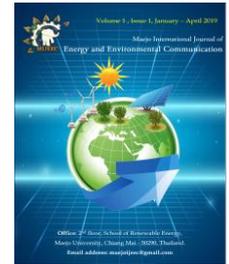




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REVIEW

University goods manufacturing program combined with engineering education

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ABSTRACT

Due to the frequent university reforms, the level of understanding higher education and conducting research programs are getting lower in recent ten years. Their knowledge level sometimes discourages and disappoints the university professor. Their active, challenging attitude to know and integrate the knowledge based on the experiences cannot be seen in most of the university students. They need to know anything about practical application. This paper is one of the proposals to provide the opportunity for university students to learn and experience more practicing through university goods manufacturing based on the CNC machine operated on computer programming.

1. Introduction

Generally speaking, Agricultural Engineering Department in the university involves two academic areas, one is agricultural machinery and mechanization and the other is soil and water (or/and irrigation and drainage). Agricultural Engineering Department belongs to the Faculty of Engineering in most of the countries, however in Japan it belongs to the Faculty of Agriculture or Faculty of Bio-resources (Mie University, 2017). The changes were done in recent years focusing more on biological and environmental conservation points of view, which is more or less different from the original agricultural machinery and mechanization. For example, since the name of Faculty of Agriculture was changed into the Faculty of Bio-resources, the percentage of the students want to study in the new faculty was drastically changed. It was very much shocking for us to find that most of the students were interested in studying biology and chemistry, not engineering based on physics and mathematics. Annually many students who were forced to be integrated into

our course at university due to the shortage of the total number of credit, because they could not imagine that they had to study what they were not interested in. Some of them stayed in the name list, however those students actually don't come to university and looking for the possibility to enter the other university. Some of them are still hesitant on how to make a decision whether to continue or stop their studies. This situation was increasing year by year. After ten years, we were forced to improve this situation for the students not to be divided after the first year passage of general education. Students were divided after one year since admission based on the following factors

- 1) Student's will be depending on their interest in academic specialty
- 2) The record of the enrolled number of credit was referred and considered for majoring
- 2) The excessive number of students is not accepted additionally beyond the maximum capacity. The above mentioned is the real story of historical background which we

encountered after the university reforms was done. Irrespective of this story, university students are lacked of practical application. It is very much essential to provide the opportunity for university students to experience practical ones. This paper shows one of the possible examples to satisfy the engineering education requirements mentioned above through the introduction of the CNC (Computer numerical control) machine (example from <http://www.Japan machine tools.net/> shown in Figure 1) and manufacturing the original university goods which can play a vital role in growing the creative idea. It is very much easy to order some of the dealers to develop university goods and provide them with a reasonable price.



Figure 1. Computer numerical control machine

In so doing the university goods are exactly purchased with comparatively cheaper price through the negotiation. However, it can not satisfy the most important condition in which the university goods should be equipped with a unique and typically original sense of the university. Besides, when we follow this way, the university has to prepare the budget always for purchasing it. Who will earn the benefits? Yes the dealer does it. The university should offer the unique program even for this kind of thing, the author thinks. It should not be necessarily a mass production, however flexibly manufactured on demand to meet the exact number of needs. In addition, the originality of those goods should be considered with the first priority.

2. University Goods

There are so many university goods and sizes based on different materials. We can get them normally at the university bookstore. Those goods are used for presents or gifts, or sometimes as the memory of the visit to the university. For the development of university goods, the following conditions and requirements must be possibly satisfied as follows.

- 1) The good design involved enough to express the philosophy of the university
- 2) Low cost for manufacturing
- 3) Original university goods manufacturing different from the other university's goods

- 4) Students can experience practical manufacturing
- 5) Goods should be popularly purchased and accepted

There can be seen so many university goods with the name of the university only mounted using conventional products such as small size notebook, fountain pen, book mark, leather belt, wrist watch, neck tie, wood carving statue and so on. As we can see the production system in industry, it has been shifted from mass production system to flexible manufacturing system drastically. CNC machine performed it completely. Same thing can be seen even in agricultural production. Agricultural robot (Bonirob farming robot, Figure 2) is one of the examples to make the mechanization possible in flexible manufacturing system application. Up to now it has seemed to be very much challenging to develop and promote the agricultural mechanization in fruit and vegetable harvesting which are classified as minority crops due to the less cultivated area, even though the agricultural robot for these crops are not commercialized yet because of PL (Product Liability) law legislation for the manufacturers to be responsible for the accidents happened caused by not suitable design. Industrial production is more comfortable to apply in actual production compared to the agricultural one. Because the former takes care of the standardized products designed by a human, however, the latter one is more difficult in so doing since the crops are not standardized. Therefore, the size, weight, color, maturity and so on are not entirely the same for individual fruit and vegetable. More complicated additional function and control systems must be installed and some additional devices must be equipped to meet the requirement for harvesting the objective fruits and vegetables without giving any damage.

