Future Applied Conventional Technology Engineering New Academic Fields from Manufacturing Country JAPAN

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Abstract. There are various traditional crafts in Japan. They have a long history, and their techniques and cultures have been inherited by many craftspeople. There are various wisdoms in many traditional crafts. In order to create new things, these wisdoms have to be studied by the science technology. Therefore, "Future Applied Conventional Technology Engineering" is defined as becoming the implicit knowledge of traditional manufacturing into formal knowledge by using science technology, and opening up new future for manufacturing by applying them to current manufacturing.

Keywords: Future Applied Conventional Technology Engineering, Traditional Crafts, Manufacturing Country, Implicit Knowledge, Formal Knowledge.

1 Introduction

Future Applied Conventional Technology Engineering was defined as becoming the implicit knowledge of traditional manufacturing into formal knowledge by using science technology, and opening up new future for manufacturing by applying them to current manufacturing. Traditional crafts products have been used by people for many years. There were various wisdoms in many traditional crafts products. It is significant that the various wisdoms are modeled after, understood and applied. On the other hand, the traditional crafts products have been loved and used by many people not as art objects but as articles for daily use. It may be said that people love the products because they are fitted in the daily life. These products are called "Highly cultural products". Characteristics of them are not highly-functional or low-price. It is a product family which is loved and recommended the use of them to other people. Feeling of highly cultural is needed to evolve the manufacturing in the future Japan. Therefore, an analysis on the feeling of highly cultural in the traditional crafts products is of the same importance as understanding of manufacturing. It is characterized as the pillar of the Future Applied Conventional Technology Engineering. This aca-

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V.G. Duffy (Ed.): DHM 2014, LNCS 8529, pp. 185–196, 2014.

demic field is examined from the viewpoints of manufacturing and products. It is looked like an integrated science including not only engineering but also social science. It was named after engineering for the idea from manufacturing.

Fig.1 showed a study method of the Future Applied Conventional Technology Engineering. There are 3 parts of research method in the Future Applied Conventional Technology Engineering. They are technique, hang and taking the measure. Techniques of traditional craftspeople are understood such as research on hang of speedy work. Especially the craftspeople can not explain the hangs because they learn them, and do not recognize them as special wisdom. The hangs become clear by comparing with another person's manufacturing. Therefore a process checking the hangs to the craftspeople is needed after analysis on various results. Taking the measure is the feeling of decision about product finish. It is the judgment in the final process of manufacturing for maintaining the feeling of highly cultural on the products.

An eye movement analysis on craftspeople was important at the stage of taking the measure for our study. An analysis on the feeling and brain activity was also needed. However craftspeople judge the product finish according to their feeling at the stage of taking the measure. In other words, this is a feeling of good response. In these ways, various scientific studies are needed to understand the manufacturing of the traditional industry.

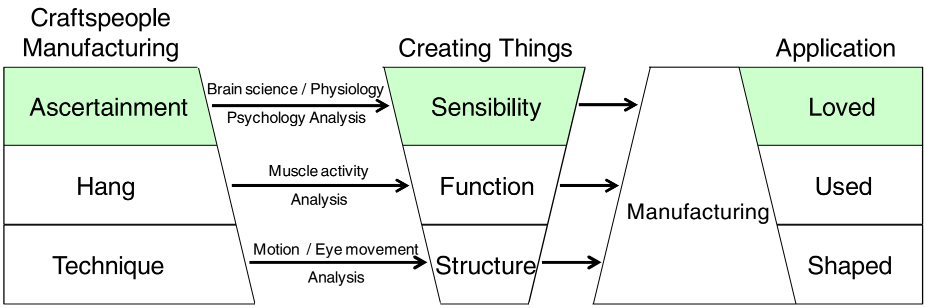

Fig. 1. Study method of the Future Applied Conventional Technology Engineering.

Prof. Hamada and his Laboratory, Kyoto Institute of Technology have studied various traditional crafts in Kyoto. There are many traditional crafts in Kyoto now, because Kyoto had been the capital city for about 1000 years in Japan and these crafts have been inherited by many craftspeople.

