CHAPTER 2

Literature Review

2.1 Definition

2.1.1 Rural Development

A rural development is basically concerned with refining the quality of life in rural regions. In fact, rural development measures vary significantly in their purposes, from an emphasis nearly entirely on economic development, to a much wider mix on economic, community and ecological goals that is more adjusted with the human development model. (Steve Goss, 2013)

According to Europe and East Europe, the rural development definition is that the “mainstream” provides central responsibility to agriculture and “integration” of farming sectors. Additionally, very little money supports to Leader-type creativities and top-down EU methodologies.

The rural development definition is according to USA: “Bottom–up” improve of community and societies and “Top–down” infrastructural development. According to developing countries: the rural development defines from World Bank’s model that is strongly leaded “local solutions”.

The rural development is the enhancement in the local existential conditions. It can be enabled by progressive sensible attempts of the national or government to improve the existential conditions of those dwellers in the rural regions. The rural development is the enhancements in the living standard of the low revenue population exist in rural regions and creating the process of their improvement self-sustaining.

2.1.2 Sufficiency Economy

The Sufficiency Economy conception was first revealed in 1974 when His Majesty King Bhumibhol advised enthusiastic aspirants of entirely revolutionizing the Thai economy to deliberate “sufficiency” as a more appropriate purpose.

“Sufficiency Economy” is a philosophy that emphases the middle path as the dominant principle for appropriate management by the population at all levels. This uses to management at the level of the individual, groups, and communities, societies as well as to the selection of a well-adjusted development strategy for the state so as to revolutionize in line with the forces of globalization though protecting against unavoidable distresses and immoderations that arise.

“Sufficiency” defines moderation and owing deliberation in all approaches of management, as well as the necessary for sufficient shield from inner and external distresses. To achieve this, the use of knowledge with practicality is essential. In specific, countless maintenance is required in the application of experimental philosophies and practices for preparation and implementation. At the same time, it is crucial to strengthen the ethical structure of the state, so that all, particularly administrative and community officials, technocrats, entrepreneurs and supporters, follows first and leading to the principle of reliability and honesty. Furthermore, a well-adjusted approach combining endurance, wisdom, diligence, persistence and practicality is essential to cope appropriately with critical confronts developing from wide and rapid ecological, socioeconomic, and cultural changes appearing as a result of globalization.

2.1.3 Appropriate Technology

An appropriate technology is a concept that represents providing for human requirements with the minimum impact on the Globe's finite capitals. The appropriate technology is based on the knowledge that progressive technology is frequently inappropriate for the desires that it is trying to address in developing countries. The principle following appropriate technology reduces the use of nonrenewable capitals to solve technical problems while encouraging self-reliance.

An appropriate technology can be a technique or a process and a product that it may be considered a social effort and a group of hardware such as water distribution system, machines infrastructures-roads, products and it may be design alternatives seemingly responsive to the system of that effort. Jaquier (1976) has of the view includes such immaterial things as experience, education, knowledge, know-how and organizational procedures. Numerous definitions are obtainable for appropriate technology and each definition characterizes different aspects of appropriate technology. Some are given below.

Jequier and Gerard (1993) describe that appropriate technology is recognized as the general term for a varied range of technologies categorized by several or any one of the following features: (i) low capital investment per division of output; (ii) low investment cost per work community; (iii) high potential for employment or low cost of final outcome; (iv) high adaptableness to a particular social ecosystem, (v) economical use of environmental resources; (vi) organizational simplicity.

Diwan and Dennis (1979) reflect appropriate technology as an essential part of the other development approach. The term of appropriate technology is frequently used to describe the technological capital and social resources best matched to Alternative Development Strategy (ADS) and to local situations in developing countries. Currently, there is no agreement about the term "appropriate technology", however it is obviously documented by its various features. In terms of physical aspects of appropriate technology construction, "appropriateness" means the use of renewable sources of energy and recyclable supplies, lowest destructive effect on the ecosystem and highest utilization of local capitals. In terms of application, appropriate technology means integration with local eco-friendly and cultural situations. It does not overcome the community but is logical, reachable and easy to sustain. Other expressions often used to define appropriate technology are technology that is intermediate: lying in scale of complexity between original and large scale; modern technology, bio technics:

modeled on biological energy movements, exploiting thermodynamic efficiencies, harmonious with the ecosystem, and low cost: concerning price of contributions and products and investment per community.

According to Darrow and Rick (1978) define appropriate technologies that are low in investment costs; using local possible materials; creating occupations, employing local labor and abilities; sufficient in scale to be reasonable by a small group of agriculturalists; understood, applied, measured and sustained by local communities wherever possible, without high level of education; supposing that societies can and working together to cooperatively carry improvements to their communities, knowing that in most of the world important results are completed by groups rather than by individuals. Moreover, the appropriate technology makes technology understandable to the local communities who are applying it and thus suggests concepts that could be used in additional innovations.

Kerr (1989) defined that appropriate technology is used to describe both an approach and a movement. It is the appropriate application of social scientific knowledge to improvement and also the movement began in 1960s, which is currently functioning all over the world. Appropriate technology could be the technology established by people of the land taking into attention the local situations that meet their own supplies and needs. It has to be simple, within reasonable reach, and complete in service.

An appropriate technology is in a sustainable approach and using locally available resources that meets the material and experienced requirements of individuals or communities without concentrating control in the hands of a choice.

Appropriate technology is exploring and attaching the potential of both simple and complex technologies in ecologically and institutionally sustainable ways to contribute to the reduction of inequality along with ethnic, gender, and class lines. Additionally, the appropriate technology is a development in the quality of lifecycle in economic, psychological, and social means for individuals and collections within communities around the world.

Furthermore, appropriate technology definition is the scheme of technology, science, and management that is practiced, evolved, and accepted by social community for increasing their productivity, and sustainability through training, education, and minimum external capitals to confirm self-reliance of the social community in their own condition.

2.1.4 Organic Agriculture

A system for crops, livestock and fish agriculture focuses on ecological protection and the use of environmental agricultural procedures. It is concerned not only with the end product, but also with the whole system used to generate and provide the farming product. The whole farm cycle which is from manufacture and processing to managing and delivery, eliminates the use of artificial crops such as genetically modified organisms (GMOs) and certain outside farming inputs such as veterinary drugs, pesticides, fertilizers and additives. Organic agrarians rely on environmental farming approaches and contemporary scientific environmental knowledge to increase the long-term wellbeing and efficiency of the ecosystem, improve the quality of the crops and protect the ecosystem. Proponents of organic approaches consider that it is a more sustainable and less harmful method to agriculture.

As organic foodstuffs cannot be notable from conservative products, consumers depend completely on third-party certification, i.e. the procedure according to which private or public certification forms provide guarantee that organic products have been manufactured and controlled according to appropriate standards. Organic standards have been used to characterize an agreement about what an "organic" right on product methods, and to carry that information and knowledge to consumers. Certification not only gives consumer trust in the organic system and foodstuffs but also leads to organic agriculture an individual identity and makes marketplace access simpler. Consequently, in contrast with foodstuff labeled as "green", "environment-friendly" or "free range", the organic label represents agreement with preparation approaches and very particular production. For agriculturalists to use the organic mark, they should obtain certification that the agricultural product complies with relevant standards following third-party assessments of their processes. Organic standards typically comprise the use of only environmental farming enhancers, protection of environmental resources, conservation of the ecosystem and preservation of biodiversity. Because of the fact that organic agriculturalists should allow for their control on their ecosystems, these techniques are usually adjusted to local conditions.

2.1.5 Knowledge Engineering

Knowledge engineering is a means of mining and extracting knowledge from experts and can be seen as encompassing methods and techniques for knowledge acquisition, modeling, representation and usage (Schreiber, 2000). Schreiber defined knowledge engineering as the designing, developing and maintaining of knowledge-based systems in the knowledge management task. It has a great cope with software engineering, and is correlated to many computer science subjects such as databases, data mining, artificial intelligence, decision support systems and expert systems. Knowledge engineering is also correlated to socio-cognitive engineering and cognitive science that the knowledge is created by socio-cognitive combinations and is systematized consistent with our understanding of logic works and human reasoning.

Knowledge engineering refers to a procedure of constructing such a semantic system. It contains such tasks as scoping, modeling, combination, utilization and maintenance within the methodology that related to software development. It focuses on the official and systematic process of logical problem solutions and purposes optimization of solutions. Knowledge modeling is based on heuristics tools and instructions (e.g mind mapping, card sorting, etc.) in an inductive procedure of finding suitable solutions in the context of contradictory interests and requirements (Zhao, 2005). Many knowledge engineering methodologies have been developed over the years, e.g., CommonKADS (Schreiber, 2000), Protégé (Angele, 1998), MIKE (Gennari, 2003), and MOKA (Martine, 1999). This research focuses on CommonKADS to capture knowledge, which is one of the most widely used knowledge engineering methodologies.

2.1.6 Ontology

There are two types of knowledge to be shared and reused: ontologies, knowledge about ‘what’, and problem-solving methods, knowledge about ‘how’. Knowledge sharing and reusing is research area in Artificial Intelligence (AI), which aims to separate knowledge components that are sharable across different domains and characterize them in a general way in order to reuse knowledge indifferent applications. The description of artificial intelligence indicates that knowledge is critical for intelligent systems. In many circumstances, knowledge can be more significant for solving a task than algorithms in order to have accurately intelligent systems, knowledge needs to be captured, processed, reused, and disseminated. Thus, ontologies can be provided and supported all these tasks.

The "ontology" can be expressed as an explicit specification of conceptualization. The structure of the domain can be captured via ontology, i.e. conceptualization. The conceptualization clarifies about the domain knowledge, not particularly about the state of affairs in the domain. Subsequently, ontology is specification of this conceptualization which using particular modeling language and particular terms specifies the conceptualization. Official specification is essential in order to be able to process ontologies and automatically activate on ontologies.

Ontology defines a domain, while a knowledge base (based on an ontology) particularly explains state of relationships. A knowledge-based system has its own knowledge base, and only what can be communicated using ontology can be stored and reused in the knowledge base. When an agent desire to communicate to another agent, who uses the concepts from some ontology to understand in communication, ontologies must be shared between agents.

There is no mutual definition of the term "ontology", while it is required from ontology to be properly defined. The descriptions can be characterized into generally three groups:

- Ontology is an expression in philosophy and its denotation is “theory of existence”: however it has many relations to the AI purposes.

- Ontology is an explicit specification of conceptualization, which commonly recognized as a clarification of what ontology is for the AI group.
- Ontology is a body of knowledge defining some domain, generally common sense knowledge domain, which ontology is as an internal body of knowledge, not as the way to explain the knowledge.

2.2 The Principle and Practice of Rural Development

The number of principles on regional development is regularly increasing. Individual principles vary in terms of the characterization of the main performers and the mechanisms of regional development. (Ward and Hite 1998; Suchacek and Malinovsky 2007). The previous couple of decades, rural sociology has changed from a practically exclusive emphasize on the sociology of farming to a wide-ranging engagement with discussions on rural development. The system of rural development through the European Union (EU) reveals both worldwide tendencies and EU policy. At a worldwide level, development rational is controlled by ‘decentralization fever’ (Tendler 1997), that is the acceptance that decentralization and contribution constructs for greater government because it carries governments partially closer to societies and allows better involve counselor ‘social inclusion’, it increases the quality and accessibility of information from populations to government, and it allows populations to more enthusiastically contribute in structures of governance (Jessop 1990; 1997; Harris 1997; Tendler 1997). At EU policy level, there has been an essential change from ideologically supporting agriculture policies to supporting more rural policies. The last underline the development of rural regions’ capability to support themselves throughout ‘partnerships’, ‘capacity building’, and ‘community-based initiatives’ (Shortall 1994; Buller 2000; Ray 2000).

Both principal and policy perspectives, this new method is covered in discussion and disagreement. It is obtainable as representative a more comprehensive form of government, local control, an all-inclusive understanding of development, and improved community participation (Ray 2000). Instead, it is obtainable as representative the well-being state's incremental removal of community services, increased accountability for service delivery by voluntary staffs, and the generation of corporations of uncertain democratic legality that be together with local government.

The sociological study of rural development has established progressively sophisticated over time. A Previous study emphasized on increasing involvement in rural development initiatives, their holistic environment, representativeness and community. These discussions have developed and continued. Furthermore, there is progressively difficult analysis of corporations (for example Edwards et al. 2000; Ray 2000), community inclusion/exclusion and authority. Rural sociology is obviously manipulated and developed from usual principal work in the social sciences. Related to the politics, health educations, and economics, disciplines of education, development studies, sociology, comprising rural sociology, has lately been seriously influenced by work on social capital, especially the work of the very productive party-political scientist Robert Putnam (2000).

The theories of rural development, as progressive by academics, policymakers and interest groups, divide into three main concepts:

- The "agricultural" method that realizes the agricultural community as protectors of the landscape and an important support of rural living. This method highlights the multi-functionality of farming; the significant variety of agricultural systems and the essential role that agricultural has performed in the development of rural society. It understands farmers as a usual goal for rural improvement support, landscapes and habitats, partially to help them adapt to modification, and partially to help them to preserve traditional agricultural practices, exploit new chances and respond to society's changing prospects for its rural regions.

- The "local development" method which emphases on the variety of rural activities, recognizes and stakeholders that in several cases farming now accounts for a relatively minor share of rural employment and production. This approach perceives rural regions as whole socio-economic systems with many individual and environmental resources, and with various drivers of modification. They desire to be “neutral” when suggesting strategies and solutions, and would place the agricultural community as just one of the clusters of stakeholders with equivalent privileges to offer for development resources.

- The “urban hubs” or “polycentric” approach which promotes the development of an amount of bigger towns and cities through the country to produce economic activity and offer jobs and trade to the surrounding rural areas.

All three main concepts assign considerable importance to guarding the environment and pressure the necessity for rural development to address community as well as economic targets.

Some of the greatest generally held interpretations of rural areas including: rural areas are significantly different from urban areas in many compliments, in terms of their attitudes, economy, community structure and services. Rural areas have inadequate economic chances, with high joblessness and low incomes. Agriculture is dominant to rural communities. The agriculture has the potential to motivate economic recovery.

Rural communities need three items: facilities, occupations and infrastructure including a transportation infrastructure that will allow them to access the occupations and facilities of near towns and cities. A method to rural improvement that is focused on the cultivate will fail to distribute these requirements to any significant level such as in Bosnia and Herzegovina, rural development must be realized as an economic, rather than a challenge, agricultural. Agricultural support is a specifically inefficient method of supplementary rural areas and, since most of the money drives to the larger agriculturalists, it inclines to subsidize the rich at the payment of the poor.

A careful inspection of rural regions and rural-urban comparisons with a whole multitude of indicators, express that many usual assumptions of rural living are more legend than reality and should not be used as a foundation for rural development policy. Especially, rural areas are much more comparable to, and related with, urban areas than commonly supposed, and agriculture shows a bordering and diminishing role in financial living, even if it remains socially important.

