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Modern Indigenous Raw Materials Processing Machineries Realization: Imperatives Of Inter- And Multi-Disciplinary, Engineering Project Teams' Approach

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ABSTRACT

It is a generally acknowledged fact that African nations are largely dependent on industrialized, and mostly, developed nations for machineries needed by industries for the production of consumer goods from primary and secondary raw materials. This contributes in no small measures, to the pressure on the external reserves of these nations that are in the main, poor, and barely developing. This is despite the fact that African nations are blessed with an abundance of primary raw materials, and without doubt, most, like Nigeria, with engineering manpower of different specialities that have not be galvanized to tackle the obvious challenge of lack of modern, indigenous, raw materials processing machineries; designed, developed, implemented, tested and manufactured in Africa, and for use in Africa and elsewhere outside Africa. This paper therefore, seeks to highlight to industry and academic based engineering professionals that no doubt, has the onerous burden of tackling this challenge for Africa, the need for, concerted, inter- and/or multi-disciplinary, raw materials processing machineries project teams', targeted at machineries for processing various raw materials to consumer goods, and other secondary raw materials. The nature of the team-based approach to problem solving, and hence, needs' realization, is explained; and, a group/team based problem solving framework is also presented in this paper.

Keywords: *Groups, Teams, Problem-Solving, Decision-Making, Indigenous, Raw Materials, Processing Machineries*

1. INTRODUCTION

Groups, according to Finnegan and O' Mahony (1996), has been proposed by researchers (for example, Shea and Guzzo 1987; Johansen, 1988) as the best means by which organizations can manage interdependencies and coordinate collaborative efforts. This view has also been supported by Geifman and Raban (2015). Organizations, here, may be commercial organizations, industrial organizations, educational institutions – that is, school organizations or, other varied types of organizations. An organization has been defined as a set or group of arrangements, according to which work is divided up in order to achieve some objectives or group of objectives (Lerner, 1982; Al-Tarawneh, 2012). It is generally agreed in the literature that, teams, when properly handled, out performs individuals; hence, in most engineering projects, because of the complexity of the problems, teams are of necessity. This is because no one person can possess all of the knowledge and skills needed for a successful solution of an engineering problem. The purposes of this paper therefore, are, to highlight the need for emphasize to be placed on groups/teams-based approaches in efforts at realizing indigenous raw materials processing machineries, and to present a framework that can be adapted and/or adopted as guide and road-map by raw materials processing machineries' project teams, for successful realization of projects.

2. GROUP DECISION-MAKING AND PROBLEM-SOLVING

According to Finnegan and O' Mahony (1996), a decision-making group was defined by De Sanctis and Gallupe (1984) as two or more people who are jointly responsible for detecting a problem, elaborating on the nature of the problem, generating possible solutions, evaluating potential solutions (see also, Wang and Ruhe, 2007; Liu, 2010; Geifman and Raban, 2015); and asserted that Huber (1980) referred to a problem as a gap between an actual and a desired result: decisions or choices can therefore, be thought of as specific and discrete actions involved in closing this gap and thus, solving the problem (see also, Liu, 2010; Geifman and Raban, 2015). A term commonly used to describe people working together as a group is 'team'. Johassen (1988) has asserted that, a team is a group in which the contributions of individuals are seen to be complementary: and, it (team), has also been defined as a small number of people with complementary skills, who are committed to a common purpose, performance of goals, and approach for which they hold themselves mutually accountable (see also, Geifman and Raban, 2015). According to Johassen (1988), collaboration, working together, is the keynote of team activity.

3. PROJECT TEAMS AND THE REALIZATION OF MODERN, INDIGENOUS, AUTOMATED MACHINERIES

It has long been the view of the Raw Materials Research and Development Council (RMRDC) of Nigeria that, the dearth of process equipment and machinery is the bane of Nigeria's under-utilization of her agricultural and mineral raw materials. Achi (2004) recommends what he called 'Projects Oriented Approach' to 'Machinery Design, Manufacture and Control' research. In this context therefore, it is contended that, the availability of modern, indigenous machineries that are ready for acquisition and utilization by entrepreneurs can only result from the systemic efforts of multi- and inter-disciplinary project teams. Experts have therefore, advised that: The Nigerian Engineers must now initiate programs of multi- and inter-disciplinary collaborations for the realization of small and medium scale indigenous, automated, machineries; for the processing of the abundant raw materials, with which Nigeria is endowed; as this will, generate employment and create wealth through added value to the raw materials, instead of exporting them in their unprocessed states. By way of illustration, therefore, let us assume it is determined that there is a need for a local substitute for a machinery that is used for the production of vegetable oil from a raw material such as, ground-nut, soya-beans, melon, and other similarly available raw materials; given that these machineries are presently imported. A project team is set up; we represent the machinery (plant) as shown in Figure 1.

