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THE ROLE OF EXPERT SYSTEM IN MANUFACTURING SPARE PARTS FOR DEVELOPING NATIONS

BY
S. HAZEM
Dept. of production Engineering, Faculty of Engineering,
Mansoura University, Mansoura, EGYPT.

نظام خبرة لتصنيع قطع غيار للدول النامية

خلاصة : هذا البحث يوضح المشكلة التي تواجه الدول النامية في توفير قطع الغيار اللازمة لصناعاتها . ثم يقترح أساسيات منهجية التفكير لعمل نظام خبرة خاص بتصنيع قطع الغيار محليا ، وكذا التقنيات والعلوم المتطلبة لجعل نظم الخبرة ذات فائدة مرجوة التطبيق في الدول النامية .

ABSTRACT: Many of the developing nations facing difficulties in providing the required spare parts needed to their industries, which in turn make them suffer economical and technological backwardness. This paper defines the spare part problem, then describes the basic conceptual methodology of spare part local manufacturing expert system, as well as the necessarily concepts needed to make such expert system worth it in the developing nations.

INTRODUCTION:

The well developed nations have gone the pace to wide range of developments and applications of expert systems into numerous fields, such as, banking, manufacturing, engineering, and alike. As for intelligent manufacturing systems the integration of manufacture and design software functions has, recently, a major significance for industrial performance [1-4]. Some of those functions compile intelligent operations planning [5,6], selections of cutting tools [7], cutting conditions [8,9], design and description of machine tools [10-12], jigs and fixtures [13]. The majority of these intelligent systems are based on vast amount of experimentally and theoretically derived data, or based on modelling techniques for the machining processes together with knowledge based system (KBS) techniques.

On the contrary, the developing nations still suffering technological backwardness. In spite of their modest economical, technological, social, and all other enviroment aspects, some of those nations concern in industrial evolution by introducing new industries and technologies. Nevertheless, those nations still out and away from the industrialization track. One of the major reasons, currently afflicting these efforts, lies in providing their industries with the adequate qualitative and quantitative spare parts needed.

In this paper, therefore, the spare parts problem has been defined, then the basic conceptual methodology of spare parts local manufacturing expert systen, has been described for the developing nations. In addition, it explores the potentiality of such system by means of local exploitation with the available knowledges and technologies.

PROBLEM DEFINITION:

Generally, it is expected from introducing new technology or industry, to increase productivity and financial results to the concerned field and the employee as well. The sequential stages of a successful trasfer of technology or industry, are shown in Fig.(1-a). From this figure it is clear that the key role is the management system block and its four sub-blocks, namely, (decision making, process planning, inventory control and maintenance system), they are also greatly interrelated. The final outcome, of such successful transfer, is the attraction of best brains able to innovate, improve and introduce new technologies and industries, then the transfer loop could be progressed. At this point, the main difference viewpoint of technology transfer is about its meaning. The industrialized nations concern it as short-time assistance to the transferred technology or industry. While, the developing nations concern of long-term service of the received ones.

As for the developing nations, the management and its sub-systems may greatly be affected by different reasons. One of the main reasons is the shortage of original spare parts in quantity and quality, as shown in Fig.(1-b). Such shortages could be due to two major factors. The first is of financial supports; the high needed budget which may reach the annual value of 10% to 15%, or more, of the machinery and equipment capital costs. The second factor is due to shipments delay from the origin(s), and/or obsolescent of the concerned parts at the original producers.

The two aforementioned factors with no doubt interrupt the whole managemet system. The poor productivity comes as the first drawback, i.e, due to the expected unbalance between the various activities of the organization structure. On the other hand, the requirements for flexible and receptive system to new ideas, is also become doubtful. The final drawback, thereby, shows lack of innovation. Consequently, the end results show the loop of deterioration to the transferred technology or industry, which in turn lead to technological and economical backwardness.

PROPOSED BASIC METHODOLOGY:

From the previous section, it seems logic to determine first cautiously which category of spare parts, is most likely to be locally manufactured in the concerned developing nation. Fig.2 shows a simple proposed classification of spare parts, which could arise at any industry. From this figure, the category of the critical non-standard spare parts, are most likely to start with.

