

## **EXPANSION OF MEASUREMENT EDUCATION FROM ENGINEERING TO SCIENCE**

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*Abstract: Measurement has two faces. The one is "Engineering face" and the other one is "Science face". The engineering face is well known as "Measurement Engineering" of each field. But the science face which contributes to not only all scientific fields and all engineering or technical fields but also our human life and human society does not enough known.*

*This paper was written as a purpose to be recognized a fact that an act of measurement is the fundamental and important operation on all Learnings and all Human Activities. "Measurement Science" is a Learning to most fit in study of the fact and "Measurement Science" should be completed as a fundamental science on the education viewpoints.*

*Keywords: Engineering face, Science face, Measurement Science, Learning*

### **1. INTRODUCTION**

The Learning which is connected with measure is placed as individual Learning of each special field's measurement and sometimes it is sub divided in more narrow special fields. However, when regard to the construction system of measurement, common construction elements, common construction structures and common characters of the systems are found. Here the thought of "Systematization of Measurement" had developed in the age of 1970 – 1980 and the effort to make common theory and common system of measurement across each special fields had discussed [1].

Next, in the background of systematization of measurement, the discussion of scientific character and social character of measurement has flourished in the age of 1990. This discussion is said as "Measurement Science" and it has very important mean in the field of Learning and Technique [2]. Because an act of measure is a fundamental behavior of a man and the act makes human operation scientifically, and then the common theory and the common system are going to emphasize as based on the potential character of a man which wish to grasp the information (input) and the social character that the man carry out to the society by behaving using the information.

This paper gives the education viewpoints(4 stages) of "Measurement Science" and suggests that all people should learn the science as a fundamental Learning to the people live in information, technique and science orientated society to raise man's cultural level in 2000 age.

### **2. 1ST STAGE – PRESENT RECOGNITION OF MEASUREMENT EDUCATION**

In the first time, the present status of general measurement education should be reviewed.

The Engineering face has been increasing the depth as a Learning of "Measurement Engineering" in special field of Nature Science Domain like Figure 1. And each Measurement is sub divided in to

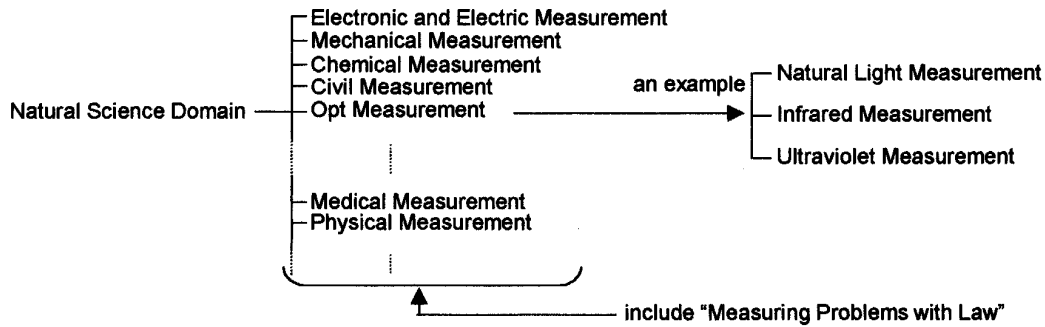


Figure 1. Present status of measurement as learning in Natural Science Domain.

more special field of measurement like showed as an example of Opt Measurement in Figure 1. Then “Measuring Problems with Law” are included in each special field measurement. At these statuses, the education of measurement mainly has being practiced in special field of natural science domain and here Physics and Mathematics are set as the foundations, and many Learnings on Engineering, for example, Electromagnetism, Electric Circuit, Electronic Circuit, Materials, Chemical Formulas, Chemical Reaction, ... relate deeply and strongly with the education. But the Measurement in each field on education is seemed as Applied Engineering or Applied Techniques so that measurement own (proper) theory and philosophy does not going to grow and becomes faint. Then in the age of 1970 – 1980, in the intention of doing to make them, the measurement of each field were regarded by systematic thought, and the existence of common construction elements, common construction structures, common characters of operation and other common characters are recognized. Here, the thought to treat The Measurement System in unification and to make theory here become born. This is called as “Systematization of Measurement” based on system conception like shows in Figure 2 [2].

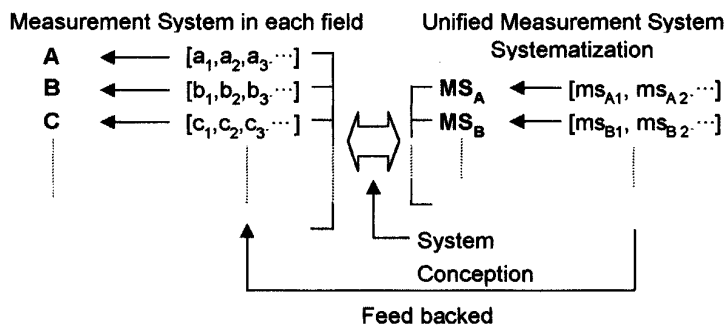


Figure 2. The thought of “Systematization of Measurement”.