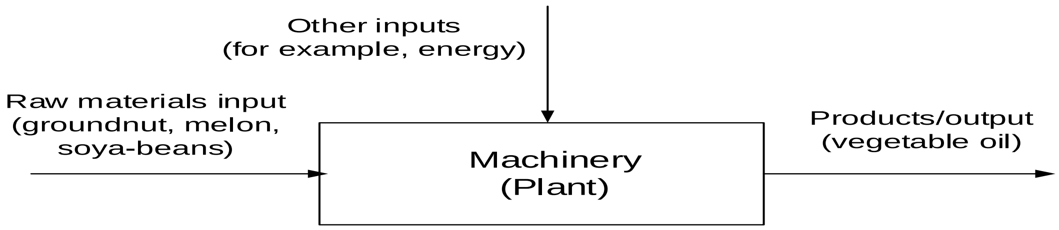

Figure 1 Machinery as a black box showing inputs and outputs

But mechatronics, as a modern concept, has had great impact on the design and fabrication of modern plants and machineries. Modern technical dictionaries have defined it as simply the synergetic combination of mechanical engineering (mecha, which stands for mechanism), electronic engineering (tronics, for electronics), and software engineering. Therefore, the black box representation indicated in Figure 1 can be partitioned and represented as shown in Figure 2.

The project team therefore, must have as a minimum, a mechanical engineer; an electrical and electronics engineer, who is quite knowledgeable in software/firmware issues and in hardware-software integration; a chemical engineer, versed in process plant design issues, to harmoniously complement the mechanical engineer; and most necessarily, an engineer, who is a specialist in Food Science and Technology. Included in the project team of course, are technicians and craftsmen in related specialties. There may be the need for a team member who is a specialist in business management and accounting issues, who will render appropriate support in these areas when the need arises. The number of persons of these various specializations would, no doubt, depend on the scale and/or complexity of the plant/machinery.

Basically, the team specifies what the inputs to the plant and the outputs from the plant are; the mechanical, chemical and food science and technology engineers specifies the various stages involved in obtaining the outputs from the inputs; the mechanical and/or chemical engineer designs, and implements, with the assistance of related technicians and craftsmen, the mechanical part of the plant; while the electrical and electronics engineer, designs, and implements, with the assistance of related technicians and craftsmen, the electrical and electronics part of the plant.

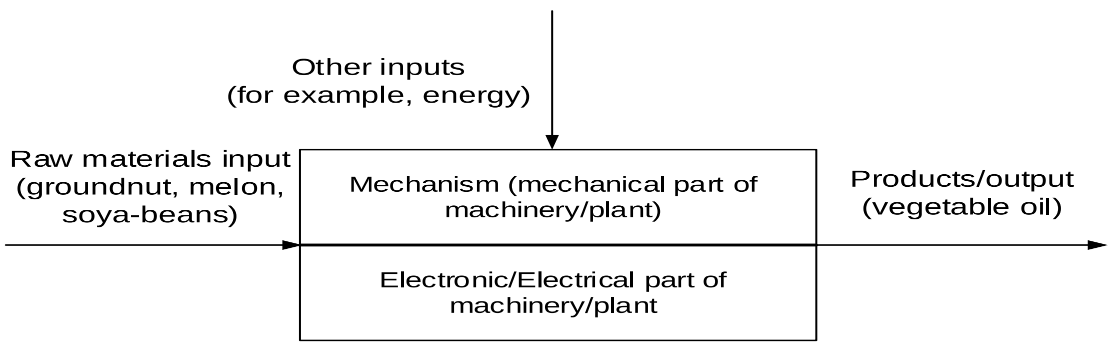

Figure 2 Illustration of a top-level decomposition of the plant

The team then integrates the mechanical and electrical parts to obtain the prototype. Testing the prototype is also carried out by the team.

4. A MODEL OF GROUP PROBLEM-SOLVING

Finnegan and O' Mahony (1996) discussed extensively, a group problem-solving process which can be adapted and/or adopted by teams' of engineers desirous of working together towards the realization of modern, indigenous, raw materials processing machineries. They contend that, the decision-making processes of groups consisted of 'group activities', which are supplemented by individual or subgroup task assignments. They therefore, presented a model of group problem-solving process, which is illustrated in Figure 3.