Agricultural Engineering is one of the academic study areas for promoting machine development and mechanization for farming. Therefore, the essential compulsory subjects necessary to conduct the academic activity in that area are mechanical engineering subjects focusing on machinery and mechanization for agriculture; mechanical engineering is normally focused on the other industrial area except agriculture.



Figure 2. The Bonirob farming robot (Kagan Pittman, 2015)

Thus the mechanical engineering must be one of the most basic and important compulsory subjects for both mechanical and agricultural engineers. From this point of view, the experience to operate and manufacture some products by use of numerical control tools will be absolutely needed and beneficial for university engineering students especially. Usually, most of the university orders the university goods designed or proposed by the university and the shop. As far as we follow this system, the university has to keep paying continuously to buy and have as stock on demand. The total amount of the stock cannot be controlled so well if the university continuously makes the order based on the frequency of estimation. To buy those university goods, the price must be cheaper as much as possible; however, the quality must be considered from the other point of view. Two conditions of price and quality are the key points for the university to satisfy these two conditions. The author would like to propose of establishing a new course of education in the curriculum. In so doing, the following merits can be found.

1) Invent control can be done so easily; therefore, the budget can be saved.

2) No need to have an unnecessary extra stock.

3) Numerical control system can be educated mainly focusing on the practice of manufacturing.

4) University can produce unique and original goods through the education.

5) University can grow up the students equipped with rich creativity.

6) This program provides the opportunity not only to learn manufacturing technology by use of numerical control tools, but also the importance of designing how those goods can be acceptable by the customers and consumers. Through this program, students can feel and learn the marketing mechanism if those goods designed based on their idea can be acceptable.

7) Students learn the importance and philosophy of originality how the university goods should be designed through this program.

8) Additionally, the university can get the financial income from the sale of those goods and the unique program can be evaluated highly.

4. Methods and Material Approach

For the actual implementation of this program, a certain amount of budget must be prepared and invested in introducing the related tools equipped with a numerical control system that cost almost five million Japanese yen more or less. The university can negotiate an industry to rent those machines temporarily explaining the purpose and spirit of how and what the university is going to do through this program if the budget cannot be prepared enough. The other possibility is to send the university students to the industry for this program for a certain period of time (for example, one week or so) by the establishment of

intensive program based on the mutual agreement between industry and university. Alternatively, this program should be approved and accredited as one of the cooperative education and career development (internship program). Those NC tools should be equipped with a multi-function mechanism to meet the requirements for various kinds of manufacturing of university goods. Compared with the existing way to order and buy the university goods from the shop or dealer, it looks more expensive in the initial stage; however, the university has to spend the money always for the purchase of university goods as far as following the existing way and left nothing beneficial in the merit obtained from education.

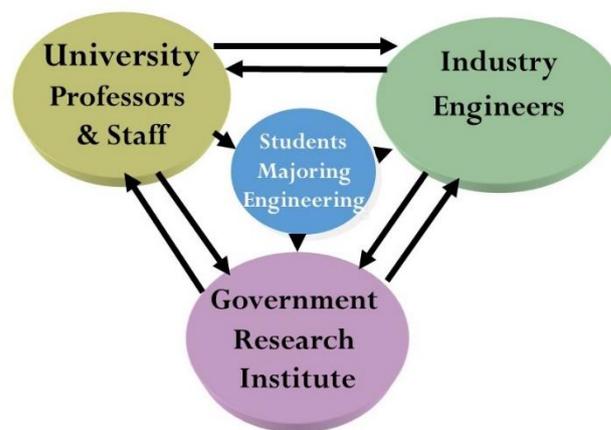


Figure 3. Relationship between University, Industry and Government organization

Japan is well known as one of the developed countries for the powerful in economy and technology. Almost five years ago when the author visited Agricultural University in Bangkok, Thailand, he could see a number of machining center that was already used for engineering education. Probably the university had more than ten sets of the machining center. The author memorizes though his memory is not exactly clear. The University has one separate special building for this purpose and giving the education to teach how those machines should be used. Actually the new products were under the process of development for manufacturing at that time. Relationship between University, Industry and Government organization outline displayed in Figure 3.