The rural development policy should emphasis on the following main concerns:

1. Improving the quality of living in rural areas by offering local communities with the infrastructure and facilities, which they realize as priorities.
2. Creating the ecosystem for agriculture to progress as a competitive business, countering to climate change, market improvements and new appropriate technologies, and formulating a net contribution to the nationwide wealth and financial plan.
3. Recognizing the significant contribution that small-scale farming makes to national food manufacture, balance of expenses and rural livings.
4. Improving transportations and public transportation, so that community dwellers can more easily access the occupations and facilities in near towns and cities.
5. Relieving rural poverty, specifically throughout providing seniors with a sufficient standard of living.
6. Reinforcement the overall economy, to which rural areas are indissolubly linked.
7. Encouraging entrepreneurs to establish businesses in the urban centers of rural towns, as a source of occupations and trade for the whole neighboring area.
8. Continuing and accelerating EU integration, to provide access to EU markets and its local, rural and agricultural finances.
9. Confronting the fundamental problems of poor government, administration and corruption, which obstruct growth and competitiveness in both rural and urban regions.
10. Remembering always the real prices as well as the hoped-for profits of rural development methods, and being considerate in design, well organized in implementation, and ruthless in assessment.

Several other methods can also be recognized, such as the “liberal free-market” method, which questions the perception of any government involvement where there is no clearly established market failure. This method is frequently obvious in strategies developed by organizations such as the World Bank or IMF, but at this time it has had no main effect on EU rural development policy.

Inside Europe, the sizeable majority of rural development support is distributed consistent with the EU model, as display in Council Regulation (EC) No. 1698/2005 and supporting regulation. EU Member States apply this model directly, supporting rural development with cooperation with EU funds, nationwide co-financing and financing by the beneficiaries themselves, consistent with a clearly defined procedure of monitoring, planning and implementation. Countries desiring to associate with the EU improve their nationwide systems along similar contours, as part of the overall procedure of harmonization with the *acquis communautaire* and with the particular target of being able to profit from EU funds under the EU's Instrument for Pre-accession in Agriculture and Rural Development (IPARD. Consequently, it is little overstatement to say that, inside Europe, sensible rural development is the EU's rural development policy.

EU rural development policy is accomplished by the Commission's Directorate-General for Agriculture and Rural Development (DG AGRI) as the "second pillar" of the Common Agricultural Policy as following:

Pillar 1 includes reliable support to agricultural activities through market involvement, the Single Farm Payment, and supports related to agricultural production. The full budget is met from the EU budget throughout the "European Agricultural Guarantee Fund" (EAGF).

Pillar 2 includes investment subsidies for modernization of cultivations, community good measures in rural regions, and other rural development measures. Part of the price is carried by the EU budget throughout the "European Agricultural Fund for Rural Development" (EAFRD), with the balance afforded by nationwide co-financing and the beneficiaries themselves. These two pillars together include the "Common Agricultural Policy" (CAP), which presently accounts for 48% of the total EU budget, divided approximately 75:25 between Pillar 1 and Pillar 2. While rural development policy at the EU level arrangements part of its agricultural policy and is man-aged by the DG AGRI, so most Member States and wishful countries implement rural development throughout their own ministries accountable for farming, though with the words "Rural Development" increasingly performing in their authorized titles. The EU Rural Development Regulation organizes support consistent with three vertical "axes" and a fourth horizontal approach:

- **Axis 1:** Improving farming competitiveness.
- **Axis 2:** Improving the ecosystem and supporting land-dwelling management.
- **Axis 3:** Improving the quality of life and varying the economy in rural regions.
- The **"Leader approach"**, which implements rural policies for rural development through public-private corporations.

These four sets of purposes are followed throughout the following measures:

1. Coaching in new agricultural appropriate techniques and rural crafts
2. Supporting young farmers to establish cultivates
3. Assisting elder agriculturalists to retire
4. Developing farm buildings and machineries
5. Supporting agriculturalists to meet demanding EU standards, e.g. public health ecological, and animal well-being
6. Assisting to set up food processing services on the farm so that agriculturalists can earn more income from cultivate goods by adding value to farm products
7. Improving product value and marketing of quality goods
8. Setting up of manufacturer groups in the new Member States
9. Support for agriculture in highland areas and other areas with lack of funding
10. Modernizing villages and rural accommodations
11. Inspiring tourism
12. Conservation and protection of rural heritage
13. Agri-environment measures to develop the ecosystem
14. Development policies present by Local Action Groups, addressing one of the following four "themes"

- The use of know-how and new appropriate technologies to create the products and facilities of rural regions more competitive;
- Improving the quality of living in rural regions;
- Adding worth to rural products, especially by assisting access to markets for small manufacture units via collective activities;
- Constructing the best use of environmental and traditional resources, including improving the value of locations of community interest selected under Natura 2000. Most of the measures have a strong emphasis on farms and are established around the countryside and community. Measures to support the rural population by producing occupations in local communities would therefore not be qualified.

Rural development must develop a Rural Sustainable Development (Copus and Crabtree, 1996).

The targets of rural sustainable development are (Baldock et al., 2001): variation of farming production (Hjalager, 1999); multi-functionality of agriculture to improve community, cultural and ecological functions of cultivation, as well as the creative function (Morgan et al., 2010; Wilson, 2007); development of food safety occupation and revenue generation in rural regions (Shortall and Shucksmith, 2001); environmental resource management and ecological protection (Emerson and Gillmor, 1999), additionally, conservation of community and social traditions in rural regions (Kneafsey, 2001; Szlanyinka, 2009).Then the result should be to allow rural communities to accomplish the following goals:

- To be unified and steady with feasible organizations and sustainable economies
- To be able to draw and maintain skilled rural communities, capable of contributing to progression and development (Shortall and Shucksmith, 2001)
- To assurance appropriate ecological management.

The principle of rural development is an appropriate concept for local development which is related to sustainable development project aims to develop and solve problem issue in rural areas.

2.3 Sufficient Economy Philosophy

Sufficiency economy has extensive applicability and delivers perceptive guidelines to the remaining problems of agricultural development, manufacturing development, and nationwide development as well as the progression of appropriate macroeconomic strategy. For farming development, at one time, there has indirectly been only one comprehensive policy for rural or farming development for the entire of Thailand. The suggestion for the agriculturalist is to specialize and to crop in response to market demand.

The Sufficiency Economy Philosophy recognizes modernization in proportion to the forces of globalization does not disagree agricultural manufacture for trades in appropriate regions. But for the bordering producers with high deal costs, the intention should be regarding an agro-system that is protected from instability by dispersal and reducing the risks involved.

King Bhumibol Adulyadej, The King of Thailand proposed the philosophy of sufficiency economy to persons in communities of Thailand on 4 December 1997. The philosophy conducts communities in living their lives consistent with the middle path. The concept of philosophy of sufficiency economy can be used to the individual level, the society level and the nationwide level. (Mongsawad, 2010)

Figure 2.1 illuminates the philosophy of sufficiency economy framework. The three interconnecting components signify the three principles of the philosophy of sufficiency economy: moderation, reasonableness and self-immunity. These three principles are interlocked and symbiotic. Moderation expresses the knowledge of people living their lives on the middle path, not the excesses. Individuals should rely on themselves without immoderation. This approach of living arises when communities have reasonableness, which accumulated experience and knowledge, accompanied by logical capability, self-awareness, precaution, understanding and compassion. They must be conscious of the consequences of their activities, not only for themselves but also for others. The third concept, self-immunity, indicates to the capability of individuals to protect themselves against any outer commotion and to deal with occurrences that are uncontrollable or unpredictable. It involves an establishment of self-reliance, as well as self-discipline. Separately from these three elements, two other conditions are required to construct the principles of sufficiency economy effort: knowledge and morality. Knowledge includes gathering information with perceptiveness to understand its meaning and the farsightedness desired to put it to apply. Morality mentions to reliability, ethical behavior, perseverance, credibility, honesty, and a willingness to work hard.

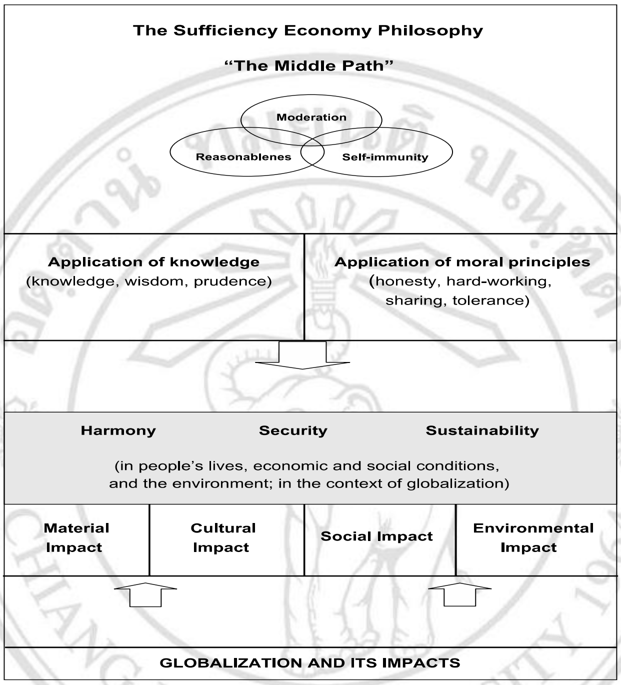

Figure 2.1 philosophy of sufficiency economy framework

By practicing these three concepts with the two fundamental conditions, individuals would be able to live securely in harmony in a sustainable community and ecosystem. Such a method of living does not indicate self-sufficiency; relatively, it reflects self-reliance that the ability to endure and deal with all types of harmful impacts of globalization.

The application of philosophy of sufficiency economy is not limited to the individual; it can also be useful to numerous different applications, such as private business. The philosophy of sufficiency economy inspires community achievement of sustainable benefit via moral approaches, including suitable corporate governance, mindfulness of all stakeholders, social responsibility, and business farsightedness with risk management. The philosophy of sufficiency economy can be applied to a nation's economic policy as well. The principle of philosophy of sufficiency economy assists form economic policy in managing elements of production: physical capital, human capital, natural capital and social capital regarding achieving quality progression. Such growth pressures populations' well being, sustainable environment.

The Sufficiency Economy Philosophy calls for a more expanded and more balanced development approach at the nationwide level. At the particular and rural level, His Majesty the King has placed forward more detailed instructions to the agriculturalists naming the perception "Trisadee Mai" or "New Theory", in 1994 and 1995, form of agriculture. The concept can be concise in three steps as follow,

1. In the first step, it is visualized that the main purpose of the agrarian is self-sufficiency particularly in rice for an agrarian annually consumption. A farmer main problem is that farmer has insufficient or uncertain water allocation. A farmer should solve the problem by sacrificing portion of farmer cultivate area by turning it into water reservoirs that should ensure farmer of sufficient water supply for rice cultivation for farmer family requirements. The construction of water reservoirs would require large preliminary expenses, which are probable to call for support from the government and other foundations. The farmer can still captivate the operation expense.
2. In the second step, the farmers are encouraged to pursue further profits by collaborating with their neighbors in the community so that they can lower the expenses of raw supplies, consumer and community products. The same alliance can also increase their negotiating power to trade their remaining products to the market.
3. In the third and more progressive step, expanded agriculture activities, such as a rice mill and a supportive store, can be considered to approaches being made to credit institutions and large international corporations such as oil companies for assistance and collaboration.

These strategies have extensive applicability over a large amount of the rural areas of Thailand, particularly in the Northeast where water supply is relatively inadequate compared to land living. The consolidation of community cooperation as defined in the second step of the concept is also very essential and has become a key focus of the current National Economic and Social Development Plan. The principles of philosophy sufficient economy, moderation and self-immunity are comprised in the procedures practiced in these several forms of sustainable agriculture.

2.4 Appropriate Technology Concept

Characteristic Features of Appropriate Technology

The main characteristic features of appropriate technology developing from the definitions of appropriate technology can be listed as follows

Low cost of technology: flexibility, diffusion and certainly appropriateness of a technology will depend on the cost of the technology. More the complexity of a technology the more will be its investment cost. More the investment cost the more will be its detachment from the poor. It is fairly normal that if the poor sections of the people are to be assisted the technology should be average with cost and complexity.

Self-reliance: determining suitability of a technology is its reliance on local environment not only for capitals for manufacture but also for know-how's and solutions. Technological self-reliance is the main factor for endogenous growth. The appropriate technology has been observed as a movement for reaching technological self-reliance completely depending on the know-how produced locally limiting the import or transfer of alien technologies. The transfer of distant technology also carries its isms and community structure that instead of solving the problems generates newer problems.

***Labor intensiveness*:** generating highest occupation opportunity is an important feature of appropriate technology. Modem technologies, in its procedure of mass manufacture, manage to relocate labor control and generate idle periods for people. The severe unemployment and underemployment as an outcome of labor exchangeable technologies will outcome in poverty.

***Smallness, simplicity and non-bureaucratic features*:** appropriate technology is designed for small-scale manufacture. The manufacture unit is simple and minor that it is easily to manage. The manufacture process services local materials and as a result this reduces both the input and output of the transport costs. As the manufacture process is organized the goods will find a ready market in the control region of its process. The technology is lacking of any complexity and because of this feature no particular skill training to manage the unit is needed.

***Non*-Violence:** additional important typical feature of appropriate technology is its non-violent type. Non-violence is non-destructive or harmful relations with the living environment, with the limited resources of the earth. Collaboration of high technology with environment and its capitals was very violent. It is obvious by the crisis of supply exhaustion and the environmental crisis.

The appropriate technology, which has concern for communities and the ecosystem at its focus, has significantly to contribute to school aged children, community, and to developing populations around the world. Using the criteria of suitability to technology (e.g., applying renewable sources of energy; using resources which are environmentally sound) can provide learning challenges, which bring the idea of sustainable development into the classroom. It is challenging to exaggerate the importance of the educational community to simplify understanding of this essential topic.

Design Criteria for Sustainable Development in Appropriate Technology

The appropriate technology does not concern exclusively to developing countries. National and local governments as well as isolated and community groups unceasingly attempt to introduce methods of technology that are efficient within economic limitations. This is proper in developed as well as developing countries. The depth of necessary and the significance of selecting the most appropriate technology are increased, however, in developing countries where the boundary of error is limited due to very inadequate resources. Consequently, the necessity to develop technologies that are suitable is of exponential prominence for populations of developing countries.

***Systems-Independence*:** relates to the capability of the technological device to stand alone, to organize the job or no additional supporting facilities or devices to support in its function (Jequier, 1979; Date, 1984; Ellis & Hanson, 1989). The price of new technology is always a barrier at some opinion but if this price is compounded because of the requirement for supporting devices. Subsequently the technology, no matter how suitable may be unachievable for the communities who demand it the most. All of these supporting components are main barriers for the majority of poor communities living in developing countries.

Consequently an assessment of the technology must contain not only the technological device in issue but supporting resources and equipment essential for its complete process. According to the standard, technological improvements should be designated only if the supportive facilities and devices are previously ready, or if only reasonable changes and developments of existing techniques are needed for implementation.