The processes of the various stages were explained by them as follows:

Stage 1. Problem Realization: This is very much an ad-hoc process that is carried out by specialized groups or by senior management. Meetings are held on regular (monthly or quarterly) basis to review organizational activities and to monitor environmental changes.

Stage 2. Planning: It is necessary that the activities of individuals or subgroups needed to be coordinated. Normally, the decision-making body (specialized group or senior management) who found the problem must decide the level in the organization where the decision should be made and whether or not to delegate this to a permanent or ad-hoc group. A 'contract' is normally drawn up between the two groups which outlines the group's objectives, budget and time frame. Inter- and intra- group communication, coordination, collaboration and cooperation patterns are also established at this stage.

Stage 3. Search for information: The purpose of the search for information is to gain deeper understanding of the problem. The task of searching for information is normally distributed among group members. Depending on the task of the group, the external and internal

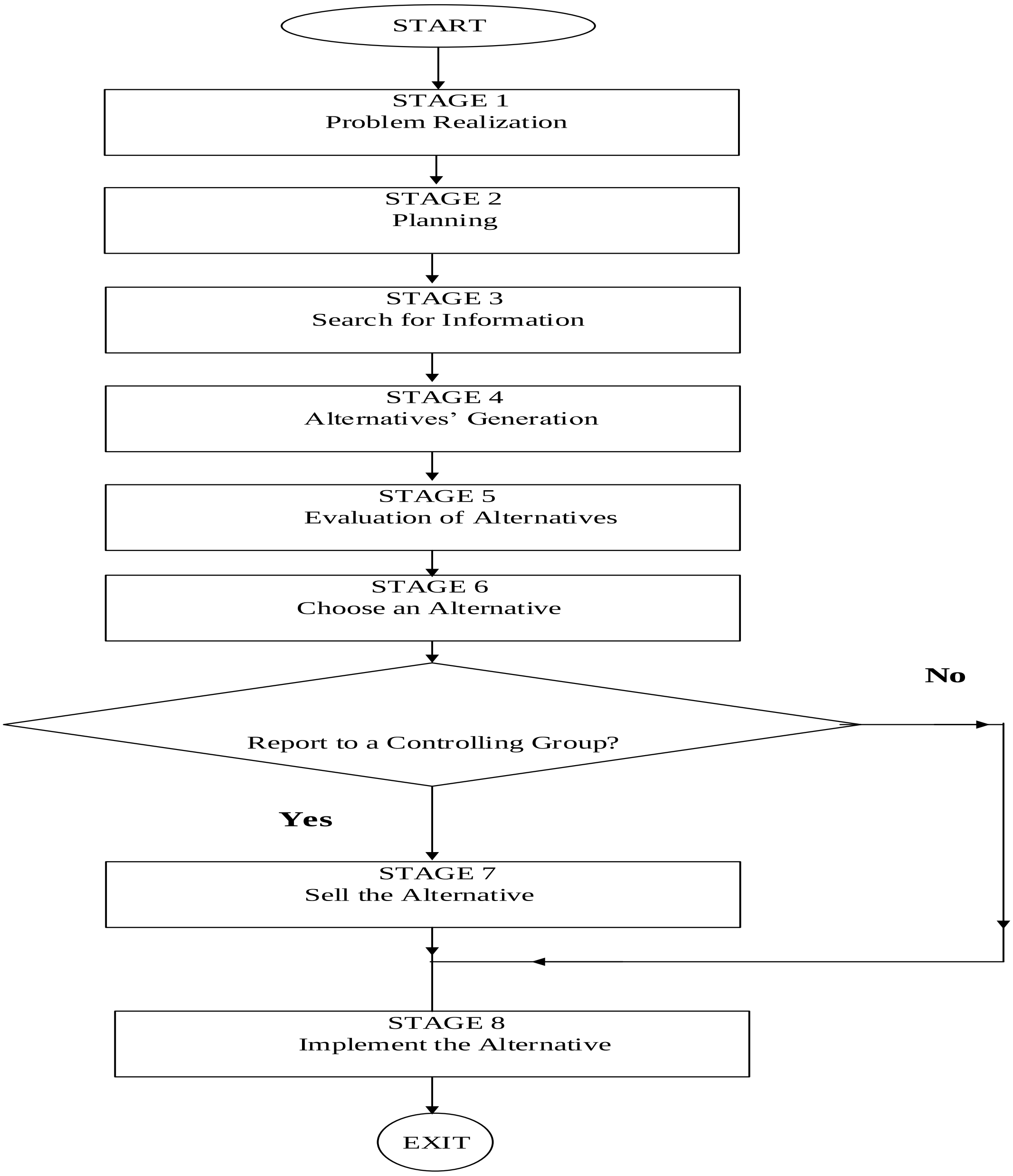

Figure 3 Flow Chart illustrating the group problem-solving process (adapted from: Finnegan and O' Mahony, 1996)

organizational environments will be scanned. The information gathered is then brought back to the group. The group compares its problem task in light of the new information, and as a result, it may sometimes reformulate its task. This is a critical step in the group decision-making process, as it is unlikely that the group will drastically reformulate the task after this.