In the case at our university, we have one NC lathe at the Faculty of Engineering. The Department of Agricultural Machinery at the Faculty of Agriculture proposed to get a similar one. However, it was not approved because the Faculty of Engineering has already. Since that time no NC tools are not provided at our university. The author does not understand how and why the other university can introduce those high technology tools. However, he understands if those machines are introduced through the budget proposal to some international financial organization. This depends on the scope and way of thinking of government officers and decision-

makers towards the future aspect and prospectus of future education how it should be. The author trusts that this program will be more beneficial and necessary for the students especially from the viewpoint of practice, and highly evaluated from the originality of the educational program. The current university students are so much familiar in operating computer than practicing of manufacturing. This kind of program should be provided to cover the shortage of practical experience combined as a part of the cooperative education and career development program if not possibly approved as one subject alone. Formerly long time ago, students were forced to use the manually operated drafter (drawing machine attached with T type ruler), however recently the universities are no more following that system because it was completely replaced by the introduction of CAD (Computer-Aided Design) system (Brooks, 1997), which we can see popularly in industry. The university should provide and offer the opportunity for the students to get the same level of knowledge required for the engineers after getting the job. If it cannot be implemented so quickly, it should be started based on the discussion and agreement between the university and the related industry in making the effort possible for future implementation.

5. Accreditation for Evaluation

The students enrolled in this program should be officially evaluated based on the accreditation by the university and the result must be recorded in the academic transcript. As already described before, this program should be desirably offered combined with the other program subjects such as cooperative education and career development, and then it functions well to meet the original purpose of this program. Considering the era towards globalization and internationalization, the class should be open and managed in English, and then many students can be accepted for a certain period focusing on the special training program to meet the conditions and requirements for the society.

One of the most severe obstacles for implementing cooperative education and career development is a communication problem in the industry. If the students are sent for the engagement of the program and cannot communicate so well, the intention of what the students want to express or what the industry man explained is not fully understood. Then sometimes the miscommunication brings serious accidents and injuries. To avoid these kinds of things, the students who are interested in the internship program are strongly requested to be qualified as a good English speaker enough to communicate during the stay in the industry. Currently, in Japan all the university students who are not only natural science students, but also the social science students are strongly recommended to join and experience the cooperative education and career development (internship) program at least more than two weeks, which looks extremely short length, but better than nothing. The industries are very

cooperative with the university in promoting this program and accepting the students. By accepting the university students through this program the industry can find the valuable human resources sometimes even though the industry is forced to prepares the special program and the certain amount of funds to be used on this program and spend an extra time for the training of the accepted students, which is different from the original work of the industry. Students can experience and learn a practical job in the industry, and think about what is the meaning of getting a job. In addition, the students understand the importance of collaboration, responsibility and leadership as one of the members at the industry of the society.

According to the recent newspaper article, in Japan, there may be almost more than ten percent "freeter" who do not have any fixed-job. The terminology "freeter" comes from the combined expression of English and German. It means originally Free plus Arbitrator which means the free worker working freely, not employed at the industry. The freeter is still increasing even now. The author thinks that most university students are not aware of the meaning of getting a job. Therefore, some of them escape so easily from the industry in the very short period and they don't like to get a job again. They like to be free and earn money based on the side job by submitting some articles to the magazine and journal. Therefore, they don't get any fixed salary per month. Total amount of salary of them compared with the normal businessman can be estimated almost a half in their life. Besides, the average number of children in one family is now 1.19 in Japan. The increasing number of free and the less birth rate will be a serious problem of Japan. Because the total activity of Japan will be lowered. Especially for the freeter, they cannot give enough education to their children because of the low level of income. The problem of poverty and hunger is well known as one of the most serious issues in the developing country, however, even in the developed country, the young people such as freeter is making country not activated. The author would like to propose more various programs focusing on practicing subjects, especially for the engineering education program.

6. Agricultural Engineering Education

As already described the agricultural engineering is one of the academic areas of engineering. With the development and advancement of science and technology, many kinds of technology are already applied to agricultural machinery, especially for automation for example. Depending on the conditions in the individual countries, the level of mechanization is different and the agricultural machines used under that condition are also different naturally. More or less the agricultural machinery will be equipped with the high technological system due to the needs of the farmer to complete the operation easily.