Image of Modernity: there is a particular criterion that should be recognized: an Image of Modernity when the appropriate technology is proposed for a developing country. The populations of many developing countries just as populations of many industrialized countries desire to identify themselves as progressive and contemporary, at least within their situation. There is a characteristic desire within most of humanity to feel significant and be noticed as worthwhile. Therefore, an image of being contemporary is vital to the achievement of any technology. Communities should consider that a technological device produces with it a degree of sophistication that can improve the user's community status as well as meet a basic human requirement. This criterion is associated to the societal/cultural standards in which the technology will be functioning. Some cultures encourage a strong commitment to the group procedure where the worthy of the entire is held in advanced esteem than individual activities.

Other cultures place**:** a high importance on individual accountability and achievement. These issues should be considered in detail while designing appropriate technology since they will contribute to the failure or success of any given strategy or method. If a given cultural community has a strong commitment to the community or area then the technology may be more performance dependent, where the overall community could take a better responsibility for the process of a greater system. Because of the unit methodology, the technological devices could be more complex which in turn could deliver a greater innovation in development for a larger community of people. In another culture community, there may not be a cooperative commitment to the general development of the culture society. In a culture community that is driven around the individual or single-family section the technological developments will require to be more technique independent where devices are proposed so that an individual can manage and afford the appropriate technology.

The cost of appropriate technology**:** a very important feature to the communities who require it the most. Ghosh (1984) describes that the mainstream of appropriate technologies, although developed with price as a main consideration, are still extremely high-priced for most communities in developing countries. The appropriate technology tends to be effective in meeting basic requirements; the price of the device must be reduced notably for the people in the developing countries to afford the technology. Cost is a main problem to overcome in the construction and project of appropriate technologies for developing countries. One of the main problems in reducing the expense of appropriate technology is that many devices are established for a one-of-a-kind usage within a particular situation under exactly social/cultural limitations (Jequier, 1979). However, the reduction of appropriate technology costs must be considered a high importance when contributing appropriate technological devices for developing countries.

Risk Factor**:** The development of new productivity carries with it a given quantity of success and failure outcome. Because of the characteristic of the device and the situation in which the technological device will be implemented the risk factor for the achievement of appropriate technologies in developing countries is of main concern and should be considered a significant criteria for improvement. There are two categories of risk factor to be considered: (1) internal and (2) external (Jequier, 1979). Internal risks involve with the method in which the technology will be suitable the local construction system (e.g., will the appropriate technology work under local community situations, is it developed). External risks relate to the required supportive systems that may be needed to keep the technology operative properly (e.g., to what quantity is the technology system reliant on and system self-regulating). These risks should be considered entirely before and during the improvement of the technological device in order to provide to communities success. Though the risk factor must be taken into concern when emerging appropriate technology it would be economically and governmentally corrupt to try to eliminate all risks. Some risks are beneficial to the growth and enlargement of locally applied appropriate technology. The challenge to the local financial and construction system is crucial for the technology to take cause and profit ownership at local level. Consequently, the risk to the achievement of appropriate technology must be considered in detail but not essentially be completely removed.

Evolutionary Capacity of Technology**:** The capability of the appropriate technology to continue to improve and enlarge beyond its initially intended purpose is an significant criteria and one that should be integrated into the development of the technological device as much as feasible. If the appropriate technological device is inactive (i.e., performs one purpose and cannot be changed) while it may deliver for a basic necessity at the present time then it will be a comparatively short existed solution to a much bigger problem. It is desired that the appropriate technology allow for a continuation of development possibility wherever and whenever (i.e., have design technological features). That is to have the ability to develop and be reconfigured to achieve a higher quantity of work and/or more sophisticated construction procedures. This may allow the technological device to initiate to compete at the local, nationwide, and worldwide levels, which must be the ultimate aim of any developing country. Without this ability the technological device has simply raised the users to a new level of poverty.

Single-Purpose and Multi-Purpose Technology**:** because of the levels of poverty of many communities in developing countries it is frequently thought suitable to develop appropriate technology that delivers for a variety of technological applications (e.g., the wheel that plows the earth, rice dryer and powers a water pump, and can be used as a transportation basis). This technological device has particular multiple purposes that may be extremely valuable to the individual of a developing country who could not have enough money to purchase individual pieces of apparatus. Furthermore, the economical advantage of this approach also reduces the technical knowledge and skills that are required to maintain the device functioning. Therefore, appropriate technology should be established to achieve a variety of applications whenever it is possible.

The ideal method for appropriate technology possibly does not exist in reality. The criteria obtainable in this chapter are not comprehensive by any methods; however, they do address to the main aspects of appropriate technology as it operates to developing countries. The best method to designing appropriate technology is complementary the criteria with the particular human needs.

Categories of Appropriate Technology

Diwan and Dennis (1979) described that there are two subsections of appropriate technology. They are family-employing technology and community-defined technology. These indicate dissimilar economic, logical, political, community, ethical, and welfare conditions. The family-employing technologies are reliable with societies, even if they lack societies. The community-defined technologies instead assume the existence and preservation of societies.

Family-Employing technology: that inspire a family and family colleagues to employ themselves in manufacture of services and goods required by the majority of the poor communities. These technologies fulfill at least three conditions from among the following: (i) they develop the productivity of labor without substituting it; (ii) the control of procedure of these technologies is in roles of those who control it; (iii) they are labor-intensive or inspire self-reliance and capital-saving and innovation; (iv) they are comparatively inexpensive technologies, easy to control and maintain so that majority of communities can achieve and use them, (v) they must use local capitals in terms of energy and inputs.

Community-Defined Technology: that is archetype for construction at the community. It assumes its preservation as a development objective and the presence of a society. A community is considered by as a minimum two conditions, (i) communities living together in a geographical region thus distribution the desires and problems of the same environmental phenomena; (ii) a genuine individual interaction between persons in an region on a day to day root so that individuals not only recognize each other, but shares each others grieves, satisfactions and regrets. Manufacture process in a community would not be complete with the resources, labor and other resources available in the community. But it is made feasible with definite community infrastructure. This society level infrastructure is extremely essential, even important for production. Its non-existence reasons a lot of problems.

The development in this direction has been the summits held recently in developing countries. In this research of *Appropriate Technology* that reports on the countries judges in which agriculturalists have had they're approximately on the potential of food and agriculture research by challenging researchers, agents from agribusinesses and policy producers about their strategies and policies. The procedure will lead to more cooperative decision-making and certify that research serves the requirements of farming communities**.** Particular the right support, such as dressed values for their produce, small-holder farmers can growth production, but nothing will be accomplished if the allocation of appropriate technology remains to be 'top-down'. The requirement is for researchers to look at the problems agriculturalists are actually undertaking, and use that as their beginning point for research. Agriculturalists and scientists have to develop new appropriate technologies together on an equal stability. Only then will 'sustainable agricultural manufacture' be succeeded. (Appropriate technology, 2010)

This research focuses on organic rice farming as an appropriate technology to develop effective social science ontologies and transfer vocational knowledge to non-science and technology educated farmers in Phrao farmer's community in Thailand as a case study. Choose an appropriate technology based on criteria and design.

2.5 Organic Agriculture Concept

A land management has an important impact on the ecosystem. Conservative farming prioritizes great yields and does slight to harmoniously cooperate with and preserve its ecosystem. These practical performs can result in extensive ecological degradation, usually resulting in water, soil and air pollution, soil erosion, biodiversity damage, and desertification. Additionally, they contribute to global warming that agriculture currently considers to more than thirteen percent of global anthropogenic greenhouse gas. Inversely, organic farming uses an individualized method to land management that focuses on protection of a land's environmental ecosystem whereas consuming fewer energy and decreasing the risks of pollution similar to conservative agriculture. Organic agriculture, consequently, pursues to provide a responsible alternative to conservative practices despite ever-growing anxieties over ecological degradation and climate change.

Soil erosion is a key cause of loss of yield volume and productiveness. The comparisons between conservative and organic farms have found that organic approaches improve the productiveness and general health of the soil in long term. Furthermore, organically managed soils determine improved moisture-retention capacity than those of conservative farms, which is significant to diminish the risk of desertification and in arid climates.

Soil conservation is one of the main concepts in organic agriculture. Soil fertility is essentially a keystone of organic agriculture by requirement because agriculturalists cannot use artificial products to restore damaged lands. They rely in its place on sustaining and constructing soil fertility throughout multi-cropping systems, lowest tillage, crop rotations, and organic fertilizers. Organic agriculture has the capability to upsurge organic matter in the soil, enriching its ability to retain water and circulate pollutants. Additionally, organic means counter with soil erosion because they use biological pesticides and preserve a permanent soil cover, rebuilding even degraded soils rapidly. While there is slightly scientific evidence representative that organic farming can reverse desertification, there are numerous useful models of organic farming systems resuming damaged lands back to soil productiveness. This recommends that organic agriculture may verify to be an effective method to respond to desertification.

Water pollution in farming is due to soil erosion and nitrate and synthetic stuffs leaking into water sources. The fact that organic farms do not use synthetic stuffs, the risk of water pollution is significantly reduced. Organically inclined soils also display diminished degrees of nitrate pollution in the water source, as organic cultivates use less nitrates than conservative cultivates, and organic soils have an increased capability to retain that. Organic farms also focus on consuming less energy and being more energy well organized than conservative farms. Studies demonstrate that they consume about forty- five to sixty-four percent of the non-renewable energy (i.e. fossil fuels) consumed by conservative farms. The organic farms were discovered to be between twenty-five and eighty-one percent more energy-efficient, depending on the weather and crops studied.

The environmental welfares of organic agriculture can also cover to climate change. The International Panel on Climate Change has intensely supported the acceptance of sustainable farming systems such as those used on organic cultivates to diminish carbon emissions. Organic approaches are certainly expected to cause minor carbon emissions which are between forty-eight to sixty-six percent less than on conservative farms. This is because of the high levels of organic substance discovered in organic soils, which allow the soil to trap and change carbon, reducing emissions over time. Organic farms also are inclined to decrease nitrous dioxide emissions because they use less nitrogen than conservative farms. This is particularly important of the fact that agronomy nowadays is accountable for sixty-five to eighty percent of nitrous dioxide pollution, which contributes to the reduction of the ozone layer.

Organic farming is valuable to environment protection and biodiversity preservation. The use of synthetic foodstuffs and stress on mono-crop specialism and concentrated yields characterizes conservative farming has led to a significant reduction in the number and diversity of plants and animals used in farming.

Organic agriculturalists depend on biodiversity for their achievement. To protect against crop-failure, for instance, organic agriculturalists plant genetically varied crops, therefore continuing a varied gene pool though learning which seeds will be the greatest strong and beneficial in the long term. Organic agriculturalists rely on nature for fertilization, maintenance of soil productiveness and pest control. The absence of synthetic insecticides offers a better-quality environmental habitat for insects, birds and microorganisms in the soil. Because of such practices and studies demonstration that plant inhabitants, bird densities, insect and earthworms inhabitants are much greater on organic farms than elsewhere.

Organic farming avoids the use of artificial synthetic insecticides, supporting the use of traditional methods and local species of pest management. These applies are known as organic Pest Management (OPM) which needs careful preparation and informed decision-making. It comprises: promoting inhabitants of biological predators that contribute to controlling disease, pests and weeds; cultivating the most resistant diversities of crops; refining soil condition to repel pathogens; cultivating plants in the suitable seasons, which also provides biodiversity; using organic-accepted insect-reduction and healthful products, such as larvae of pest predators. These are careful operative methods of controlling pests, as also promoting a vigorous and varied ecosystem.

Additionally, organic farming discards the use of genetically modified organisms or products, including creatures and plants, while the potential risks modeled by such products are discussed widely. This is organic philosophies consider that the use of GMOs de-stresses biodiversity and is an unnatural adding to the gene pool of farming crops, creatures and micro-organisms existing on cultivates. Consequently, the exclusion of GMOs uses every step of production, processing or distribution of organic products. There is the risk that GMOs may input organic products throughout cross-pollination. Organic cultivates can only certify that there has been no purposeful use of GMOs in their products.

Ultimately, animal wellbeing and benefit is another important issue in organic farming. The organic farming depends on disease preventive methods though limiting the management of veterinary treatments to livestock. Organic livestock standards additional need that animals obtain sufficient space, fresh air and appropriate shelter. They also need particular nutritious programs using mainly organic feedstuffs. This is a more caring and biological method to livestock agriculture that conservative agriculture does not essentially take into thoughtfulness. There are also probable wellbeing benefits to this method, as these methods decrease stress in animals that is supposed to prevent diseases.

Social Benefit on Rural Development

Organic farming may have an important social impact on rural communities. The organic farming may cause improved occupation opportunities in rural communities. Organic agriculture frequently needs more manual labor-intensive to recompense for the loss of artificial synthetic pesticides and synthetic fertilizers, and consequently generates more employments in rural communities. The amount of additional labor needed differs based on the outcome and farm in issue. Organic agriculturalists also diversify their crops and spread their planting schedules throughout the year in order to maintain biodiversity and enhance the health of the soil. This creates opportunities for year-round employment, reduces turnover and may alleviate problems related to migrant labor. Crop diversification also mitigates the effects of crop failure by spreading the risk among a wider variety of crops and products. Greater job opportunities on organic farms contribute to strengthening rural communities as well, by halting exodus to urban areas for jobs.

Organic agriculture has the result of consolidation rural communities and supporting rural development. The farmers need to adapt rural community conditions by managing labor, resources and land in a method that improves production and remains sensitive to the ecosystem in order to remain competitive. The organic farming doing so needs constantly experimenting with new appropriate techniques and combining local knowledge to learn best practices**. Agriculturalists also depend on their neighbors to sustain standards in order to certify the reliability of their own soil, water and air.** Partnership on these subjects reinforces draws within the rural community, which leads to corporations and better organization among organic agriculturalists. Organized groups or cooperatives can thus pool their resources, enjoy greater access to markets, and gain leverage in trade negotiations. There is some evidence that increased co-operation results in more active participation in local government and new businesses among rural communities.

Consumer protection is extra basis of organic farming. Consumers desire organic products to those made on conservative farms because they realize that organic products avoid artificial synthetic fertilizers and insecticides. The organic products are good for the ecosystem and perceived to produce foodstuffs that are healthful and taste better. Strong controlling frameworks, where the government proves organic certifications, are required for consumers to trust the organic products that they consume.

Ultimately, organic farming can provide food safety. Though the worldwide food supply is sufficient, 850 million persons around the world still go starving. Furthermore, the cost of food has increased considerably in the previous decade and there is excluding genetic diversity in our foodstuffs because of conservative agricultural approaches. Thus, great populations are increasingly exposed to the risk of food scarcity because of poverty and disease. Organic farming may have the prospective to encounter these challenges. Considering the fact that organic approaches do not need expensive chemical involvements, organic production is measured a more available means for rural agriculturalists to become self-sufficient. Organic farming also develops approach to food by decreasing risks of disease, increasing productivity and biodiversity over the long term, and providing a method for rural production and access to foodstuff.