Following titles are a part of presentations on the past various conferences.

- A Study of the Effect of the Shape, the Color, and the Texture of Ikebana on a Brain Activity [1]
- A Study on Preference of Shuso Japanese Paper -Comparison of Japan, China and France- [2]
- MOTION ANALYSIS OF WEAVING "KANA-AMI" TECHNIQUE WITH DIFFERENT YEARS OF EXPERIENCE [3]

- SKILL LEVEL DIFFERENCES OF URUSHI CRAFTSPEOPLE IN URUSHI PRODUTS [4]
- STUDY ON THE DEGRADATION MECHANISM OF THE URUSHI PRODUCTS [5]
- Subjective Evaluation of Kyo-Yuzen-dyed Fabrics with Different Material in Putting-past (Nori-oki) Process [6]
- Highly Cultured Brush Manufactured by Traditional Brush Mixing Technique “KEMOMI” [7]
- Influence at Years of Experience on Operation Concerning Kyoto Style Earthen Wall [8]
- Biomechanical Analysis of “kyo-Gashi” Techniques and Skills for Japanese Sweets Experts [9]
- Subjective Evaluation for Beauty of Texture on Metal Surface with Chasing Operation [10]

3 case studies are introduced in the second chapter.

2 Case Study

2.1 Case Study 1: Motion Analysis of Body Movement between the Expert and the Non-expert Clay Plasterers

Background. In Japan, there are many industries based on traditional methods. Plastering a wall with clay, “Tsuchi-Kabe” in kyoto, is one of the traditional industries in Japan. The number of experts in the “Tsuchi-Kabe” industry has decreased with industrial development. Therefore, in order to the Japanese society for preserve the traditions of “Tsuchi-Kabe”, effective guideline to improve the skill of craftspeople in wall plastering needs to be developed.

Purpose. This study compares the upper and lower limbs motion between an expert and a non-expert during the plastering of “Tsuchi-Kabe”.

Method. An expert plasterer (age54, height 170cm, weight 66kg) with a 26 years experiences and a non-expert plasterer (age37, height 166cm, weight 53kg) with a 4 years experiences participated in this study. Fig.2 showed the scene of experiment. Both subjects wore similar clothing consisting of tops and short pants. Fig.3 showed the 3-dimensional motion analysis system; MAC 3D SYSTEM (Motion Analysis Inc.), which allows optical real-time motion capture. Filming was performed during three trials plastering a wall with clay by expert and non-expert plasterers. Fig.4 showed a measurement on the plastering motion of “Tsuchi-Kabe”. A trial was defined as one vertical movement of the right hand from bottom to top while plastering a wall.