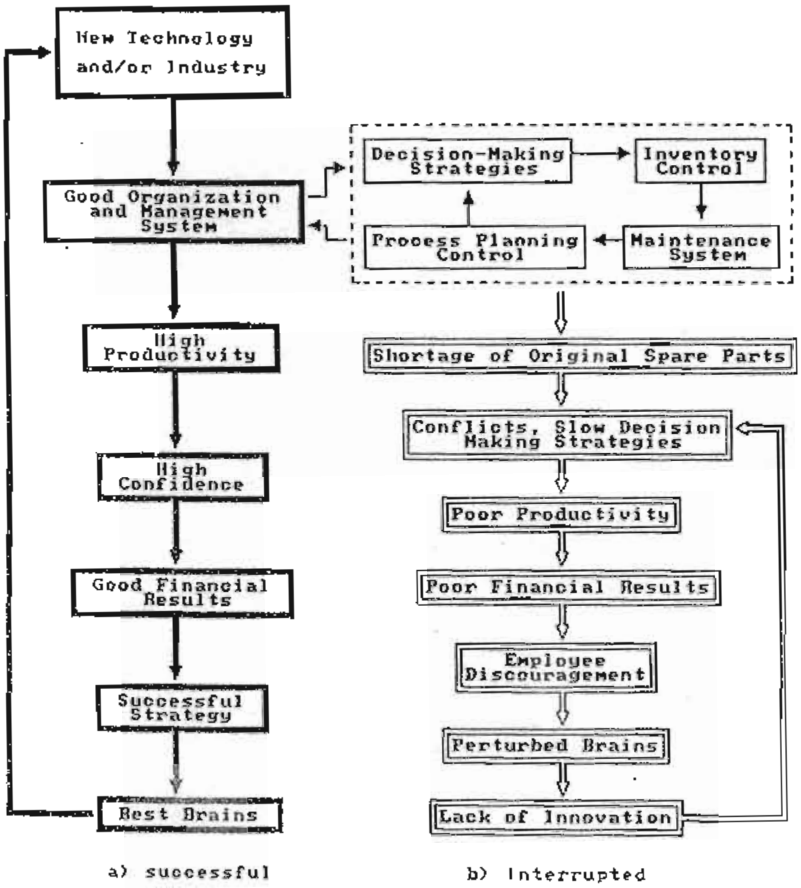

Fig.1 Conceptual Image of Technology Transfer.

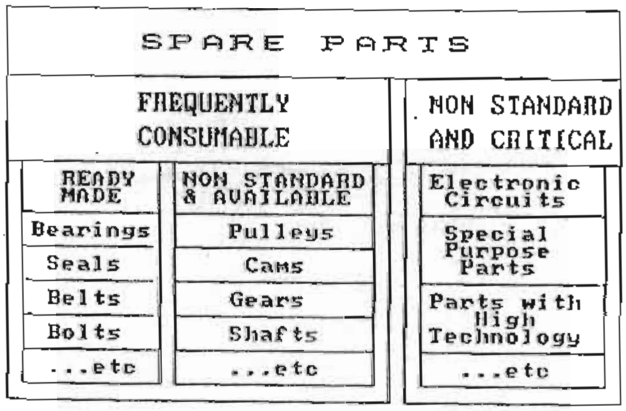

Fig.2 Proposed Classification of Spare Parts.

Based on the selected category of spare parts, the main frame of the basic conceptual methodology, to the expert local manufacturing system, is shown in Fig.3. This methodology consists four subsystems, which are composed the main frame of the proposed expert system. In addition, computer aided design (CAD) and reverse engineering (R.E.) modules are embedded in the expert system. Also, a knowledge-based interface is built-in, to clarify the part establishment in regard to its drawings, specifications, machine planning (MP), inspection planning (IP), and machining data analysis (MDA). The end piece of advice, or the due yield of this methodology is either purchasing the original, or local manufacturing and its consequent procedures, of the concerned spare part(s).