In Japan, the Ministry of Agriculture and Fishery wanted to promote the extension of the simple machine not

equipped with an expensive control system such as for automation to provide the machine cheaper (MAFF, 2007). However, it was not successful because most of the farmers were part-time farmers, not professionals. They are not so familiar with the machine as the professional ones; therefore, they preferred to accept more automated expensive ones. In addition, the price of the machine equipped with those systems was not so much different in price almost 200,000. The part-time farmers wanted to have an expensive machine due to the reason for completing the operation precisely and quickly with the help of those additional control systems. This came from one of the characteristic features of Japanese agriculture focusing on rice cultivation and more percentage of part-time farmers, who are comparatively rich enough to purchase the expensive machines due to the regular monthly income from the other side job. They can purchase that expensive machine and they need it to complete the operation time by use of the weekends and national holidays. Apart from the farmer as the user of agricultural machinery, the engineer in agricultural engineering should be equipped with a certain level of knowledge not only mechanical engineering but also electrical- electronic engineering as expressed by Japanese made English terminology "mechatronics". More computerized machines are getting popular even in agricultural machinery (Cetinkunt and Mechatronics, 2007; Karnopp et al., 2007; Bradley, 2018). For the development and innovation of the related technology, the agricultural engineer should be equipped with the various kinds of knowledge and experiences in addition to the basic engineering one. Especially the practicing and the experiencing the most important and requested ones for university students, because of the shortage of the total time to be enrolled and engaged in the curriculum of engineering education while they have more time to be involved in operating computer more or less. To cover the shortage of those practicing time and provide more opportunity to experience practicing this program will be needed, the author trusts. Due to the frequent university reforms, it became quietly difficult to find and identify the name of the department or faculty characterized by the letter of agriculture. Most of the faculty or department removed the expression of "agriculture" and changed into "bioengineering, bioscience and bioresources". This university reforms made the society confused. Very few people know what kind of education program is now under operation though the students were previously educated focusing on agricultural engineering. Due to the change of social situation in the world, the direction for agricultural engineering to go must be adjusted and modified keeping our eyes on the change of social needs in the world.

Through this program, the followings can be found.

1) The level up of global communication (English skill level) can be performed

2) The shortage of the knowledge and experience for practicing can be covered

3) Up to date education can be provided

4) Global engineer can be grow up

5) Creation of original and unique idea can be well trained among the students

6) Similar program should be organized and offered at the university level to advertise more different unique and original program different from the other universities and produce the excellent graduates. One time in the past the author made a proposal of international cooperative education and career development by use of university facility such as university farm and other experimental stations.

One of the other possibilities of implementing this program can be explained below:

(Process 1) One of the universities establish this program with the assistance of partner universities.

(Process 2) After the required NC tools are facilitated, the core university offers the international cooperative education and career development program (together with the help of industry) and a certain number of university students can be accepted from the partner university annually for almost two months. Special program must be prepared for this program by the organizing core university.

(Process 3) All the participants must be evaluated and accredited by the program committee. Credit should be transferred based on the evaluation result in addition to the certificate of participation.

(Process 4) A certain number of committee members are requested to join in the process of evaluation and discussion for further improvement of the program.

The reason why the author would like to promote this program combined with engineering education program is as follows; Basically the industry develops this kind of program if the condition that the aim of getting more income for industry can be satisfied. The acceptance of students does not necessarily bring the income to the industry. Sometimes the program cannot be operated completely to meet the purpose of the program, because those accepted students are not accepted as the workers. The industry must prepare the special program for the purpose of cooperative education and career development, which does not promise the additional income through this program. The industry however can find sometimes the excellent human resources who may be able to serve possibly for that industry in future. This is an additional merit for the industry.

7. Conclusion

The agricultural engineer should be involved in the three bodies as one of the important partners, such as industry, farmer, and university. The university graduate should be equipped with the higher knowledge and experienced enough to communicate and to lead them. In this

paper the university goods manufacturing program is introduced as one of the examples from the viewpoints how the university can offer and prepare the effective and efficient program focusing on more practicing. However, the knowledge and experience obtained from this program can provide a valuable opportunity and produce highly evaluated graduates to contribute to the global society. One of the possibilities for implementing this program, many ways can be found. One of them is to combine this program with the international cooperative education and career development program.

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