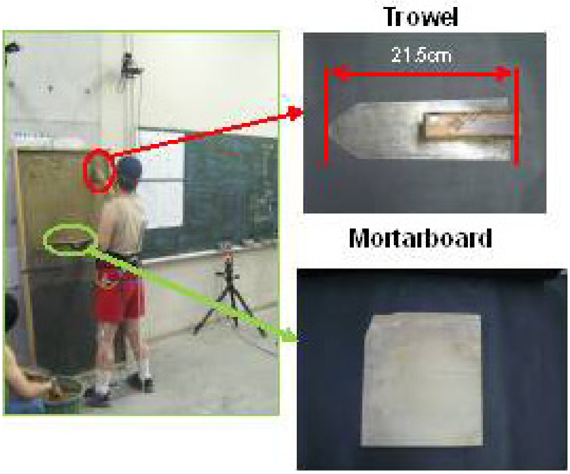

Fig. 2. Plastering “Tsuchi-Kabe” and tools

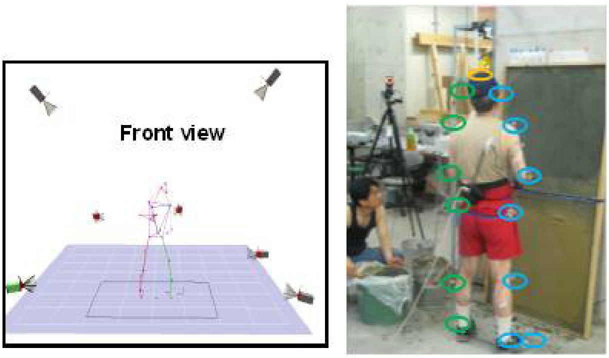

Fig. 3. Cameras and markers setting

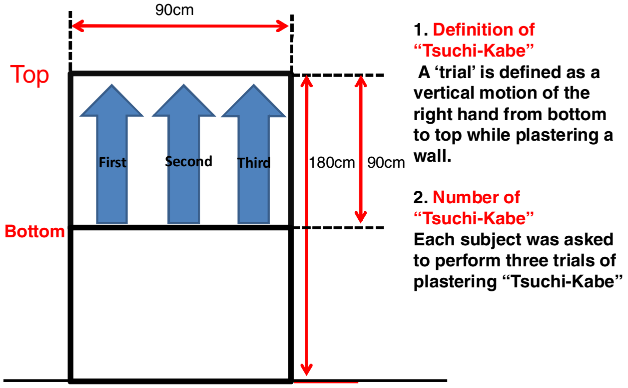

Fig. 4. Measurement of motion during the plastering of “Tsuchi-Kabe”

Results. 1. The upper limb of the expert had less inclination as compared to the non-expert plasterer (Fig.5, 6). 2. Ankle distance was consistent throughout the trails for the expert while the non-expert was not consistent. However, the ankle distance of the expert was longer than that of non-expert (Fig.7). 3. The knee joint angle remained constant after intermediate phase in the expert. However, knee joint angle of non-expert plasterer linearly decreased (Fig.8).