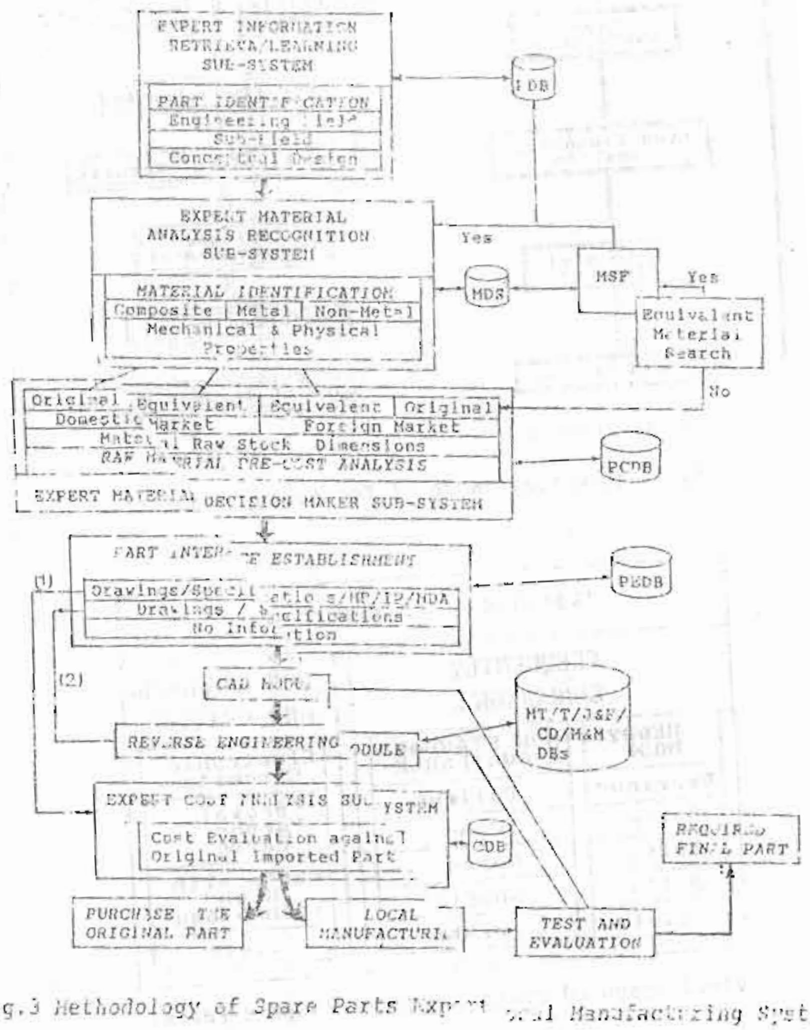

Fig.3 Methodology of Spare Parts Expert Local Manufacturing System.

The first subsystem block, in the form of data acquisition, deals with all data and information available about the spare part under consideration through the parts identification database (PDB), linked if possible with a cetral data bank, which involves several engineering fields and their associated spare parts, as well as every possible piece of information in relation to the concerned field(s). The second subsystem block is in the form of an intelligent based - knowledge material system. This block is a critical one. It depends greatly upon the materials producing capabilities, as well as a good statistical survey about the available materials in the domestic market. In addition, this knowledge-based material recognition should be in concrete interrelation to the local material research institutions. In case of recognizing the original material, or an equivalent one(s), that is through material data base (MDB), and material searching frame (MSF). These data should be fed back, in the learning mode, to update the knowledge-based acquisition system of the first block. The third subsystem implies the pre-cost analysis of all available material selection alternatives. Consequently, The corresponding pre-cost database (PCDB) should be provided with all cost parameters, and any all cost factors that may affect the domestic or foreign material sourses.

The part establishment interface block has been provided to the proposed system, to guide its path through the information provided by the part identification database (PDB), as well as the establishment of the part database (PEDB), to one of three paths according to the CAD/CAM available information. The first path represents well defined spare part, needs no interface with the CAD or R. E. modules. The second path needs R. E. interface to intelligently select the necessary machine tools (MTsDB), cutting tools (TDB), jigs & fixtures (J&FDB), cutting data (CDDB), and material machinability (M&MDB), and their alternatives as well. The third path requires the help of the embedded CAD and R.E. modules to activate the intelligency of the whole system. The success of the second and third paths depend greatly on the database-knowledge engineering interfaces, which in turn would be the backbone of the proposed main frame, to give the final decision of making or purchasing the spare part under consideration.

As for the fourth subsystem block, it concludes the overall incremental costs, for all alternatives available, this have been done by means of the five data bases corresponding to the alternative frames F1 through F5, evolve the search plan for the adequate cost evaluation route, as shown in Fig. 4. Those frames, involve any data and information in regard to the concerned alternative, give priority to any possible local activities helping the local manufacturing reach. In addition to the five frames, there is one more decision block which has been added before the final decision of either purchasing or local manufacturing the considered spare part(s). This block, namely Other Beneficial Aspects, takes in consideration any local economical, enviromental,social, new technological, new experts, and any other aspects may favour the local manufacturing decision, even with higher incremental costs compared to the purchased original one(s). Otherwise, no doubt that the purchase of the foreign original part will be.