Stage 4. Creation of alternatives: This is a stage where the group operates as more than a collection of individuals. Although, ideas are often generated by individuals, alternatives are very much the result of group interaction, which generally takes place in a face-to-face environment.

Stage 5. Evaluation of alternatives: The evaluation stage is very much an iterative process. During this stage, the group cycles between face-to-face meetings and individual task assignments. Not all alternatives are evaluated to the same depth; some are dismissed early on, while others require greater consideration. Each alternative is compared with the others to determine how far each goes towards filling the gap between the desired and current situation. External advisors are often brought in at this stage and their activities have to co-ordinated.

Stage 6. Choose an alternative: The processes of evaluation and choice are closely tied; as in this stage, the group makes choices on whether to accept or reject an alternative. In most groups, the final act of choice is made by consensus, with considerable negotiation taking place, at group and individuals' levels before, hand.

Stage 7. Sell the alternative: This stage is only applicable if an ad-doc group is performing the decision task. This stage is important for an ad-hoc group, as they must be able to justify the choice and it is on the quality of this alternative that the work of the group will be judged. The permanent group will either accept their recommended alternative, choose another, ask for clarification, or reject the alternative.

Stage 8. Implement the alternative: The implementation stage is the final step in the problem-solving process, as the means to solve the problem has been established, and it just has to be implemented. This can be done by the same group, or more often, it is given to an existing lower-level group.

This described group problem-solving model is refreshingly illuminating. One of the theses of this paper is that, appropriate adaptation of the model as framework and/or roadmap by raw materials processing machineries engineering project teams will lead to a high level of achievement of team goals and objectives.

5. FACTORS THAT POSITIVELY CONTRIBUTE TO THE ACHIEVEMENTS OF GROUP/TEAM OBJECTIVES

Finnegan and O' Mahony (1996) made a distinction between the decision-making steps in group decision-making and the processes by which they are achieved. According to them, while the steps involved in the decision-making process are important, the means by which the group progresses from problem-realization to choice is through the communication of information and ideas, as well as the collaboration of group member. They asserts that Malone and Crowston (1990) contends that, collaboration, which is the act of working together in groups, is achieved by coordinating the work of individual workers who cooperate in order to achieve a solution to a problem. Accordingly, Finnegan and O' Mahony (1996) observes that, communication, collaboration, cooperation, and coordination, as enunciated by Pinsonneault and Kraemer (1989) are considered vital factors in the group decision-making process. The following definitions of these vital factors that can positively contribute to the achievements of group/team objectives, when properly internalized by group/team members as individuals, as well as the group/team as a body, were therefore, offered by them:

Communication: This refers to the transfer of information between parties involved in the problem-solving process.

Cooperation: This refers to low-level working relationships between individuals in a problem-solving group.

Collaboration: This refers to working relationships, where, a group goes beyond cooperation between individuals to operate 'as a group' and exhibiting 'collective intelligence'.

Coordination: This refers to the synchronization of activities within a group.

Of course, the various activities in the group problem-solving process, and group members, must be managed by a manager (the leader), as a manager, rather than making a decision himself or herself, has been seen by some management theorists as actually managing a group, making a decision (Litterer, 1978; Awujo, 1997; Geifman and Raban, 2015).

6. CONCLUSION

African nations have been known to have largely been dependent on industrialized, and mostly, developed nations for machineries needed by industries for the production of consumer goods from primary and secondary raw materials. This has contributed in no small measures, to the pressure on the external reserves of these nations. This is despite being blessed with an abundance of primary raw materials; but lack modern, indigenous, raw materials processing machineries; designed, developed, implemented, tested and manufactured in Africa, and for use in Africa and elsewhere outside Africa. This paper has therefore, sought to highlight to industry and academic based engineering professionals the need for, concerted, inter- and multi-disciplinary, raw materials processing machineries project teams', targeted at machineries for processing various raw materials to consumer goods, and other secondary raw materials. The nature of the team-based approach to problem solving, and hence, needs' realization, has been explained; and, a group/team based problem solving framework presented; that can, be adopted and/or adapted by inter- and multi- disciplinary project teams.

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