
**USING CASE BASED REASONING FOR KNOWLEDGE MANAGEMENT
AMONG SMALL SCALE FARMERS IN NDAGANI REGION OF RURAL
KENYA**

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ABSTRACT

Agriculture is a key pillar of Kenya's GDP. In Ndagani area, Tharaka Nithi County of rural Kenya there are many small scale farmers. Some of the farming practices carried out by these farmers include small scale dairy farming, poultry farming, pig farming, tea farming, coffee farming and horticulture among others.

For farming effectiveness, farmers need adequate access to information and knowledge in areas such as improved seedlings, fertilizers, new agricultural technologies, credit facilities, market facilities as well as early warning systems such as droughts, diseases and pests. This knowledge may exist usually in documents, websites, files, computer databases but also within people.

Previous research has shown that the small scale farmers in Ndagani primarily share agricultural knowledge via informal oral communication which essentially makes preservation as well as the dissemination of the knowledge difficult. For knowledge to be of benefit, knowledge management has to be effected. There are many approaches to manage knowledge, which the farmers could adopt. This paper explores one of these approaches namely Case Based Reasoning as an approach to knowledge management among small scale farmers in Ndagani, Rural Kenya.

Keywords: Knowledge, Knowledge Management, CASE Based Reasoning, Knowledge Based Systems, Artificial Intelligence, Farming

Knowledge Management

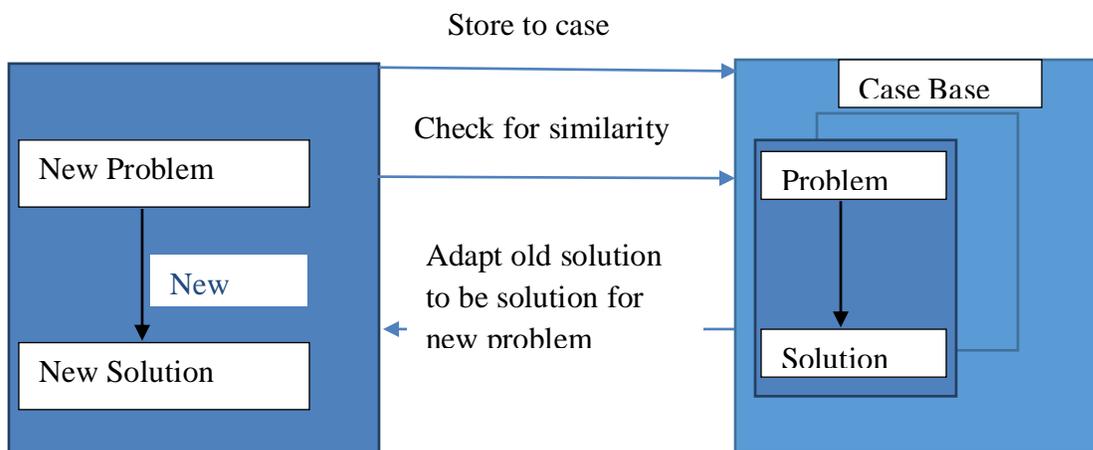
In the information age, knowledge rather than physical assets or resources is the key to competitiveness Moran (1999). Alavi and Leidner (1999) define knowledge as a justified personal belief that increases the individual's capacity to take action. According to Davenport and Prusak (1998), knowledge is processed data or a representation of information in a form that a computer system can utilize to solve a particular task. Nonaka and Takeuchi (1995) identify two types of knowledge namely tacit and explicit knowledge. Explicit knowledge is that which exists in documented format while tacit knowledge is that existing in people's minds as experiences, intuitions, heuristics, expertise or as rules of thumb.