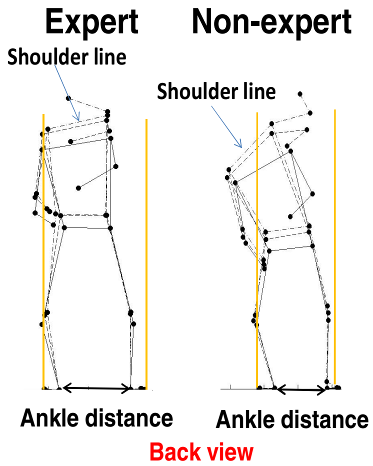

Fig. 5. Typical motion of plastering wall in expert and non-expert

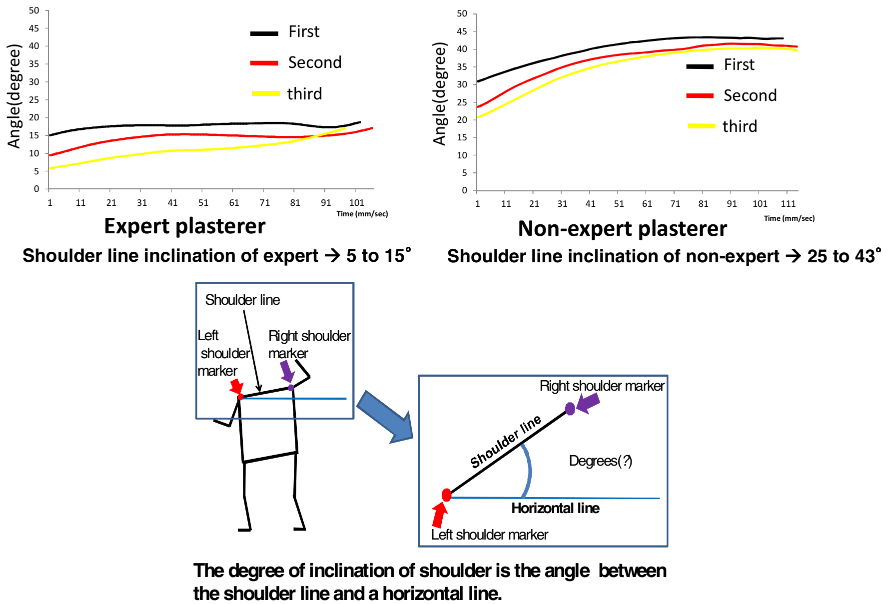

Fig. 6. Inclination of shoulder line

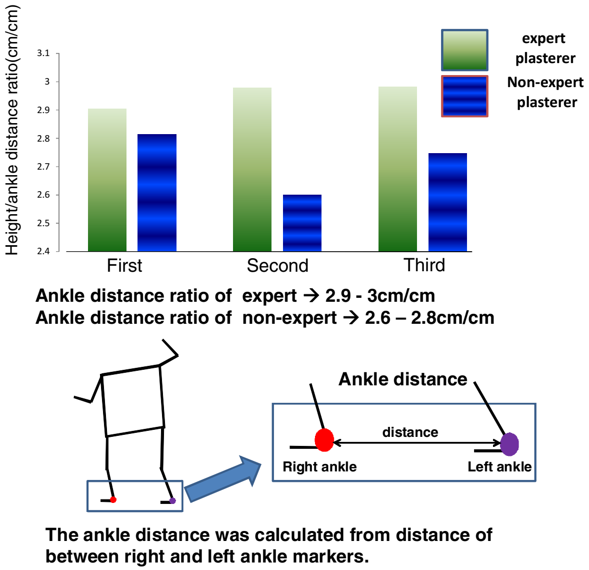

Fig. 7. Determination ankle distance

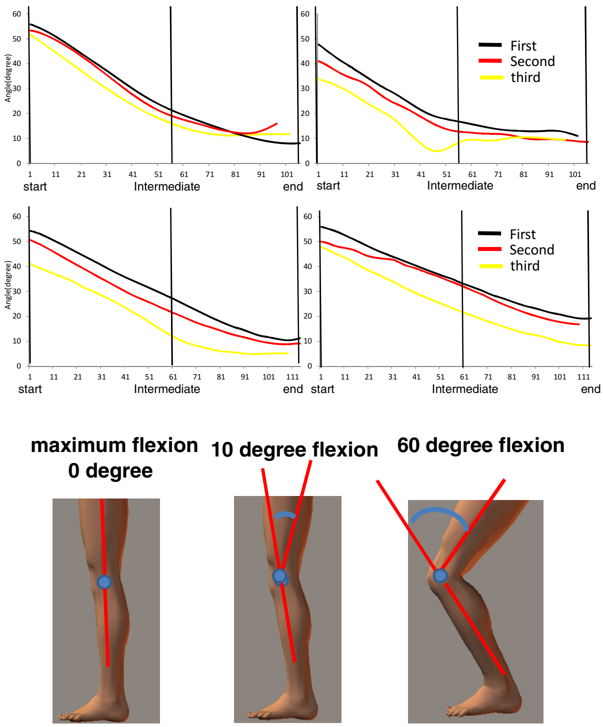

Fig. 8. Definition of the knee joint angle

Summary. Therefore, expert plasterer maintained better stability than the non-expert while plastering "Tsuchi-Kabe". This stability seems to be important for the craftsmen to continue working for longer hours before feeling tired or stressed. The results from this study can be used as an effective guideline for novice plasterers.

2.2 Case Study 2: Effects of Motor Learning on the Edge Shape of Japanese Kitchen Knives

Background. In Japanese traditional food, the Japanese kitchen knife is one of the most important equipment. The effects of motor learning on the Japanese kitchen knife edge had not been reported.

Purpose. The purpose in this study is: 1. To investigate the edge shape of the Japanese kitchen knives in unskilled during 21 days, especially compare with skilled. 2. To investigate the motor learning effects of unskilled human movement in the sharpening Japanese kitchen knives during 21 days.

