching task

communication model	Information Exchange Specification worksheet CM-2
Transaction	**Generation capacity**
Agent Involved	1. Sender (genco): plant info., fuel source, generation type, generation capacity, max capacity Receiver (MO): plant info., fuel source, generation type, generation capacity, max capacity
Information Items	MO request information from Genco 1. Role: fuel source, generation type, generation capacity act as a core object, while plant info. and max capacity are the support object 2. Form: - plant info. and generation type are data string - fuel source is data string and chart - generation capacity present in both data string and chart - max capacity present in the form of data string and chart 3. Medium : command line interface
Message Specification	
RECEIVE-MESSAGE	Type : REQUIRE Content : get information Reference : N/A From : genco To : MO
MORE-INFORMATION-MESSAGE	Type : REQUEST Content : request more information Reference : Committee order From : genco To : MO
Control over message	

On the other hand, form CM2 has shown the information description such as CM2 for competitive equilibrium that give the retailer information and competitive level from retail electricity provider to Market Operator (MO), which use competitive level as a core object, while retailer information is support object. Moreover, CM2 form also presents the message from the communication plan like the CM2 of competitive equilibrium which has three messages. The first message is the report which shows the content for present previous operation from retail electricity provider to Market Operator, and also shows the message to get information that send from market operator to retail electricity provider. The last message is the request messages that refer from regulator committee order to market operator and retail electricity provider for request more information to support their decision. The CM1 and CM2 forms for market clearing on supply bid matching can be shown in the Figure 8. Base on the Tables 5-7, it is about the information description of competitive equilibrium. For this task, it sends the retailer information and competitive level from retail electricity provider to market operator and use it as support information to regulator. Finally, this case can use as a guideline to develop the common information model (CIM), and use for develop the energy management system (EMS) in order to reduce the unexpected risk of information system development in the future.

5. Conclusion

As a result, researcher can conclude that analysis and development of the ideal strategic map by using balance scorecard, and create the OMTI table can help any strategic planner to identify the task of each agent in Electricity Supply Industry (ESI). Moreover, each task in OMTI table that researcher use to create the task template and communication plan by using commonKADS methodology can help the strategic planner to know which information has sent or received by which agent on CM1 and CM2 form. Finally, this research can extend by using as guidelines to identify the difference gap of information that transfer in current system, and the ideal system in the future.

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