### 3. 2ND STAGE – MEASUREMENT EDUCATION BASED ON “SYSTEMATIZATION OF MEASUREMENT”

The education of measurement introduced “Systematization of Measurement” extends on the engineering fields. Generally, a system is constructed by sub systems and the sub system is divided in to sub-sub system. The minimum unit is element or component and it is functional component. Here, “System Analysis” and “System Engineering” which is operated in the engineering by using the

knowledge got by the system analysis become important on the education. And then the “System Demands (reliability, usefulness, compatibility, economic problem)” become important subjects. The education items by system analysis on measurement were arranged in Figure 3 in the age of 1970 - 1980. In this age, individual detections developed and the principles and the theories were discussed. And not only the indication of detected results but also the analysis of detected signal were demanded. Here, the detection methods of physical volume and engineering volume or industrial volume were discussed on “Measurement Object” and “Detection and Signal”, the electronic circuits using on “Signal Conversion” were constructed, the theories for “Signal Analysis” were established, and the “Signal Transmission” was discussed on digital and analog transmission problems. The other side, “Measurement Control” and “Accuracy problems” was studied relate with “Result and Decision” and “Measurement Object”.

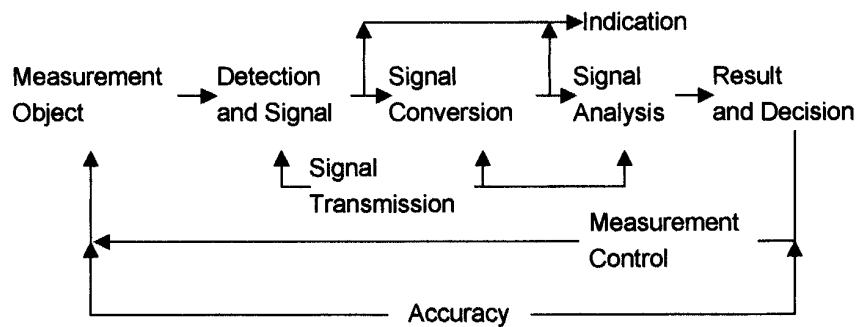


Figure 3. Education items arranged by Systematization of Measurement.

#### 4. 3RD STAGE – ADVENT OF THOUGHT OF MEASUREMENT SCIENCE

The face of Science came out through the discussions of “Systematization of Measurement”. Because a lot of measurements exist in our daily life, our social activities, our scientific works, our engineering works and our industrial works have possible to discuss on the system of common basis. And the philosophy, the frame, the mathematical structure, the systematic construction and the social role of measurement were emphasized by active measurement scientists and technicians. Main discussion points were transferred from measurement system and the construction to the relations with measurement object and detection (sensing), and then to the relation with measurement object and measurement result (analyzing result).

#### 5. 4TH STAGE – MEASUREMENT SCIENCE AND IT’S EDUCATION

In the age of 1990, “Measurement Science” has become established as an important Learning [4]. Here, “Social Role”, “Social Mission”, “Social Effect” and “Mental Effect for a Man” of measurement are discussed, and “Methodology(philosophize and mathematical directions)” of measurement is emphasized. Figure 4 shows a simple structure of Measurement Science on the viewpoint of education. Block letters in the figure are education items and the number shows the education order.

- In the first, the relation with **SOCIETY** (human society) and **Measurement Object** should be taught (1), (2).
- In the second, **Social Role** and **Social Mission** of measurement must be explained by Measuring

- problems with Low (3).
- In the third, the practical techniques of measurement (instruments) should be explained based on the thought of systematization (4), (5), (6). This is concentrated on **Sensing, Signal Conditioning and Analyzing**.
  - In the fourth, **Social Effect** and **Mental Effect for a man** must be taught relate with **Social Role** and **Social Mission** (7).
  - In the fifth (in the last), **METHODOLOGY** of measurement must be explained under the understanding of the philosophy, sociality and fundamental techniques of measurement (8).

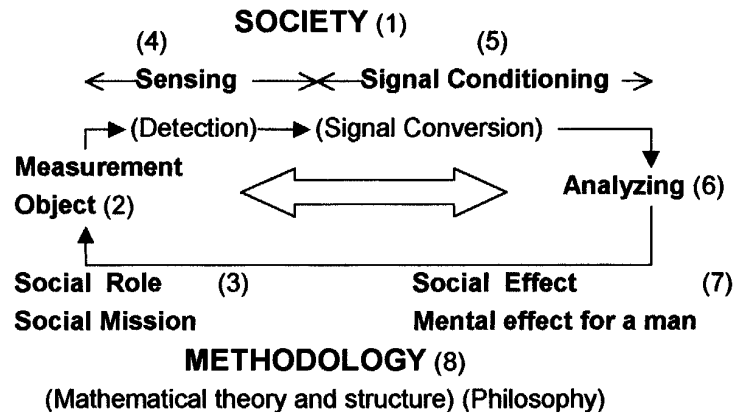


Figure 4. A simple structure of Measurement Science on the viewpoint of education.

## 6. CONCLUSION

In this paper, the education viewpoints of Measurement Science are arranged. An act of measurement is fundamental operation of a man and the measurement contributes in society through human activity so that everybody should be learned the thought of Measurement. An act of measurement is a typical act to get information and point of physics education or natural science education in the information and technique orientated society.

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