Method. There were 2 subjects in this study. The information of them was shown in Table 1. Japanese kitchen knife was shown in Fg.9. This knife's blade length was 16.5 cm. Whetstones were used, and its roughness was medium level.

Table 1. Information of subjects

	Skilled A	Skilled B	Unskilled
Age (yrs.)	50	38	18
Career (yrs.)	30	19	none

Fig. 9. Japanese kitchen knife

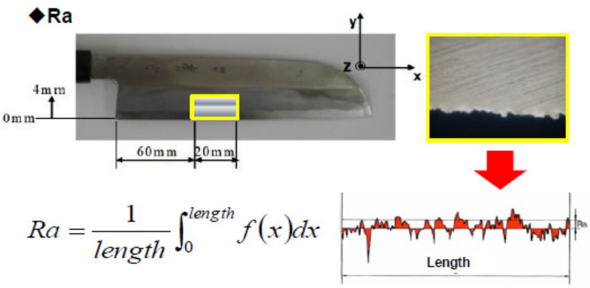

Fig. 10. Calculation of Ra

Shape of blade was organized by the optical microscope, its magnification was x200. Roughness (Ra) was analyzed by the laser displacement meter. Fig.10 showed calculation of Ra. Electromyogram of subject was measured by the electromyography system, and its sampling rate was 1 kHz. Unskilled subject was trained more than 5 times a week. Measurements were conducted 4 times (Day1, Day2, Day7, Day21).