2.6 Learning Theory

2.6.1 Behavioral Learning Theory

Connectionism, *E. Thorndike:* provides stimulus-response (S-R) framework of behavioral psychology: Learning is the result of associations forming between stimuli and responses. Such associations or "habits" become strengthened or weakened by the nature and frequency of the S-R pairings. There are three primary concepts:

- Concept of effect - responses to a situation that are followed by a rewarding state of affairs will be strengthened and become habitual responses to that situation.
- Concept of readiness - a series of responses can be chained together to satisfy some goal which will result in annoyance if blocked,
- Concept of exercise - connections become strengthened with practice and weakened when practice is discontinued

The concepts of connectionism are learning requires both practice and rewards that is concept of effect /exercise. A series of S-R connections can be chained together if they belong to the same action sequence that is concept of readiness. The connectionism describes transferring of learning occurs because of previously encountered situations and intelligence is a function of the number of connections learned.

Double Loop Learning, *C. Argyris*: defines that learning to change underlying values and assumptions. The action theory learning process is discovery of espoused and theory-in-use, invention of new meanings, production of new actions and generalization of results. The double loop learning involves applying each of these steps to itself.

The features of double loop learning are effective problem solving about interpersonal or practical issues needs common public testing of theories-in-use. The double loop learning needs learning circumstances in which participants can assess and experiment with their theories of action.

Drive Reduction Theory, *C. Hull*: interested in experimenting intervening variables that affected behavior such as inhibitors, incentives, and prior training: routine strength. Corresponding other types of behavior theory, strengthening is the primary consideration that determines learning. However, in Hull's theory, drive reduction or requirement satisfaction. The feature of drive reduction defines that drive is important in order for responses to happen i.e., the learner must desire to learn. The organism in order for conditioning to occur i.e., the learner must be concentrating, must perceive incentives and replies. Additionally, response should be created in order for conditioning to happen i.e., the learner must be active. Moreover, conditioning only appears if the reinforcement satisfied a necessity i.e., the studying must satisfy the learner's desires.

Repair Theory, *K. VanLehn*: describes that how individuals learn procedural skills with specific attention to how and why they make errors i.e., bugs. The theory proposes that when a method cannot be performed, a bottleneck occurs and the individual applies numerous strategies to overcome the bottleneck. The feature of repair theory is bugs that cause mistakes in procedural tasks are systematic and can be recognized. When the bugs related to a specific task are identified, they can be used to improve learner performance and the instances used to teach the process.

Originality, *I. Maltzman*: provides an uncommon incentive situation for which conventional reactions may not be readily accessible. This proposes dissimilar reactions to the same situation and unusual reactions as written responses. The originality principle can be improved through instructions or practice to generate unusual responses.

Sign Learning, *E. Tolman*: refers the connection between cognitive theory and behaviorism. Consistent with Tolman's theory of sign learning, an organism learns by following signs to a target, i.e., approach learning, escape learning, avoidance learning, choice-point learning and latent learning. The concepts of sign learning are always purposive and goal-directed and frequently involve the use of environmental factors to achieve a target e.g., means-ends-analysis. Furthermore, organisms will select the easiest or shortest pathway to accomplish a goal.

Social Learning Theory, *A. Bandura*: explains that learning would be very laborious, not to indication dangerous, if individuals had to rely exclusively on the consequences of their own movements to inform them what to do. Fortunately, most individual behavior is learned observationally throughout modeling: from perceiving others one forms an idea of how new behaviors are accomplished, and on subsequent occasions this implied information assists as a guide for action. The concepts of social learning theory is the maximum level of observational learning is accomplished by first organizing and practicing the modeled behavior symbolically and then passing it obviously. Coding modeled behavior into texts, labels or images results in better retention than simply perceiving. People are more probable to adopt a modeled behavior if it results in results they value. Additionally, persons are more probable to adopt a modeled behavior if the model is comparable to the observer and has respected status and the behavior has practical value.

2.6.2 Pedagogical Learning Theory

Conditions of Learning, *R. Gagne*: there are five conditions that are verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes. The different internal and external conditions are essential for each kind of learning. The feature of conditions of learning is nine conditions that are gaining attention (reception), informing learners of the objective (expectancy), stimulating recall of prior learning (retrieval), presenting the stimulus (selective perception), providing learning guidance (semantic encoding), eliciting performance (responding), providing feedback (reinforcement), assessing performance (retrieval), and enhancing retention and transfer (generalization).

Criterion Referenced Instruction, *R. Mager*: refers to goal and task analysis in order to identify what desires to be learned, performance objectives that accurate specification of the results to be accomplished and how they are to be assessed: the criterion. The criterion-referenced examination is evaluation of learning in terms of the knowledge and skills identified in the objectives. Moreover, the development of learning modules tied to particular aims. The instructional criterion referenced aims are derived from work performance and reflect the knowledge and skills: competency that desires to be learned. Learners learn and practice only those skills not yet mastered to the level essential by the purposes. Learners received opportunities to practice each aim and get response about the value of their performance. The learners should obtain repeated practice in skills that are used frequently or are challenging to learn. Additionally, Learners are allowed to arrange their own instruction within the constrictions imposed by the prerequisites and development is controlled by their own ability that is mastery of objectives.

Elaboration Theory, *C. Reigeluth*: Instruction should be systematized in increasing order of complexity for optimum learning. There are seven strategies of optimal learning that are an elaborative sequence, learning prerequisite sequences, summary, synthesis, analogies, cognitive strategies, and learner control.

Lateral Thinking, *De Bono*: The idea of lateral thinking is that many problems need a different viewpoint to solve effectively. The key success factors of lateral thinking point are recognizing leading ideas that differentiate insight of a problem, searching for different methods of looking at things, reduction of strict control of thinking, and use of chance to inspire other ideas. Consequently, trying to break the components up and recombining them in a different way perhaps randomly can receive a different perspective on a problem.

Experiential Learning, *C. Rogers*: addresses the needs and wants of the learner. The simplification includes: setting a positive environment for learning, clarifying the points of the learners, organizing and constructing available learning resources, balancing emotional and intellectual elements of learning, sharing thoughts and feelings with learners but not dominating. When the student participates entirely in the learning process and has control over its environment and direction, and it is principally based upon direct confrontation with practical, social, individual or research problems, and self-evaluation is the principal technique of evaluating progress or achievement. The concepts of experiential learning are important learning occurs when the subject substance is relevant to the individual interests of the learner. Learning which is intimidating to the personality e.g., new attitudes or perspectives is more simply integrated when external intimidations are at a minimum. Learning profits faster when the threat to the personality is low. Furthermore, self-initiated learning is the most durable and extensive.

Situated Learning, *J. Lave*: social interaction is a critical constituent of situated learning that learners get involved in a community of practice, which represents certain beliefs and behaviors to be learned. This differences with most classroom learning accomplishments, which involve knowledge is abstract and out of perspective. The concepts of situated learning are knowledge desires to be obtainable in a reliable context, i.e., surroundings and applications that would usually involve that knowledge. Learning needs social collaboration and interaction.

2.6.3 Adult Learning Theory

The Characteristic of Adults as Learners (CAL) model personal characteristics situational characteristics. Aging results in the weakening of certain sensory-motor abilities e.g., hearing, eyesight, response time. While intelligence abilities e.g., decision-making skills, reasoning, vocabulary incline to improve and life phases and developing phases e.g., marriage, job changes, retirement. The situation is part-time versus full-time learning (i.e., schedules, locations, procedures) and voluntary versus compulsory learning: the self-directed, problemcentered nature of most adult learning. The concepts are adult learning programs should exploit on the experience of contributors. Adult learning programs must adjust to the aging limitations of the participants. Adults should be challenged to attempt to progressively advanced stages of personal development. Additionally, adults should have as much choice as possible in the obtainability and organization of learning programs.

Andragogy, *M. Knowles*: adults are self-directed and expect to take responsibility for decisions. The learning design realizes that adults desire to know why they need to learn something. Adults need to learn experientially, adults approach learning as problem solving, and adults learn best when the topic is of immediate value.

Minimalism, *J. Carroll*: learning activity for adult learning instruction is all learning tasks should be meaningful and self-contained activities. Learners should be given realistic projects as quickly as possible. The instruction should permit self-directed reasoning and improvising by increasing the number of active learning activities. The training materials and activities should provide for error recognition and recovery. There should be a close linkage between the training and actual system. The concepts of minimalism are consisting of allowing learners to start immediately on meaningful tasks, minimizing the amount of reading and other passive forms of training by allowing users to fill in the gaps themselves, including error recognition and recovery activities in the instruction and making all learning activities self-contained and independent of sequence.

Attribution Theory, *B. Weiner*: How individuals interpret events and how this relates to their thinking and behavior. This is a major paradigm of social psychology. The Factors affecting attributions for achievement include ability, effort, task difficulty, and luck. Attributions are classified along three causal dimensions that include location of control, stability, and controllability. Attribution is three stages process that behavior is observed, behavior is determined to be deliberate, and behavior is attributed to internal or external causes. The characteristic of success consists of effort, ability, level of task difficulty, or luck. The causal dimensions of behavior are location of control, stability, and controllability.

2.6.4 Cognitive Learning Theory

Adaptive Control of Thought: ACT, *J.* Anderson: remember structure including:

- Declarative memory takes the form of a semantic net connecting propositions, images, and orders by associations.
- Procedural memory and long-term memory signify information in the type of productions; each production has a set of actions and conditions based in declarative memory. The nodes of long-term memory all have some degree of stimulation.
- Working memory is that part of long-term memory that is most extremely activated

The features of adaptive control of thought are problem space identify the goal structure of the problem space. This provides instruction in the context of problem-solving and provides immediate feedback on errors. This adaptive control of thought minimize working memory load and adjust the "grain size" of instruction with learning to account for the knowledge gathering procedure. Moreover, this theory enables the learner to approach the goal skill by successive approximation.

Algo-Heuristic Theory, *L. Landa*: identifying mental procedures of conscious and particularly unconscious that motivate expert thinking, learning, and performance in any extent. The algo-heuristic cognitive learning theory has featured including algorithmic, semi-algorithmic, heuristic-based and semi-heuristic based. The concepts of this theory are more significant to teach algo-heuristic procedures to learners than knowledge of processes; instead, instructors need to know both. Procedures can be taught through instructions and demonstrations of operations. Teaching learners how to determine procedures is more valuable than delivering them already formulated. Additionally, breakdown processes into elementary procedures of length and size appropriate for each learner that is individualization of instruction.

Structural Learning Theory, *J. Scandura*: Learning matter includes domain, range and procedure. The concepts of structural learning theory may be another rule sets for any assumed class of tasks. Problem solving may be enabled when higher instruction rules are used, i.e., rules that make new rules. Higher instruction rules comprise creative behavior that is unanticipated outcomes as well as the ability to solve complicated problems by creating it possible to learn new rules. When possible, educate higher order rules that can be used to originate lower order rules. Educate the easiest solution pathway first and then educate more complex pathways or rule sets. Furthermore, rules must be constituted of the minimum competences controlled by the learners.

Cognitive Dissonance, *L. Festinger*: There is an inclination for persons to pursue consistency among their cognitions i.e., beliefs and opinions. When there is an inconsistency between behaviors or attitudes (dissonance), somewhat should change to remove the dissonance. How to eliminate dissonance: reducing the significance of the dissonant beliefs, adding more consonant beliefs that compensate the dissonant beliefs, changing the dissonant beliefs so that they are no longer unpredictable. Dissonance results an individual must select between behaviors and attitudes that are inconsistent. Reducing the significance of the contradictory beliefs, acquiring new beliefs that change the balance, or eliminating the conflicting attitude or behavior can remove dissonance.

Constructivist Theory, *J. Bruner*: Learning is an active procedure in which learners construct new concepts or ideas based on their present or past knowledge. There are four domains of constructivist theory that are tendency towards learning, the ways in which a body of knowledge can be structured so that it can be most readily comprehended by the learner, the most effective orders in which to present material, and the nature and pacing of rewards and punishments. Concepts of constructivist theory are instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness). Instruction must be structured so that the learner can comprehend easily (spiral organization). Moreover**,** Instruction should be proposed to facilitate extrapolation and or fulfill in the gaps (going beyond the information given).

Soar, ***A. Newell et al.***: Soar is a construction for human cognition stated in the form of a production system. Soar is the idea of a problem space that all cognitive performances are some form of search task. Break apart is the primary mechanism for learning and signifies the conversion of problem-solving performances into long-term memory. The occasion for break apart is a bottleneck and its resolution in the problem solving procedure i.e., satisfying production rules.

Multiple Intelligences, ***H. Gardner***: including linguistic, musical, logical-mathematical, spatial, body-kinesthetic, intrapersonal (e.g., insight, metacognition)**,** and interpersonal (e.g., social skills). The concepts of multiple intelligences are individuals should be encouraged to use their preferred intelligences in learning. Instructional activities should appeal to different forms of intelligence. The assessment of learning must assess multiple forms of intelligence.

To improve learning behavior of learner may be classified into cognitive learning behavior. This study applies Bloom’s Taxonomy for learning process measurement regarding to cognitive level to prove the additional social science ontology effectiveness.

2.6.5 Bloom’s Taxonomy

Bloom’s Taxonomy has a significant influence on educational theory and practice. Bloom's taxonomy of educational aims was established as a tool for a variety of purposes. Bloom’s taxonomy is systematized from simple to complex and specific to abstract cognitive classifications (Krathwohl, 2002), representing an aggregate framework that has been broadly applied in educational research (Kunen, Cohen, & Solman, 1981). More particularly, Bloom's categories reveal levels in knowledge construction (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). Structuring knowledge indicates drive from basic descriptive explanations of opinion to operating a variety of cognitive strategies, such as analysis, evaluation and creativity (Anderson et al., 2001).

The knowledge dimension indicates to the form of knowledge being learned including procedural, conceptual, factual or metacognitive. The cognitive procedure dimension mentions to six levels in cognitive processing, which are remembering, understanding, applying, analyzing, evaluating and creating. The original cognitive procedure dimensions in the taxonomy are now obtainable as active verbs, and two categories were altered as to their hierarchical position: evaluate and create (Krathwohl, 2002). The revision of Bloom's taxonomy suggests that it is now appropriate to analyze both the cognitive process and learning outcomes used by learners to complete a task.

The cognitive process dimension on Bloom's revised taxonomy is divided into remembering, understanding, applying, analyzing, evaluating and creating (Anderson and Krathwohl, 2008) which represents the method of thinking and learning process for a learner and supports the learners to maintain and transfer the learning knowledge. The Bloom's revised taxonomy focuses to assess the learning process of learner in terms of appropriate cognitive process and knowledge form then the trainers will apply in learning process measurement to support the educational potency, instructional assessment analysis, curriculum design etc. (Box, 2004, Chyung and Stepich, 2003, Lister and Leaney, 2003, Scott, 2003, Airasian and Miranda, 2002, Mayer, 2002).