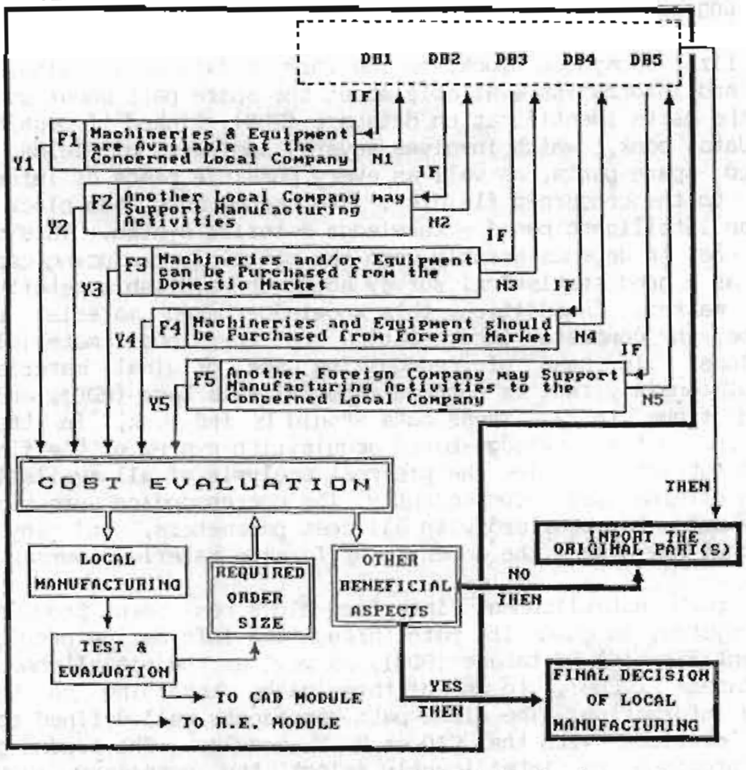

Fig.4 Image of the Expert Cost Analysis Subsystem.

In this respect, the overall costs evaluation per one peice should be considered to the first local manufactured spe_imen, then another cost evaluation step to the required order size should be proceeded to evaluate the final decision come up from the whole proposed expert system.

DISCUSSION AND CONCLUDING REMARKS:

The developing nations seem to believe that, as far as the various activities are balanced, in some way, within an organization structure, then productivity is exist even in some relative measurement. while they are not considering how productivity does or does not affect the innovation of that structure.

In this respect, such nations must work-upon that productivity is a function which is greatly affected by the organization structure, and the balance it makes between the various activities. Also, innovation requires that structure to be flexible and receptive to change to new ideas. From all and above, the concerned developing nation should clearly understand that knowledge engineering, with no doult, is the kernel key to any intelligent system. Also, it is the biggest problem into a machine-manipulable form, which they have to work out hard. They are also requested to design their own, or to be designed in particular to them such expert systems, according to their needs and potentiality.

As for the proposed expert locally manufacture spare part system, first the spare part(s) category to be considered, should be ditermined. Then, a large amount of data from all concerned companies, in the same field of engineering, is urgent to make up the intelligent retrival and/ or learning information subsystem. In the second place, material sciences and technologies, as well as the advanced manufacturing techniques, are must in the theoretical and practical fields. Third, the know how to deal with the computer aided design and manufacturing softwares as well as the hardwares, are also must to the academic and industrial levels. The final subsystem block, namely cost analysis, should be treated carefully, in preparing its databases based on the principle of priority to the local manufacturing concerns.

Finally and not the last, the main due results of a technology transfer policy are, improving productivity and encouraging innovation within a considered industrial field. The co-share responsibility between the developed and developing nations is, therefore, an important domain to the field of technology transfer. This leads to well prepared developing nation to get along with the applications of the new transferred technology and the needed expert system(s). In this way, the potentiality to make use of a spare part(s) expert local manufacturing system, would be good among the developing nations. Until then, such expert system should be designed in particular to those nations taking into considerations their needs and capabilities.

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