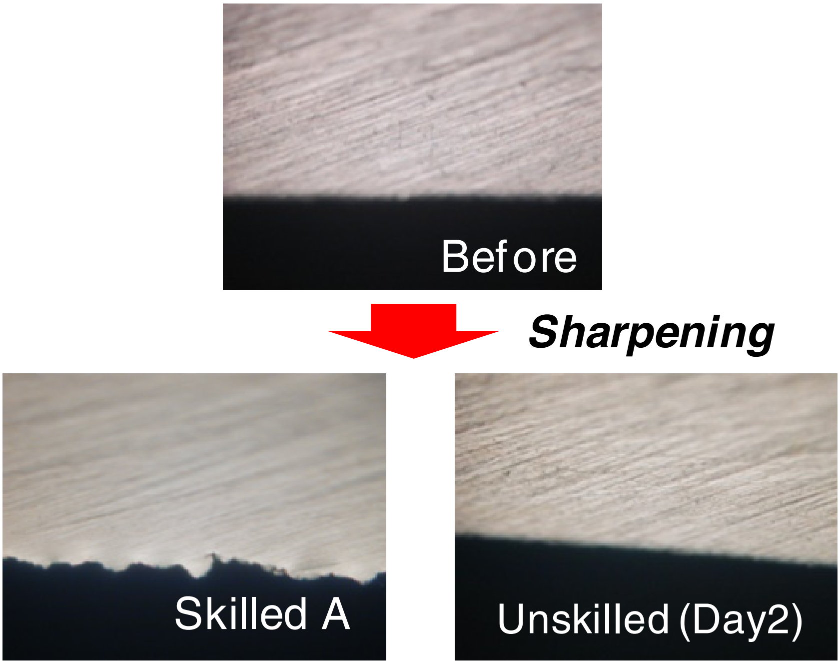

Fig. 11. Edge shape of knife

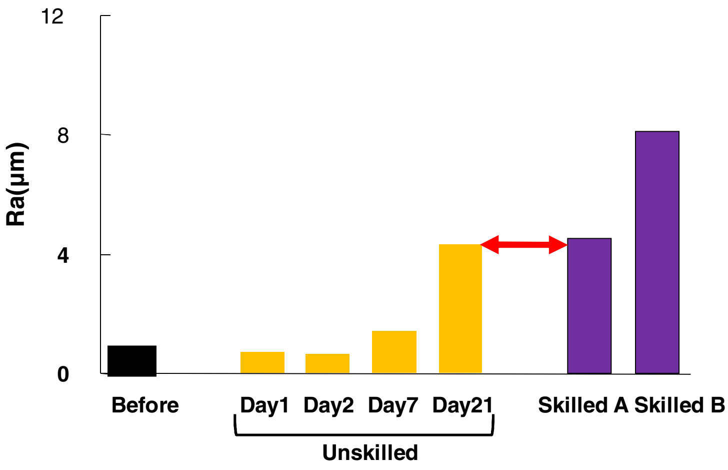

Fig. 12. Change of Ra value

Results. Fig.11 showed the edge shape of knife. There was no roughness in the case of unskilled subject on Day2. Fig.12 showed the change of Ra. Ra value of unskilled subject became similar to the one of skilled A on Day21. The edge shape of unskilled subject was improved little by little.

Fig.13 showed the change of EMG in the case of unskilled subject. EMG of the flexor carpi ulnaris and the deltoid were changed on Day7 and Day21. The knife was more strongly pressed on the whetstone, and it was pulled faster than before.

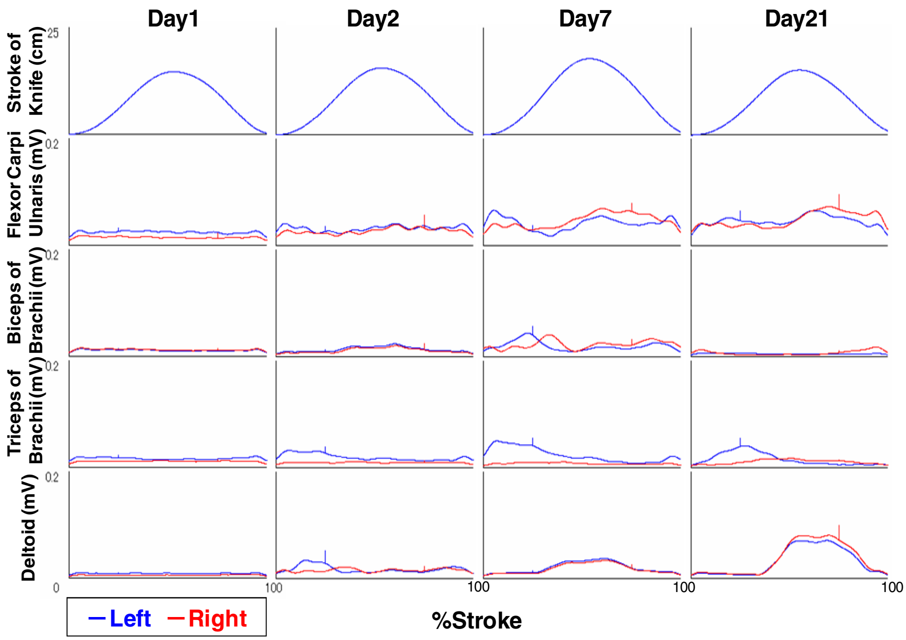

Fig. 13. Change of EMG in the case of unskilled subject

Summary. Training was more improved, the roughness of knife became larger and the EMG of the flexor carpi ulnaris and the deltoid became larger. In this study it was clarified that skill level was increased little by little.

2.3 Case Study 3: Biomechanical Analysis of "Kyo-Gashi" Techniques and Skills for Japanese Sweets Experts

Background. "Wa-Gashi" means the traditional Japanese sweets. "Kyo-Gashi" is one of the Wa-Gashi. It is called that by making in Kyoto. A finger technique is important for Kyo-Gashi, because of making by hands. Especially, subtle finger motion is one of the most important factors. Therefore finger motion skill of the "Kyo-Gashi" expert was analyzed in this study.

Purpose. In order to clarify the making process of Kyo-Gashi sweets, the expert's fingers and hands motion were recorded by the motion analysis system.

Method. Subject was the Kyo-Gashi expert. He was 34years old, and his experience was 14 years. Three dimensional motion capture system was used to analyze the fingers and hands motion on Kyo-Gashi making process. Fig.14 showed measurement scene of this experiment. In this study, an An wrapping process was measured. "An" means a sweet bean paste in Japanese. The "An" is wrapped in another "An" by fingers and hands. This process is one of the Kyo-Gashi making processes.