Revision Bloom's Taxonomy dimensions to six levels of cognitive processes:

Remembering: The remembering level is operationally described as information retrieval: remembering level as expressed includes those behaviors and experiment situations, which emphasize the remembering, whichever by recall or recognition, of materials, ideas, or phenomena (Bloom et al., 1956). Bloom's classification of remembering level, then, combines the cognitive procedure of retrieval with the numerous forms of knowledge, which are retrieved.

Understanding: The understanding level characterizes the main class of abilities and intellectual skills. The dominant feature of the performance of understanding is taking in new information via certain form of communication. The taxonomy does not limit communication to the demonstration of information in linguistic: verbal or written form. Relatively, information can be obtainable experientially or symbolically thus a learner attempting to understand the ideas fundamental a representation would be involved in the act of understanding.

Three forms of understanding are defined in the taxonomy: translation, interpretation, and extrapolation. *Translation* implicates encoding received information into some types other than that it was received. While translation includes the identification of the literal construction underlying the received information, *interpretation* may need a restructuring of ideas into a new structure in the mind. Ultimately, *extrapolation* is beyond the literal level of understanding. It includes inferences and expectations based on literal information in the communication and concepts and simplifications already controlled by the learner.

Applying: The third cognitive level of cognitive skills, *Applying*, is probably the minimum well defined in Bloom's Taxonomy. It is explained in association to a particular form of knowledge concepts and is explained primarily in terms of how it relates with other levels of the Bloom's Taxonomy. Bloom notes that the understanding of a concept needs learners to know the concept well enough that they can properly demonstrate its use when particularly requested to do so. "Applying," though, needs a stage beyond this. Given a new problem to the learner, Bloom will apply the appropriate concept without having to be driven as to which concept is precise or without having to be presented how to use it in that situation. Bloom additional clarifies that a concept understood at the level of understanding can be used only when the conditions for its use are indicated. However, the applying of a concept is revealed when one correctly uses the concept in a situation in which no mode of solution is specified.

Analyzing: The analyzing underlines the detection of associations of the parts and of the technique they are structured. Analyzing is divided into three subsections: the identification or categorization of (1) components, (2) associations among components, and (3) organizational principles that rule components. This category overlay with the categories of understanding and evaluating level on Bloom's

Taxonomy cognitive dimension.

Evaluating: contains making decisions about the value of knowledge. Consistent with Bloom that includes the use of conditions as well as standards for assessing the range to which specifics are correct, operative, satisfying or cost-effective. The decisions may be either qualitative or quantitative and the conditions may be either those determined by the learner or those that are given to Bloom. Two types of conditions or evidence are distinguished within this classification: internal and external. By definition, *evaluating* is a type of decision-making, done at a very awareness and considerate level, as contrasting to decisions that are made quickly without much aware consideration. Bloom refers to the concluding as opinions as opposed to decisions, which by definition comprise evaluation.

Creating: principally involves the generation of new knowledge constructions. Creating is described as placing together components and parts as to form an entire. This is a procedure of working with components, parts, etc., and linking them in such a technique as to establish a pattern or construction not obviously there before. Usually, this would comprise a recombination of parts of previous experiences with new material, restructured into a new and more or minus well-integrated entire.

Anderson et al. (2001) taxonomy comprises two basic dimensions. The first is mentioned to as the knowledge domain and involves four types of knowledge: factual, conceptual, procedural, and metacognitive. *Factual knowledge* contains basic components learners should know to be familiar with a discipline or solve a problem in it. *Conceptual knowledge* includes the interrelationships among the basic components within a larger construction that allow them to function with each other. *Procedural knowledge* comprises how to do something, approaches of inquiry, and criteria for operating skills, algorithms, methods and techniques. *Metacognitive* knowledge includes knowledge of cognition generally as well as consciousness and knowledge of one’s own cognition.

The second dimension is mentioned to as the cognitive process domain and involves six forms of thinking. *Remembering* comprises retrieving relevant knowledge from long-term memory (Anderson et al., 2001). *Understanding* involves structuring meaning from instructional communications, including graphic message, oral, and written." *Applying* includes carrying out or operating a process in a specified situation. *Analyzing* involves breaking substantial into basic parts and defining how parts have to do with one another and to an overall construction or determination. *Evaluating* involves making decisions based on conditions and standards. *Creating* involves placing components together to form an intelligible or useful entire and reorganizing components into a new pattern or construction.

With the components of both dimensions described, educational aims could be categorized. To demonstrate, Anderson et al. (2001) provide the example of an objective an educator could establish in a science class: the learner will study to use the reduce-reuse-recycle method to preservation. Because it involves knowledge about doing something, this objective is categorized as practical along the knowledge dimension. As the objective involves carrying out something, it is categorized as function along the cognitive process dimension.

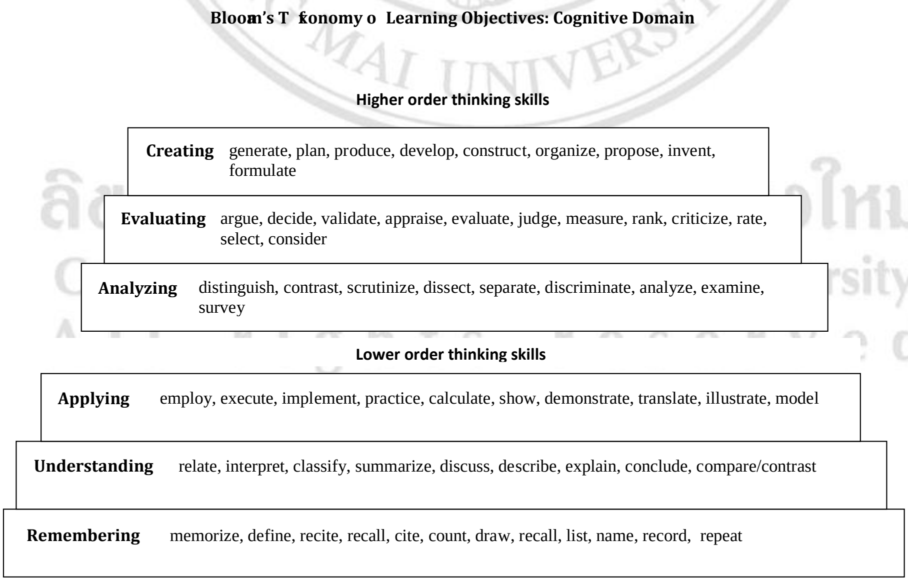

Figure 2.2 Bloom's Taxonomy Behavior Vocabulary

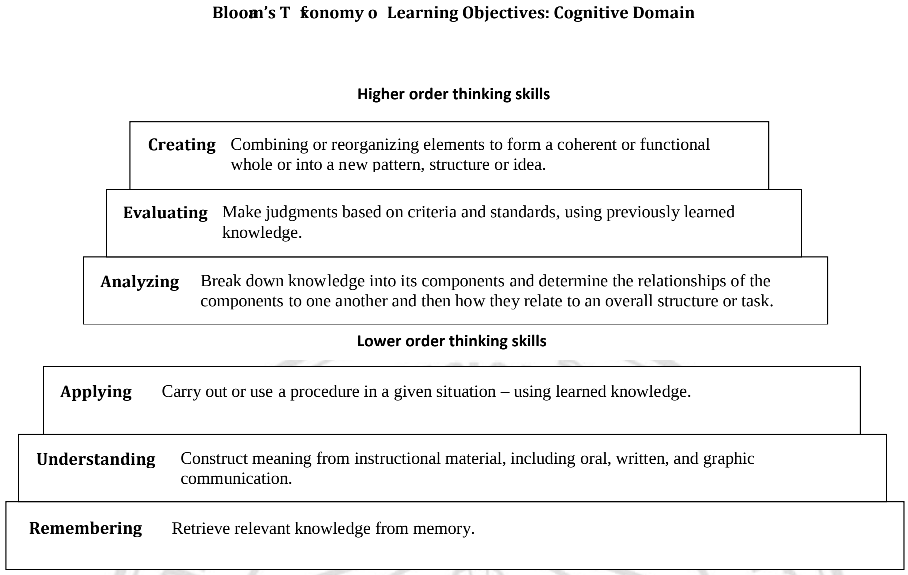

Figure 2.3 Bloom's Taxonomy Activities to Measure Learner's Cognitive Level Behavior

Table 2.1 Bloom's Taxonomy cognitive domain

Level	Definition	Sample Verbs
Knowledge	Recall and remember information.	defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states, memorizes, tells, repeats, reproduces
Understanding	Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words. Establish relationships between dates, principles, generalizations or values	comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives examples, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates, shows relationship of, characterizes, associates, differentiates, classifies, compares distinguishes
Applying	Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the workplace. Facilitate transfer of knowledge to new or unique situations.	applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, solves, uses, systematizes, experiments, practices, exercises, utilizes, organizes
Analysis	Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.	analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates, investigates, discovers, determines, observes, examines
Evaluation	Make judgments about the value of ideas or materials.	appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports, calculates, estimates, consults, judges, criticizes, measures, decides, discusses, values, decides, accepts/rejects
Create	Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure. Originality and creativity	categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes, synthesizes, imagines, conceives, concludes, invents theorizes, constructs, creates

2.7 Knowledge Engineering

Knowledge engineering at one time was in a part of artificial intelligence. Then as the previous decade, knowledge engineers have established their principles to improve the procedure of knowledge acquisition (Chua, 2004). These principles are applied to use knowledge engineering in many real situation issues. Initially, there are different forms of knowledge that are described as "know what" and "know how" (Levy, 2003) "tacit" or "explicit" and knowledge from Nonaka's definition (Nonaka, 1995). Next, there are dissimilar kind of expertise and experts. Then, there are several means to signify knowledge and use of knowledge. Ultimately, there is the use of organized technique to relate the difference with each other to present knowledge-oriented activity. These generated numerous knowledge engineering methods to solve different problems in several domains such as financial analysis, assessment of electronic circuit designs, diagnosis of bacterial infections, or advice on mineral exploration. In this study, knowledge engineering methodologies: CommonKADS was reviewed in order to propose a methodology for applying a selected method in the appropriate technology domain knowledge.

Knowledge Engineering Lifecycle

Knowledge engineering is different from conventional software engineering generally at the primary steps of the lifecycle, when user requirements and functional approaches or domain knowledge are being acquired. The user interface design, system testing, maintenance and updating systems as the tools for implementation may differ, but the concepts that manage all software systems are the same. Consequently, though the initial steps of knowledge acquisition will involve a knowledge engineer and one or additional domain experts, following steps will involve software engineers for integration/implementation. Knowledge-based Engineering (KBE) lifecycle was proposed by Preston (Preston, 2005). The KBE emphasizes on six critical phases i.e. identify, justify, capture, formalize, package, and activate as following.

- **Identify** purposes at identifying the driving elements of the project. The key activities of this stage are studying manufacturing requirements and technical feasibility of the project.

- **Justify** refers to encourage and certify the relevance of the project. It involves assessment of resource requirements, risk, profit, costs, and development of a project plan.

- **Capture** purposes to gather all domain knowledge related to the application that is to be generated. The knowledge is organized and systematized into an informal model.

- **Formalize** refers to develop an official model from captured domain knowledge. The production from the capture stage will be systematized into standardized form.

- **Package** mentions to implementing the official model into KBE-platform, i.e. programming. This stage primarily focuses on application specification and development.

- **Activate** is the procedure of settling the finished application. This is emphasis on maintenance and dissemination. KBE application lifecycle is typically used for defining the significant procedures from the beginning to the end of the project. Therefore, most knowledge engineering methodology offers tools that support the knowledge engineering project lifecycle.

Currently, the scopes of knowledge engineering works are much wider than basically the development of expert systems. By the arrival of the Web and Semantic Web, the focus of many knowledge engineering works has changed (Gil, 2011; Schreiber, 2013), and the development of official computational ontologies is now a main emphasis of attention for those concerned with the elicitation, analysis, representation and validation and exploitation of human knowledge.

2.7.1 Knowledge elicitation

Knowledge elicitation involves a set of approaches and techniques that effort to elicit the knowledge of a domain expert, usually through some method of direct communication with the expert. Knowledge elicitation is a sub-procedure of knowledge acquisition that deals with the elicitation or acquisition of knowledge from any source, and knowledge acquisition is a sub-procedure of knowledge engineering, which is a regulation that has developed to support the whole process of identifying and deploying knowledge-based systems.

Knowledge Elicitation Techniques

There are ranges of methods that can be used to elicit domain knowledge from experts. A method is defined as ordinary if it is one an expert informally approve when expressing or showing expertise. Such methods involve interviews or the observation of real problem solving. There are other techniques describe in which the expert assumes an arranged task. The major approaches to knowledge elicitation were given a comprehensive explanation of methods that were probable to be of usage. There are many variations on the approaches this research has described. Below this research has provided taxonomy of approaches as following.

Interviews

Usually, everyone begins in knowledge elicitation by defining to use an interview method. The interview is the most normally used knowledge elicitation method, and it profits many forms. Three types of interview are commonly well known within the knowledge engineering community. The interview methods are the unstructured, semi-structured and the structured interview. In all instances, the main purpose of the interview is to elicit information regarding how a specific task is presented or how a specific decision is made.

In the entire interview methods revealed to this point and in some of the other techniques there also exist a number of risks that have become acquainted to practitioners of knowledge elicitation. One risk is that in an interview experts will only generate what they can express. If there are non-verbalizable aspects to the domain, the interview will not recuperate them. It may be that the knowledge was never obviously signified or articulated in terms of language: deliberate, for instance, pattern recognition expertise. Subsequently there is the condition where the knowledge was formerly studied obviously in a propositional or language-like form. However, during experience such knowledge has developed to be routinized or automatized. This can ensue to such coverage that experts may concern the complicated decisions they create as based only on feelings or intuitions. In real fact, these results are based on great amounts of memorized data and experience and the repeated application of knowledge.

The structured interview is an official version of the interview in which the individual eliciting the knowledge strategies and directs the meeting. A meaningful benefit of the structured interview is that it provides structured transcripts, which are easier to analyze than unstructured discussions. This performs to improve the effectiveness of the structured interview, and it also allows the elicitor and expert to emphasize their attention on a controlled division of important issues.

Additionally, semi-structured interview method is the teaching back that is technique of Johnson and Johnson (1987). In this semi-interview method, the expert clarifies something to the elicitor who then efforts to describe it to the expert that the knowledge is efficiently 'taught back' to the expert. The expert subsequently has an opportunity to verify and, if necessary, adjust the information and knowledge.

Unstructured interviews have no detail agenda arranged either by the knowledge elicitor or by the expert. Obviously, this does not mean that the elicitor has no aims for the interview, but it does mean that it has significant scope for progressing. As stated previously, the unstructured interview is suitable for a multiplicity of purposes. First, the method can be applied when one of the objectives of the interview is to start an understanding between the knowledge elicitor and the expert. There are no official obstructions to the discussion covering all substantial either participant understands well. Then, one can become a comprehensive view of the topic easily; the knowledge elicitor can fulfill in the gaps in their own perceived knowledge of the domain. Next, the expert can explain the domain in a technique with which expert is accustomed, deliberating topics that expert considers significant and disregarding those expert reflects uninteresting.