Case Based Reasoning Systems

A Case Based Reasoning System is a type of a knowledge based system found under the broader field known as Artificial Intelligence. Knowledge based systems compute using stored knowledge. Other systems classified as knowledge based systems include Expert Systems and Artificial Neural Networks among others. While a system like an Expert system emulates a domain expert by capturing the knowledge and storing it in forms of rules, Case based reasoning system's knowledge is presented as a library of past cases in a case base. Case based reasoning systems attempt to copy how humans perform reasoning and learn from a psychological perspective. A new problem is solved by finding a similar first case and using it in the new problem situation. When a problem is successfully solved the experience is retained in order to solve similar problem in the future. When an attempt to solve a problem fails the reason for the failure is identified and remembered in order to avoid the same mistake in the future. Case Based Reasoning systems record experiences into cases which then correlate a current problem into an experience. A case is usually represented using three components namely:

- The problem- the problem for which a previous solution was found or for which a solution is being sought
 - The solution- the response derived for a problem
 - The outcome- the state of the world after the solution was applied
- Cases can be represented using numbers, text, multimedia, plans etc. It should be noted that cases are records of real events. Solved cases are stored in a case base.

The case based reasoning process can be explained using the following diagram:



Old problems for which solutions have been found are stored as cases in the case base. When a new problem is encountered, a check is made of the problem's similarity with any problem in the case base. If a match is found, the already existing solution to a previous problem is now adapted to solve the new problem. In all this an assumption is made that similar problems have similar

problems. The newly solved problem now becomes a case and is stored in the case base where necessary.

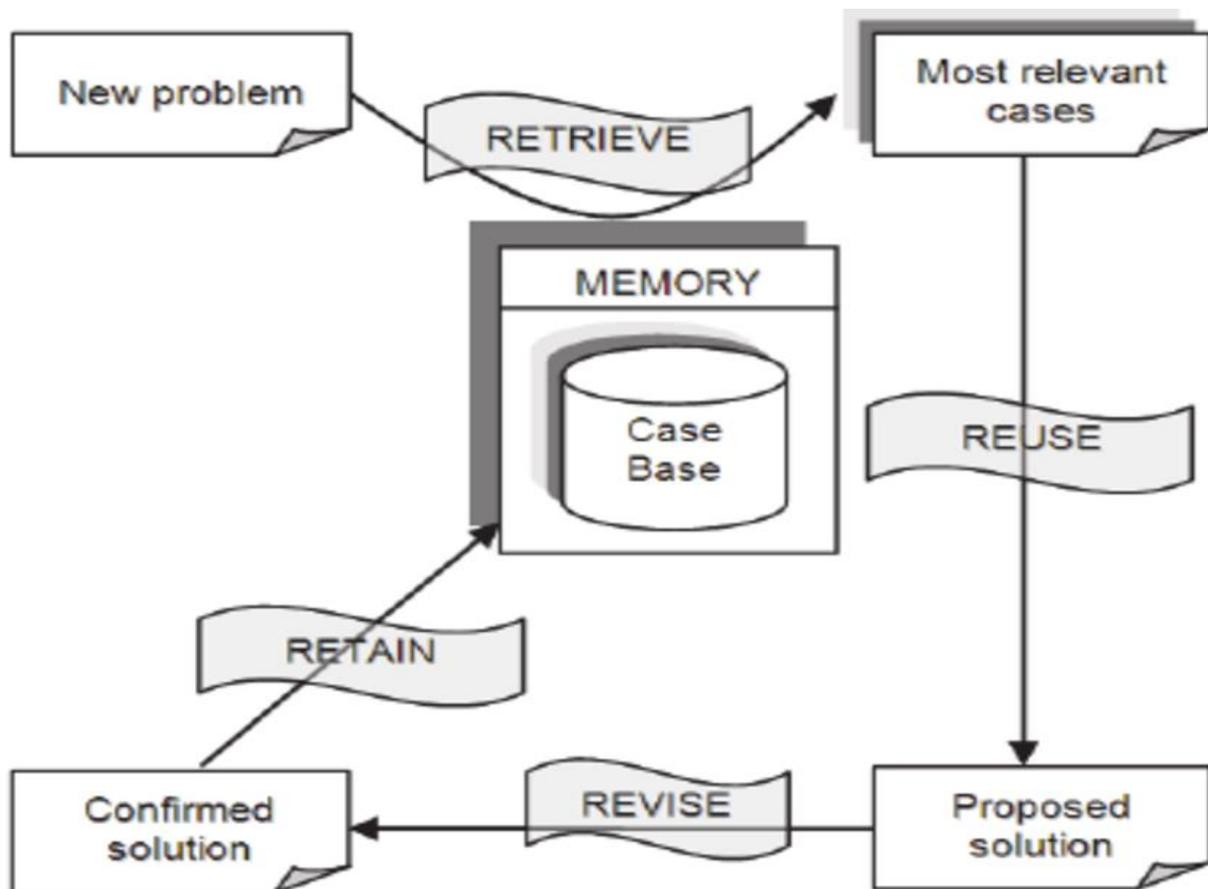
It is of interest to note that case based reasoning is how people routinely make decisions. Human experts in their particular fields rely on experiences. It is novices who rely on rules and first principles. Case based reasoning therefore by the virtue of closely emulating human reasoning earns a point for knowledge management.