Fig. 14. Measurement on fingers and hands motion of Kyo-Gashi expert

Results. Fig.15 showed An wrapping process of Kyo-Gashi sweets. The An wrapping process was divided into 3 phases.

- 1st phase : first half of an-wrapping (wrapping until two-third from the bottom)
- 2nd phase : last half of an-wrapping (wrapping one-third from the top)
- 3rd phase : final shaping (adjusting the shape)

Fig.16 showed a flexion angle of left second finger in the An wrapping process. In the 3rd phase, left second finger repeated extension and flexion in the range of 50 degrees. Repetitions of extension and flexion were in the 8 to 11 range. Therefore the expert adjusted the number of repetitions to create ultimately similar final products.

Desired weight of sweets was 50 g. Average of weight was 50.5 g. The expert wrapped An with an accuracy of 0.5 g. There was a high repeatability on An wrapping process in the case of the expert.

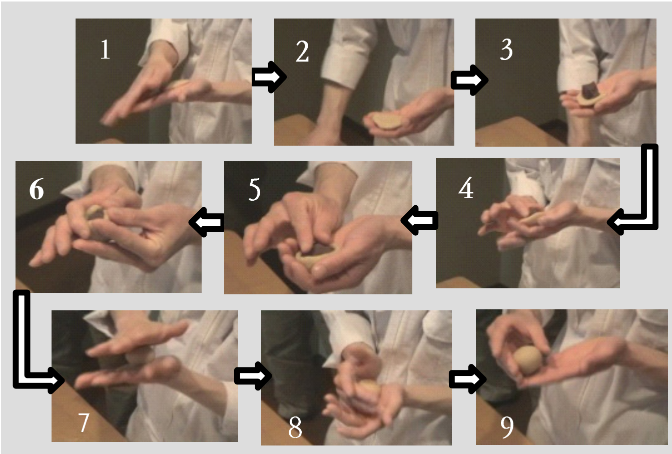

Fig. 15. An wrapping process of Kyo-Gashi sweets

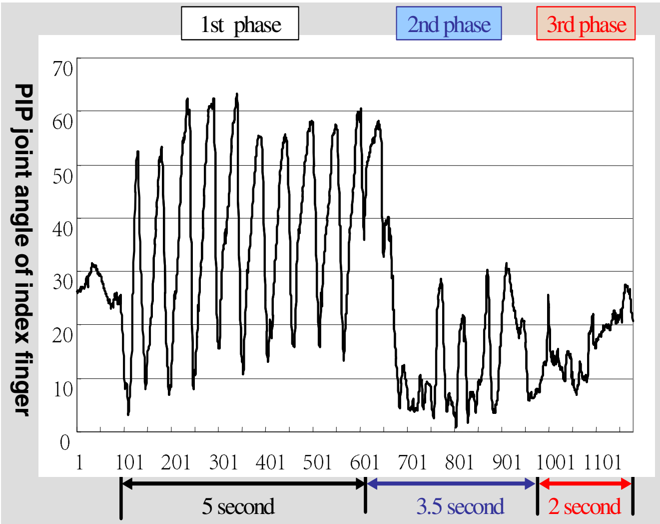

Fig. 16. Flexion angle of left second finger in the An wrapping process

Summary. It was clarified that there was a complex finger motion in the Kyo-Gashi making process. Furthermore expert conducted a sensitive conditioning on An wrapping process.

3 Conclusions

What will Manufacturing Country Japan aim? Japan create a new environment, society, and culture on manufacturing. This is just the Future Applied Conventional

Technology Engineering. Modern engineering technology is good enough, but if it use the wisdom of traditional crafts, it will become better. There are many traditional crafts in the world. In the future, if all countries will use the wisdoms, human beings and the world could go to the next step.

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