Protocol Analysis

Protocol Analysis (PA) is a general expression for a number of different techniques of presenting some method of analysis of the experts essentially solving problems in the domain. In all situations, the elicitor records of what the expert does using written transcripts or preferably a video or audio recording. Protocols or transcripts are then completed from these records and the elicitor attempts to extract significant structure, instructions and procedures from the protocols or transcripts.

The emphasis and depth of the analytic determinations is usually is verbalized by the aims of the knowledge elicitation practice. If the goal is to comprehend the sequential ordering of tasks in the context of some greater business process, this will need a fewer detailed type of protocol analysis compared to conditions where the purpose is to develop a computational model of the mental procedures related with problem-solving behavior.

When suitably elicited, non-verbal and verbal protocols can support to clarify the normal following flow of thinking and operating, and they are valued elements of the analyst's knowledge elicitation tool. Despite this, protocol analysis does have its have limits. First, protocol analysis methods distribute with the unstructured interview the problem that they may provide unstructured transcripts that are difficult to analyze. Additionally, they emphasize on specific problem cases and the scope of the knowledge produced may be extremely limited. It is difficult to originate typical domain principles from a restricted number of protocols. These are some of the disadvantages of protocol analysis. Though, there are more understated problems. For instance, two actions, which look precisely the same to the knowledge elicitor, may be very dissimilar in their intent and extent. The knowledge elicitor basically does not know enough to distinguish the actions.

Concept Sorting

The concept sorting that is dissimilar to interview techniques and protocol analysis is a form of arranged knowledge elicitation method that is probable to be unfamiliar to the domain expert. The method is suitable when the elicitors wish to elicit the dissimilar relationships that are between a fixed set of concepts. In the form of concept sorting that it was described an expert is obtainable with a number of cards on each of which is written a concept word. The cards are rearranged and the expert is questioned to sort the cards into either a fixed amount of piles or other to sort cards into any number of piles the expert discoveries suitable. This procedure is repeated various times.

Using this card sorting one attempt to become various views of the structural association of knowledge by inquiring the expert to do the card sorting over and over again. Each time the expert sorts the cards; the expert should make at least one pile that varies in some technique from earlier sorts. The expert should also provide a name or category label for each pile on each different sort. Doing a card sort needs the elicitor to have some fundamental concept of the domain. Cards have to be prepared with the suitable labels before the meeting. However, no great understanding is needed as the expert provides all the considerable knowledge in the procedure of the sort.

This study uses interview approach to elicit domain knowledge from experts, which it is appropriate method. Semi-structure and unstructured interviews are used to capture appropriate technology domain knowledge for non-educated science farmers.

2.7.2 knowledge analysis

Knowledge analysis is a method to analyze problems or issues throughout a knowledge perception to comprehend problems or issues at a depth level and shape new insights about them. Occasionally this having new insights is adequate. One can form them to generate better solutions or determinations to problems or issues, build better services and products, begin alterations and innovations at other times.

Concepts, principles and models to support knowledge analysis; the terms and descriptions are provisional and developing.

Knowledge mapping: organizing and constructing information, knowledge and conceptions to create them simpler to access, understand and apply.

Models of guidance and learning: distinguishing between instructions, various form of knowledge, information, skills and decision.

The path to mastery: how persons learn and develop along the path from beginner to expert to master and how this path modifies with distinctive disciplines.

Changes in how they make sense of the worldwide: through our growth from childhood to maturity, the method they make sense of understanding the worldwide drives through a number of transformations.

The primacy of context: a precondition to understand something/someone is an understanding of what totalities they are a part of how understanding contexts makes a possible for re-structuring problems.

Distinctions: simplicity, understanding and learning typically need more and better distinctions.

Triple-loop feedback: the eventual in learning. A determined and subtle consciousness of all aspects of the outside domain delivers constant feedback for re-evaluating our aims, our activities and our strategies. There are two models of triple-loop feedback/learning which both provide understanding into performance enhancement.

Communication as reality: how persons communicate, comprehend and relate to each other. How knowledge, understanding and meaning are greatly influenced by social environments.

Technology as driver and enabler: how technology can assist in how they obtain, comprehend, exploit and disseminate knowledge. Their developing awareness generates and desires new technologies; which influence their developing awareness. It is an interdependent relationship.

This research use knowledge mapping as a toolkit for knowledge analysis to structure knowledge systematically.

2.7.3 Knowledge representation

Knowledge representation may be titled by different names such as organizing, codifying or customizing knowledge (Schreiber, 1999). The objective of this procedure is representing the domain knowledge to outfit the knowledge selection. Associating this process with SECI model, knowledge representation is transforming tacit knowledge into explicit as organized knowledge that is corresponding to the *externalization* mode in the SECI model. The representation of knowledge was done by writing, drawing or coding the knowledge into a codified format (e.g. process). Currently, the emergence of multimedia and information technology is that knowledge can be characterized in many forms and formats such as database, sound, video, picture, concept map, 3-D model, etc. These technologies create it possible for experts to coherent their tacit knowledge into explicit knowledge, which was almost unreasonable in the past.

A knowledge representation (KR) is most basically a replacement, a substitute for the article itself, used to allow an entity to define values by thinking rather than performing. It is an established of ontological commitments, i.e., a response to the inquiry.

A Knowledge Representation is a Replacement

Any intelligent entity that desires to cause about its world confronts a significant, inevitable detail: reasoning is a procedure that goes on inside, though most articles it needs to aim about exist only outside. A program or individual involved in preparation the assembly of a bicycle, for example, may have to purpose about objects like wheels, sprockets, handle bars and chains, etc. It purposes as a replacement inside the reasoner, a stand-in for the objects that exist in the world. Procedures on and with representations substitute for processes on the actual thing. In this reason is in part a substitute for action in the world, when we cannot or do not need to take that action. (Brachman and et.al, 1985)

Two minor explanations extend this view of representations as substitutes. Firstly, it performs to serve equally well for intangible substances as it does for tangible substances like gear wheels. Representations function as replacements for abstract ideas like actions, beliefs, procedures, connection, categories, etc., allowing them to be defined internal an entity so it can reason about them. Secondly, formal substances can obviously exist inside the device with perfect reliability. Mathematical articles, for instance, can be captured precisely, accurately because they are official substances. As nearly reasoning task will confront the requirement to deal with natural substances (i.e., those confronted in the real world) as well as official substances, imperfect substitutes are pragmatically unavoidable.

The importance of the inaccuracy may of course contrast; certainly much of the art of choosing a good representation is in result one that reduces or possibly even eliminates inaccuracy for the particular task at involvement. But the unavoidable imperfection of substitute's means can supply as a minimum one certification for any article reasoning in any approach about the environmental world. Representation only an entire inference thus does not allowed reasoning from mistake; it can only certify that inference is not the basis of that error. Assumed that comprehensive based reasoning will unavoidably be wrong, the step from an entire inference to other models of inference is thus not a transfer from entire accuracy to error, but is in its place a query of balancing off the probability of one more source of error against the efficiency that it may offer.

A Knowledge Representation is a Set of Ontological Commitments

That is choosing a representation method making a set of ontological commitments. (Brachman and et.al, 1978). The commitments are in result a strong pair of glasses that define what they can realize, carrying some part of the world into high-pitched attention, at the expense of distorting other parts. These commitments and their concentrating effect are not a related side effect of an illustration choice. A knowledge representation is a set of ontological commitments. It is *inevitably* so because of the unavoidable inadequacies of representations. It is *usefully* so because sensible selection of commitments offers the opportunity to emphasize attention on features of the world we believe to be applicable.

The concentrating result is a vital part of what a representation offers, because the complexity of the ordinary world is overwhelming. The glasses provided by a representation can offer that guidance: In effective what and how to see, they allow that to cope with what would then be unsustainable complexity and aspect. Hence the ontological commitment created by a representation can be one of the most important contributions it suggestions.

There is a record of work trying to form good ontologies for a variability of task domains, including early effort on an ontology for fluids (Hayes, 1978) the lumped component model extensively used in representative electronic circuits (Davis and et.al, 1991) as well as ontologies for belief, period and even programming itself. Ontologies can be written down in an extensive variability of languages and notations (e.g., logic, LISP, etc.); the crucial information is not the arrangement of that language but the content, i.e., the set of concepts proposed as an approach of thinking about the domain. The important part is notions like components and networks, not whether they select to write it as predicates or LISP concepts. The commitment that creates by choosing one or another ontology can make a different vision of the task.

The ontological commitment of a representation consequently starts at the level of the representation technologies and collects from there. Additional levels of commitment are created as they placed the technology to work. The prototypes are proposed to capture prototypical diseases (e.g., a "classic case" of a disease), and they will be systematized in a taxonomy indexed about organ systems. This is a reasonable and perceptive set of choices but obviously not the only way to operate frames to the task; so it is another level of ontological commitment.

Consider for example defining which of the resulting is to be considered *diseases* (i.e., abnormal states necessitating cure): homosexuality, alcoholism and chronic fatigue syndrome. The ontological commitment is adequately noticeable and adequately important that it is frequently a subject of discussion in the field itself, quite independent of constructing automated reasons. Commitment to a specific view of the world consequently starts with the choice of a representation technology, and accumulates, as following choices are prepared about how to see the world in those terms.

A Knowledge Representation is not a data structure

The selections being prepared are representation, not data structures. Part of what builds a language representational is that it conducts meaning (Hayes, 1979), i.e., there is a correspondence between its concepts and items in the external world. That correspondence in turn conducts with it restraint.

For instance a semantic is a representation, though a graph is a data structure. They are different types of articles, even though one is always used to apply the other, exactly because the net should have a semantic. That semantics will be obvious in part because it restrains the network topology: a network claiming to define family memberships as they know that cannot have a cycle in its parent relations, while data structures are obviously under no such restraint and may have random cycles. Though every representation must be *implemented* in the system by some data structure, the representational property is in the equivalence to something in the world and in the restraint that correspondence insists.

The ontology will be used as knowledge representation to improve learning behavior of non-science educated farmers.

2.7.4 Knowledge Validation

A process is exposed to structural criteria to determine their reliability and value by knowledge claims. A knowledge validation process starts when an expert proposes a document comprising a codification of some part of experts' knowledge, and finishes when that contribution is either established for attachment in a repository, or excluded. The repository cannot accomplish validation automatically instead (Marwick, 2001); measuring quality needs the perceptions of peer reviewers or substance matter experts (Markus 2001, Soo *et.al* 2002). However, characterizing validation procedures as a simple categorization mechanism fails to allow for the meaningful impact such procedures may have on contributors who must cooperate with them (Ashford 1996, Graham *et.al* 1985, Miner 2003) to improve understand these consequences, drawing on two established bodies of theory: the literature on indicating theory assistances clarify how validation procedure characteristics can affect individuals' insights of repository quality, whereas the literature on strengthening theory is useful in foreseeing how the same procedure characteristics affect real contribution behaviors.

The perceptions of knowledge validation procedures might perform significant roles in manipulating individuals' contribution behaviors. The initial findings with knowledge managers and knowledge contributors to identify the significant characteristics that contributors are accomplished of observing and forming decisions about. This process congregated on three key characteristics: Firstly, The time lags between submission of a new contribution and a judgment by a reviewer. Secondly, the scope to which knowledge contributors can detect the validation process in action. Finally, the restrictiveness is overall elimination rate of the validation process.

Validation and verification include a set of methods used in software engineering and, so, in knowledge engineering to assess the quality of software systems including knowledge-based system. There is frequently misunderstanding about the difference between validation and verification, but the conventional interpretation is that *verification* is the procedure of proving whether the software system encounters the *specified* requirements of the users, while *validation* is the procedure of testing whether the software system encounters the *actual* requirements of the users. Boehm remarkably characterized the difference as follows (Boehm, 1984): *Verification* is constructing the system right. *Validation* is constructing the right system.

Verification can be observed as a part of validation. It is improbable that a system that is not built accurate to be the accurate system. However, verification is improbable to be the entire of validation, because of the difficulty of capturing identifying user requirements. As noticed above, this is a particularly significant difference in knowledge engineering. Obviously, the aim in software and knowledge engineering is to attempt to certify that the system is both constructed right and the right system; that is, the aim is to construct the right system, right.

This is significant where knowledge-based system technology is used in knowledge management: validation and verification methods provide techniques to measure the characteristic of knowledge in a knowledge base, and to signify where work desires to be done to correct uncharacteristic knowledge. In this situation, verification expresses that whether or not the knowledge bases are imperfect as software artifacts, whereas validation expresses that whether or not the matter of the knowledge base accurately signifies the knowledge of the human experts that contributed it. Both are obviously vital. It is value noting in this situation that verification is fundamentally an objective test: there are complete measures of the acceptability of a piece of software. However, validation is usually subjective to a certain scope, where these must compare officially represented knowledge to informal declarations.

The validation and verification approaches can be applied in knowledge engineering is undetermined (Meseguer, 1995), but it is indeed impractical to expect formal verification to serve as the only validation and verification technique in a knowledge-based system development project, because it will rarely be achievable to certify that the formal specification is a comprehensive and acceptable statement of the users' requirements. Therefore, knowledge-based system validation and verification will usually essential to involve various methods, including formal verification against formal specifications where are possible, and empirical validation which is including operating test cases and evaluating the system in the operational setting (Preece, 1990). This is especially significant in the perspective of knowledge management, where a great part of validation will be essentially subjective: proving that the signified knowledge correctly captures what’s going on in an expert’s mind.

The final point mentions to the *capability* of the knowledge engineers, and reveals the modern view of software quality being determined mainly by the feature of the development procedure (Preece, 1995). Validation and verification methods support in determining maintainability, and a repeatable validation and verification capability is a precondition for achievement in knowledge engineering. Maintainability is also of enormous significance in knowledge management, where an organization's knowledge bases will usually develop over the organization's generation.

Consideration of the significance of validation and verification to effective knowledge engineering and knowledge management increases another question: how successful are the knowledge-based system validation and verification methods in existing use? Apparently, if the methods are incomplete or unreliable, subsequently they cannot be reliable to provide measurement of software quality and project achievement.

The knowledge from appropriate technology in this study, which relies on expert experience, is based on social scientific domain knowledge. Knowledge engineering is a means of mining and eliciting and knowledge from experts and can be seen as encompassing methods and techniques for knowledge acquisition, modeling, representation and usage (Uschold, M. & Gruninger, M., 1996,) Many knowledge engineering methodologies have been developed over the years e.g., CommonKADS (Uschold, M. & Gruninger, M., 1996, Protégé Schreiber, Akkermans, Anjewierden, Hoog, Shadbolt, Velde, & Wielinga, B., 2000, MIKE (Angele, J., Fensel, D., Landes, D. & Studer, R., 1998 & MOKA (Gennari, J. H., Musen, M. A., Fergerson, R. W. Grosso, W. E., Crubezy, M., Eriksson, H., Noy, N. F. & Tu, S. W., 2003). This research focuses on CommonKADS to capture knowledge which is one of the most widely used knowledge engineering methodologies. The CommonKADS model has variety of components such as the organization model, task model, agent model, knowledge model, communication model and design model. This research focuses on the knowledge model to structure the organic rice farming knowledge based on science and technology based framework derived from problem consideration, conceptualization, reasoning and implementation of a solution. Organic rice farming knowledge will be model based on each of the science and technology based method frameworks by CommonKADS in order to acquire scientific and technology knowledge for problem solving for organic rice farming case study. The scientific and science and technology knowledge were modeled into four corresponding parts; task knowledge, inference knowledge domain knowledge and ontology knowledge.