The life cycle of a typical case based reasoning system is presented below:

Typically a case based reasoning process goes through four stages in its life cycle. These stages are:

- Retrieve the most similar case
- Reuse a previous solution of the most similar case to the current problem
- Revise to make changes to the current situation if need be
- Retain by storing the applied solution

Diagrammatically this is presented as:



Case Based Reasoning for Knowledge Management

Watson (2003) notes that there is a close match between the activities of the case based reasoning cycle and the requirements of a knowledge management system. He demonstrates that case based reasoning can therefore be ideally suited to the creation of knowledge management systems.

Many Artificial Intelligence approaches have previously been used for knowledge management. An example Watson (2000) highlights the use of expert systems for knowledge management. But there are other instances where a rule based system like an expert system may be not the best choice for knowledge management favouring case based reasoning. Some of these instances are as presented below:

- When there is already a case base in existence
- There exists cases with similar solutions to similar problem descriptions
- A domain theory does not exist but example cases can easily be found
- In a knowledge environment where it is difficult to specify knowledge in terms of rules but example cases can be easily found
- Where an expert in the domain area is not readily available, is incapable of articulating his knowledge verbally, expert may be too expensive yet example cases can be easily found

Mansar and Marir (2003) highlight the use of case based reasoning as an approach for managing knowledge in Business Process Redesign. Gronau and Laskowski (2003) make a compelling case concerning the use of case-based reasoning to improve information retrieval in knowledge management systems. They liken someone making a search query on a knowledge management system to that of describing a problem in a case base setup. Salem (2007) reviews case based reasoning for medical diagnosis. He reviews two case based reasoning systems for the diagnosis of cancer as well as heart disease diagnosis. The systems operate as a doctor diagnostic assistant providing diagnosis and recommendation. The systems can also be used for training undergraduate and postgraduate doctors. According to Watson(1997), Case based reasoning has been applied in diverse areas including by organizations such as IBM, VISA International, British Airways, Volkswagen and NASA in applications such as customer support, decision support, aircraft maintenance, quality assurance, process planning and many more.

Case Based Reasoning Systems for Knowledge Management by Farmers

Many diagnostics and advisory problems that farmers encounter are in most cases similar to older problems for which problems already exist. A fellow farmer may have come across such a problem and found a solution. A field extension worker who may not be readily available may possess knowledge about the problem. A collection of conference proceedings may exist with up to date research touching on the problem and solution. It is therefore much more efficient to handle the new problem from the archives of the previous solutions rather than generate the entire solution again from scratch.

Ndagani area neighbors Chuka University in Tharaka Nithi County of country Kenya. Small scale farming is practiced with subsistence farming, small scale horticulture farming, poultry farming for meat and eggs, dairy farming for milk and beef, pig for pork, sheep and goat for mutton. Sources of knowledge concerning farming is obtained from fellow farmers, from

government extension workers, students and lecturers in the nearby Chuka and Embu universities, from bazaar meetings organized by local authorities among other sources. The university also has researchers researching on new technologies in farming which is disseminated in conference proceedings, seminars and in documented formats. All this knowledge can be beneficial to the farmers if timely availed when needed. This research paper recommends the use of case based reasoning system to collect and store diagnostic and advisory knowledge in a case base. The farmers can then utilize it for advice and diagnosis.

Such a recommendation is made by Burgos-Artizzu et al, (2009) who proposes the use of case based reasoning system that allows users to input digital images of a crop field and automatically and in real time the system determines the processing method most suited for each image. The percentages of weeds, crop and soil present in each input is as well estimated.

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