The four main parts are linked to task knowledge, which describes the knowledge-intensive tasks of the organic rice farming; inference knowledge, which describes using knowledge to carry out the reasoning process; domain knowledge, which refers to knowledge of human experts based on their experiences; and ontology knowledge, which describes specification of conceptualization of organic rice farming experts.

2.8 CommonKADS

Knowledge engineering is a means of mining and extracting knowledge from experts and can be seen as encompassing methods and techniques for knowledge acquisition, modeling, representation and usage (Schreiber, 2000). Many knowledge engineering methodologies have been developed over the years, e.g., CommonKADS (Schreiber, 2000), Protégé (Angele, 1998), MIKE (Gennari, 2003), and MOKA (Martine, 1999). This research focuses on CommonKADS to capture knowledge, which is one of the most widely used knowledge engineering methodologies.

Knowledge model provides the way of expert thinking, which people learn from could think as an expert. Figure 2.2 shows a CommonKADS framework model. The CommonKADS model has variety of components such as the organization model, task model, agent model, knowledge model, communication model and design model. This research focuses on the knowledge model to structure the appropriate technology knowledge from sustainable development projects based on social science reasoning: biology, physics, chemistry and mathematics based framework derived from problem consideration, conceptualization, reasoning and implementation of a solution. Figure 2.3 illustrates the knowledge model of CommonKADS.

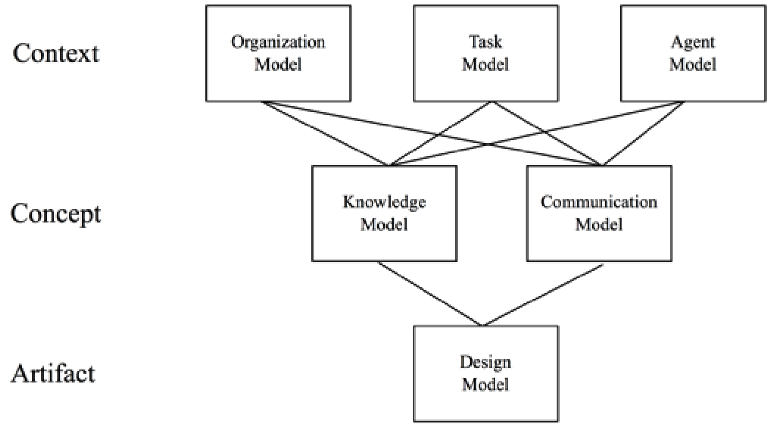

Figure 2.4 The framework of CommonKADS

Appropriate technology knowledge will be model based on each of the social scientific reasoning based method frameworks by CommonKADS in order to acquire social scientific knowledge for problem solving for knowledge workers case study. The social scientific knowledge was modeled into three corresponding parts; task knowledge, inference knowledge and domain knowledge. The three main parts are linked to task knowledge, which describes the knowledge-intensive tasks of the sustainable development projects; inference knowledge, which describes using knowledge to carry out the reasoning process; and domain knowledge, which refers to knowledge of human experts based on their experiences.

CommonKADS viewpoint for *Common* Knowledge Acquisition and Design System, which is a current form of KADS. The approach purposes to support structured knowledge engineering. It signifies the bottlenecks and opportunities in the organizations, allocates and applies their knowledge resources, and so provides toolkits for corporate knowledge management. It also provides the approaches to present a comprehensive analysis of knowledge-intensive tasks and procedures. CommonKADS provides the development of knowledge systems that provide designated parts of the business process (Schreiber, 1999).

CommonKADS methodology proposed a structured method to break down and construct knowledge engineering procedure. It offered CommonKADS model suite for generating requirements specifications for knowledge system as shown in Figure 2.2. The technique supported a top-down approach and offered responses for feasibility assessment and quality control.

Context level analyzes the organizational situation and the consistent critical success issues for a knowledge system.

Organization model specifies the analysis of the main features of an organization, in order to determine problems and prospects for the knowledge system, determine their feasibility, and measure the impacts on the organization of envisioned knowledge engagements.

Task models are the applicable subparts of a business progression. The task model analyzes the worldwide task design, a business progress's input and outputs, requirements and performance criteria, as well as required resources and capabilities skills.

Agent models are the representatives who are the initiators of a task. It defines the personalities of agents, especially their competences, authority to perform, and restrictions in this particular. Additionally, it lists the communication relations between agents in carrying out an intensive-task.

Concept level supports the conceptual description of problem-solving purposes and data that were conducted and distributed by a knowledge system.

Knowledge model clarifies in detail the form and structures of the knowledge used in accomplishment a task. It offers an implementation-independent explanation of the function that distinctive knowledge elements show in problem solving issues, in a method that is understandable by human mind.

Communication model presents transaction between the agents participating in a conceptual and implementation-independent method, with the knowledge model.

Artifact level incorporates the above levels together in the design model to structure the requirements specification for the knowledge system.

Design model provides the methodological system specifications in term of architecture, representational constructs, implementation platforms, computational mechanisms and software modules required to implement the roles placed down in the knowledge model and communication model.

In terms of knowledge procedures, CommonKADS methodology offers knowledge templates for supporting the knowledge modeling procedure that establish predefined reusable knowledge models and which have confirmed to work at one time. This methodology concerns all knowledge activities i.e. create, store, retrieve, disseminate, illustration and application. Though, knowledge distribution approaches did get considerably consideration in this methodology. The concept of network and organizational culture are analyzed in organizational model in the context level. While this technique did not provide a particular process for conducting a specific task, it is comprehensive enough to be able to apply in any knowledge intensive task. This methodology is mentioned for knowledge management projects that affect the knowledge conversation between agents in inter-organization and intra-organization

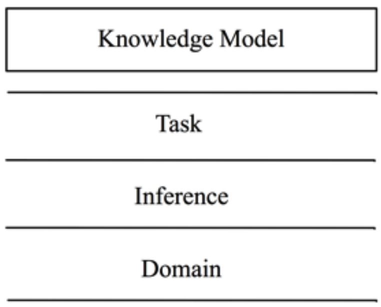

Figure 2.5 Knowledge Model of CommonKADS Template

Task Knowledge: A kind of expert knowledge is the task level. This is occasionally named procedural knowledge. This is knowledge involved with goals, sub-goals, and tasks.

Inference Knowledge: There is also knowledge and expertise that has to do with what is named in the inference level. This is knowledge about how the elements of expertise are to be systematized and used in the overall system. It expresses us the kind of inferences that will be created and what function knowledge will perform in those inferences. This is rather a great level description of expert behavior and might frequently be implied in human expert practice.

Domain Knowledge: This term is being used in the limited appreciation of knowledge that defines the concepts and components in the domain and relations between experts. This category of knowledge is sometimes mentioned to as declarative knowledge that it explains what is known about things in the domain knowledge.

2.9 Ontology

2.9.1 Specification and conceptualization

The "explicit specification of conceptualization", derives from Thomas Gruber. The particular meaning depends on the understanding of the terms "specification" and "conceptualization". Explicit specification of conceptualization means that ontology is an explanation of the conceptions and relationships that can exist for a community of agents or an agent. This explanation is reliable with the usage of ontology as set of concept explanations, but more typical.

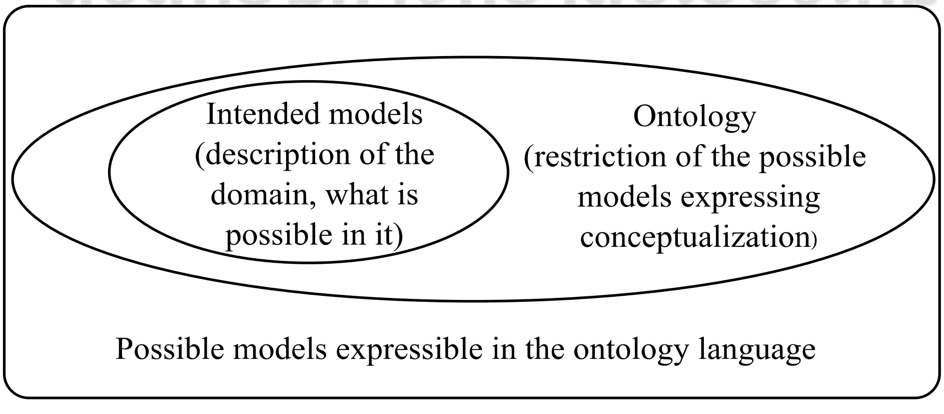

Figure 2.6 Ontology expressing intended models for description of the domain

A conceptualization can be stated as a purposeful semantic structure that determines embedded knowledge restraining the structure of a piece of a domain. Ontology is a specification of this structure partially, i.e., it is typically a logical theory that states the conceptualization obviously in some language. Conceptualization is independently language, while ontology is language dependent. The usage can be illustrated in the Figure 2.4 it displays how ontology confines possible usage of concepts used in the description of the domain. Notification that ontology does not have to exact all the possible restraints that the details in conceptualization depends on the intended application requirements and stating conceptualization in ontology, furthermore depends on the ontology language usage.

In this purpose, ontology is important for the determination of enabling knowledge sharing and reuse. Ontology is in this perspective a specification used for creating ontological commitments. Basically, an ontological commitment is an understanding to use a vocabulary (i.e., ask queries and make assertions) in a condition that is reliable (but not complete) with particular to the theory identified by ontology. Agents subsequently commit to ontologies and ontologies are proposed so that agents could share the knowledge.

The knowledge representation is based on the specification of conceptualization. A conceptualization is an intangible, simplified understanding of the world that wishing to indicate for some commitment. All knowledge-based systems or agents are committed to some conceptualization, obviously or implicitly. When the domain knowledge is characterized in a declarative formalism, the objects that can be characterized are named the universe of discussion. This objects and the describable relationships among them are revealed in the representational vocabulary with which a knowledge-based represents knowledge. Therefore, in the context of AI, the ontology of a program can be clarified by defining a set of representational terms. In such ontology, characterizations associate the terms of entities in the general of discussion (e.g. associations, classes, functions, or other objects) with explanations of what the names mean, and official axioms that confine the clarification and well-formed use of these terms. Officially it can be seen that ontology is a declaration of a logical theory.

Ontologies also work a vital role in the selection or construction of a representation formalism to demonstrate knowledge. Explaining conceptualizations, and consequently choosing ontological commitments, is a crucial component of the task of representing knowledge, because conceptualizations select that things are appropriate to be represented and these are not (Davis *et al.*, 1993). Demonstrating knowledge involves both the design of the formulation of a particular set of sentences in this language and a knowledge representation language which define certain things in the world such set of sentences is typically named a knowledge base. Ontological commitments lead to the explanation of both the knowledge base and the knowledge representation language that the difference existence that the representation language provides a minimum set where the effects of the commitments occur as organization and inference facilities. A suitable illustration is Allen's ontology of time (Allen, 1984).

A conceptualization is an abstract object, which is only implicit in a knowledge representation. Ontology is a specification of a conceptualization (Gruber, 1994). It involves a description of the concepts, substances, and relations, which build up a conceptualization. One of the fundamental roles of ontology is to enable the learning of ontological commitments and conceptualizations in their own, i.e. disassociated from the knowledge representations they might generate. Another significant role is to provide knowledge sharing and reusability (Neches *et al.*, 1991, Patil *et al.*, 1992, Gruber, 1994).

The ontology is frequently known as taxonomy, which is a classification of things in a hierarchical form. It is characteristically a tree or a pattern, which definite sub summation relation (i.e., A includes B meaning that everything that is in A is also in B). An instance is classification of living systems. The taxonomy normally constrains the proposed usage of classes, where classes are subsets of all set of potential individuals in the domain.

Nevertheless**, ontologies require not being limited to taxonomic hierarchies of**

classes and requiring not being limited to descriptions that only present terminology and do not enhance any knowledge about the world. To indicate a conceptualization, axioms, which restrain the potential interpretations for the described terms may be also required. Practically, ontology expresses the vocabulary with which inquiries and declarations are substituted among agents. The ontological commitment is formerly an agreement of reliability for communications.

Recently, ontology has been used in a wide variety of research (e.g. Anuma *et.al* 2008, Saito *et.al.* 2007, Chou *et.al.* 2008). Ontology is a shared common language or vocabulary, which describes how things are organized in a particular domain and provides a shared common understanding of the relationship between people and computer (Uschold *et.al,* 1996). Additionally, ontology eliminates the problems of conflicting meanings and terms during content retrieval. The role of ontology is to promote the reuse of knowledge structures in the form of ontology libraries. The main objective of an ontological library is the description of knowledge conceptualization related to large amounts of domain knowledge.

Ontologies are currently considered for representing semantic information. However ontological design is a challenging task, requiring the collaboration of organization experts and ontology engineers. Hence, ontologies are manually created and adjusted, which results in a static domain information model, occasionally modified. Nonetheless, once designed their general type makes them a great mechanism for application interoperability. Without general ontologies, interoperability becomes an indeterminate process, which may not be acceptable for some applications.

Ontology analysis the word *ontology* defines "the study of the state of being." Ontology explains the states of being of a specific set of items. This explanation is typically made up of truisms that describe each thing. In knowledge representation, ontology has developed the essential term for the part of a domain model that eliminates the *instances*, yet defines what they can be. Ontological analysis is the process of expressing this part of the model.

What builds up a specific domain ontology is limited by the representational abilities of the *meta-model* that the language used to structure the model. Each knowledge representation language varies in its approach and variety of expression. Generally, ontology comprises of three definitions: *role* definitions, *concept* definitions, and additional inference definitions.

The concept definitions establish all the *kinds* of objects in the domain. In object-oriented conditions this is named the class definitions, and in database conditions these are the entities. There can be three aspects to the concept definitions:

Firstly, concept taxonomy, the taxonomy is common to knowledge representation languages, and throughout it is stated the description of the categories in expressions of generalization and specialization. Secondly, role defaults that indicate for each concept what the default standards are for any characteristics. Thirdly, role restrictions that identify for a concept any limitations on the standards in a role, such as what types the standards must be, how many standards there can be, etc.

Roles that signify relationships are unidirectional. A role definition could have three parts:

- The role taxonomy that specifies the specialization association between roles. For instance, ontology for defining vehicles might include roles termed has-engine, has-headlights and has-seats, which relate objects that signify vehicles to objects that characterize engines, headlights and, seats respectively. The role has-parts, then, could be uttered as the simplification of all these roles, and the consequence is that all the values of all the more particular roles would also be values of the more overall role.
- Role inverses that specify a form of inference that permits the accumulation of a role in the conflicting direction when the advancing link is completed. For instance, if the inverse of has-engine was engine-of, subsequently when the has-engine connection between the object that signifies the vehicle and

the object that signifies the engine is created, the engine-of linkage will automatically be additional between the engine object and the vehicle object.

- Role restrictions may be expressed that it can only perform between objects of certain forms: domain/range restrictions, or can only perform an indicated number of times: cardinality restriction. This is the same information stated in role restriction for conceptions, some representation languages deliberate this information to be part of the role, and some deliberate it to be part of the conception.

2.9.2 Roles of Ontologies in Knowledge Engineering

Three levels of ontology can be differentiated in knowledge engineering: top, core and domain ontology. Each of these levels has its particular use or roles. The distinctive purposes of reuse of ontologies place distinctive requirements on ontologies. The qualitative requests rise with the instruction presented below, *i.e.* the requirement for cautious and effective analysis and in specific for a formal base come to be greater (Guarino, 1995, Guarino, 1998) on the perception of proper ontology.

Domain ontologies comprise the concepts of some domain of application: Domain ontologies could be used not directly correlated to constructing knowledge systems, but as repositories for information and systematizing knowledge. These ontologies could also directory-distributed knowledge in corporate knowledge, or comprise common, consistent terminology in expert or scientific communities.

An additional role, related to the preceding one is in knowledge acquisition where groups have to effort together and an ontology turn out to be a common, approved upon understanding of the terminologies in a domain, that can be read by group members with dissimilar background knowledge (Gruber, 1994).

Ontologies build explicit to what conceptualization of terminologies a specific knowledge-based system is committed. In structuring a knowledge base some has to create commitments, so constructing them explicit in ontology supports more controlled development and maintenance of a knowledge-based system. Ontology is more than a simple specification or documentation. It has a quality assurance character and strong justification, because ontology provides reliable use of terms. For example, when the domain is about vehicle maintenance, the term "vehicle" has a distinctive meaning, *e.g.* it is a device, than in the context of vehicle sales, where a vehicle is a product. This role is the standard any in the perspective of knowledge engineering methodology (e.g. (Wielinga *et al.*, 1992), (vanHeijst *et al.*, 1997))

The most frequently mentioned role is in qualifying reuse of knowledge for constructing new applications for the same domain. Though the preceding role is possibly the most often used currently in knowledge engineering, the main upcoming advantage is to be predictable from referring repositories of ontologies aggregated from projects or previous experiences.

Core ontologies include the categories that describe what a field is concerning. A field is about area of practice, discipline or industry that unites several application domains, as e.g. particular subfield of engineering, law, medicine, etc. The classifications are not certain common denominator of a set of application domains, but restrict what is applicable in these domains. As hypothesized by Valente, 1995, core ontologies have a practical character and reflect the main structure of reasoning or disagreement in a field.

The practical perception might be comprehensible by the fact that fields are usually fields of practice, frequently concerned with artifacts. As a result, kinds of knowledge can be distinguished by their roles. That these roles might also reflect the major structure of reasoning is more hypothetical, but may be considered as that domain knowledge is a model of a system in the world, and that reasoning refers some function on this simulated system, or the development of a system (Clancey, 1992). For example, in medicine the main classifications that construct up the core ontology are diseases, examinations and therapies, and the numerous disciplines that construct up our understanding of troubled biological procedures perform the role of supportive clarification (vanHeijst *et al.*, 1997). Also in electro-mechanical engineering, three main kinds of knowledge can be distinguished: organizational: a configuration of components, from which, specified the functional or behavioral explanation of the components, a behavioral explanation can be derived, which can be the contribution for quantification: mathematical modeling (Borst *et.al*, 1997).

Top ontologies: The role of a top ontology is that it can construct explicit what the ontological commitments are of certain domain ontology. The most difficult method to import a top ontology to a domain ontology is when the domain ontology is articulated by top ontologies, i.e. when the top ontologies have been operationalized as a illustration formalism extension inferential calculus. This role also happens for core ontologies. A core ontology might involve its own, distinctive formalisms, but might also extend or modify the more common versions of a top ontology. For example, permitted connection is an adapted interpretation on the more general notions of physical connection and purpose.

2.9.3 Ontologies in designing educational systems

The overview of environment, kinds and roles of ontologies proposes, that in designing and constructing educational systems, core ontologies may perform a prominent role. Top ontologies expose fundamental common sense, and are consequently not usual candidates for participating roles in education. However, as top ontologies define our common sense understandings on the world, they comprise the elements of our naive physics; biology *e.g.* autonomy and agent; psychology *e.g.* intention; belief and sociology *e.g.* communication. These naive concepts might interrelate with the acquisition of the more scientific versions and explanations educated at school. Also in the use of metaphors in instruction new subject substance, top ontologies might construct is more exactly conscious where metaphors may enable and where they may break down. For example, the hydraulic metaphor for electricity does not clarify the behavior of induction. Domain ontologies may have a significant role in reuse, similar in knowledge engineering in general. The content of education could be mainly continuous in a culture, but the educational circumstance in a context may simply differ in needs and favorites about educational methods.

This study develops ontologies of knowledge gained from the appropriate technology knowledge from sustainable development projects and agricultural academic researches and Thai core curriculum for local community people in remote areas of Thailand. Structured knowledge could be more useful and effective for rural community to learn from and apply to develop their communities. In this context, a formal social science ontology is used to provide benefits, by sharing and reusing knowledge of the appropriate technology knowledge from sustainable development projects and agricultural researches and among academic researchers, local community people in case study. The knowledge from the experts' experience, which is scattered in different areas of Thailand, could be gathered, shared and reused via appropriate ontological knowledge management and agricultural researches. This could improve management performance in multiple sustainable development projects and academic researches. The methodology in this research utilized social science ontology-based knowledge management to gather, share and apply scientific knowledge from the academic researches and appropriate technology knowledge from sustainable development projects.

2.10 Annotation

Annotation approaches can associate with particular domain in a document to broader concepts and valuable domain knowledge stored in a knowledge base and ontology (Handschuh, 2005). The typical principle of annotation is not about trying to attribute a label to every word but it is finding those things, which are listed in the instructions. The annotations could not intersect with each other, or be contained within each other, unless the specific instructions allow this. Moreover, all set of annotations must be the work of a single annotator only and will be of an only document in separation, and would not consider other documents. Machines for automation purpose could not proficiently achieve the concepts, domain knowledge or ontology from unstructured document (Gruber, 1993). Accordingly, the creation of semantic annotation associated with document content.

2.11 Semantic Annotation

Semantic Annotation (SA) attaches a term or extent of particular domain to a semantic database or ontology or domain concept where additional information and knowledge are stored. The semantic annotation approach proposes a framework of semantic web for constructing such metadata that it denotes to the procedure of indexing and retrieving useful domain knowledge from documents, therefore, generating annotation or metadata on top of documents. This annotation is well expressed for a specific domain using appropriate syntax and semantics, thus, the objective of semantic annotation is to create metadata, which can be exploited by both manual annotation and automated annotation by machines.

There are two basic semantic annotation tools for producing semantic annotations which are automatic and manual semantic annotation. The automatic annotation provides recommendations for annotations that could operate many more documents. However, this automatic annotation is less precise and still requires intervention by knowledge workers. The most fundamental annotation tools allow annotators to manually generate annotations that are more accurate and in common with virtuously documented annotation tools but provide some support for ontologies. This research uses manual semantic annotation technique on Bloom's taxonomy vocabulary to measure learning process of non-science and technology educated organic rice farmers. (Uren and et. al, 2006).

Table 2.2 The critical review of problem and solutions for non-science educated learning process behavior

Critical Review	Concepts/Theories/ Tools and Techniques		Reasons
	Old	Recent	
1. Problems	Non-science and technology educated rural people	Social science and technology knowledge	Social science and technology knowledge can improve learners to understand and apply appropriate technology for their community problem-solving
2. Solutions	Domain knowledge from experts (experts' jargon)	Knowledge Engineering	Domain knowledge (experts' jargon) will be elicited systematically by knowledge engineering into task, inference, domain concept and social science ontology
	Training domain knowledge of appropriate technology from sustainable	Tutorial social science ontology	Tutorial additional social science ontology to learner before training domain knowledge that has a lot of experts' jargon and social

Table 2.2 The critical review of problem and solutions for non-science educated learning process behavior (continued)

Critical Review	Concepts/Theories/ Tools and Techniques		Reasons
	Old	Recent	
2. Solutions (continued)	development projects and academic research		science technology vocabulary can assist learners to understand appropriate technology knowledge much more better and improve their learning process behavior
	No learning process behavior measurement	Semantic annotation on Bloom's Taxonomy vocabulary	The measurement of learning process behavior uses semantic annotation on Bloom's Taxonomy that can assess cognitive level of learners of learning outcome

2.12 Conceptual Framework

This study has mainly concerned with transferring an appropriate technological knowledge for people who have not enough basic education unsuccessful today because most rural farmers lack science and technology knowledge which is important to understand and apply appropriate technology to enhance their community. The finding of appropriate technology knowledge transfer is rural farmers in Thailand who have not enough of basic education and science technology knowledge to understand and apply appropriate technology domain knowledge or expert's jargons for solving their rural community problems successfully. According to Thai education system provides 9 years: Pratom 6 of compulsory education, with 12 years: Mattayom 3 of free basic education guaranteed and set by the 1999 National Education Act. In 2003, compulsory education was extended to 9 years, with all students expected to complete with 15 years: Mattayom 6 (Ministry of Education, Thailand, 2008). Most of rural people in Thailand had education at elementary education level which are elementary school (Pratom 4-Pratom6) 92.58%, lower secondary school (Muttayom 1-3) 46.82% and upper secondary school (Muttayom 4-6) 25.29%. (Office of the Permanent Secretary, Ministry of Education, 1992). Moreover, it can be seen from Office of the Permanent Secretary, Ministry of Education, (2013) that most rural people at 91.36% in Thailand complete elementary education level more than other levels. The findings highlight a lack of specification of conceptualization understanding in basic education level of rural community people in Thailand being unsuccessfully transferred appropriate technological knowledge, which is maintained in the sustainable development projects.

The conceptual framework of this research provide that the social science and technology ontology in appropriate technological knowledge should be the keystone of sustainable development projects, which knowledge workers need to understand and solve real world problems. The requirement to remember and understand expert's specification of conceptualization means a method is needed to transfer appropriate technology and academic research knowledge from multiple sustainable development projects via additional social science ontology knowledge as knowledge representation. Ultimately, appropriate technological knowledge can be shared and reused in order to solve rural community problems. Furthermore, rural communities can learn from collaborative and expert experience to create new solutions to problems. Accordingly, it is necessary to manage appropriate technology knowledge and an additional ontology is needed to extend this appropriate technology knowledge to other social landscapes across Thailand. This research aims to propose a tutorial ontology effectiveness modeling on organic rice farming using knowledge engineering. This ontology knowledge model will deal with the specification of organic rice farming conceptualization of the sustainable development projects in Thailand, using Phrao District in Chiang Mai Province, Thailand as a case study. The additional social science ontology knowledge developed in this research provides such a support to vocational learning and used by rural community in the case study to effectively navigate and utilize the appropriate technological knowledge of the sustainable development project knowledge to enhance their communities and vocational life long learning. (Shown in **Figure 2.5**)

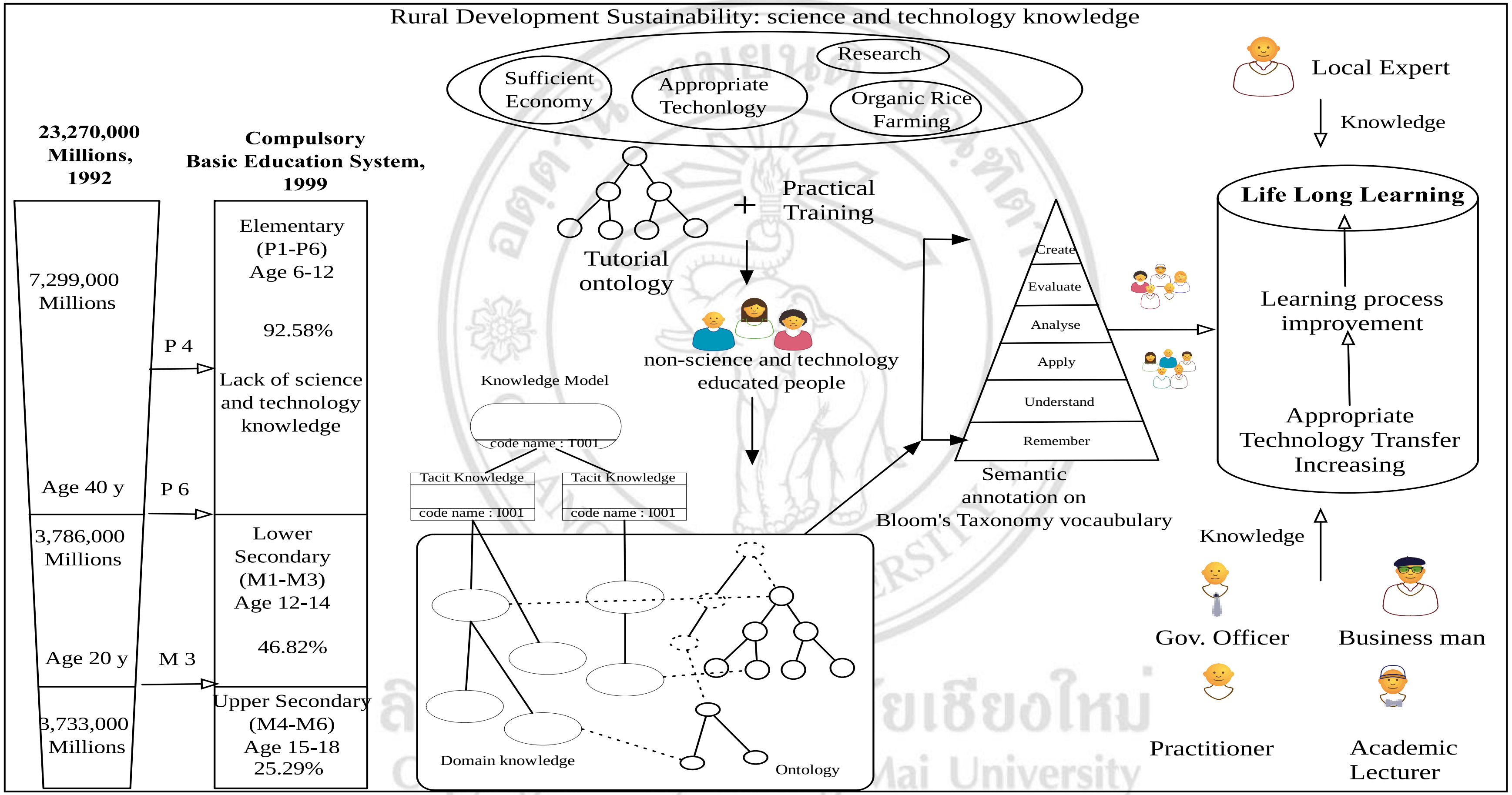

Figure 2.7 Conceptual Framework