Biography: Mitsuo Nagamachi

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Dr. Mitsuo Nagamachi is a founder of Kansei Engineering/Kansei Ergonomics, which is well known throughout the world as an ergonomic new product development technology and he has so far created many new products from cars, home appliance products, brassieres, cosmetic products, handrails, toilets, and even a river bridge.

Nagamachi was born in Kobe, Japan, in 1936 and graduated from the psychology department of Hiroshima University in 1963. Following this, he studied medicine and engineering. He undertook consulting activities for Nissan, Toyota, and Honda among others, and during this time he learned statistical quality control, manufacturing system, robotics, safety engineering, as well as management. After graduating, he moved to the Engineering School, Hiroshima University, to teach human factors engineering and management and has been a teacher for 32 years. During the period 1967–1968, he was a guest scientist at the Transportation Research Institute of the University of Michigan where he formed a close relationship with Dr. Richard Pew, who was a professor at that time. Just after returning to his country, he was invited by the Japanese Government, MITI, as the youngest ergonomic researcher of the Automobile Research Committee whose mission was to make the Japanese automotive industry a world player Nagamachi's main research will be divided into four fields: (1) Job design and cell production systems; (2) Participatory ergonomics; (3) Safety management using the brain model; and (4) Kansei engineering/Kansei ergonomics.

1 JOB DESIGN AND CELL PRODUCTION SYSTEM

He was engaged first in mathematical theory of human behavior and constructed a mathematical model about Hebb's theory in his doctoral thesis, but he was most interested in the living human mind. When consulting Japanese companies, he always considered the workers in the factories. His ergonomic principle has always been to enrich the workers' satisfaction, as well as to promise the company profits. At a very young age, he was fascinated with *Design of Jobs* written by Luis Davis and James C. Taylor and he extended the job design idea to Japanese factories. He carried out EEG measurement in the workplace to demonstrate the monotony and boredome of the workers' jobs. He equipped a conveyer belt in his laboratory to examine workstyles and found that a one-man work system was the best for ensuring the workers' satisfaction and fulfillment. Then, he introduced his idea of job design in Mitsubishi Electric Company's factories in Fukuyama and Nakatsugawa. He introduced many real job design innovation in the work places and these findings influenced Japanese work style to enhance QWL. He was nominated the chair of Japan QWL by the Japanese Government and he endeavored to introduce the idea of job design philosophy throughout Japanese industry. During his activities, he founded a one-man work system in the automotive industry, where a worker assembled a whole vehicle by himself and productivity increased twofold due to worker motivation. In this innovation, participatory ergonomics was also introduced in the procedure. His interest with the one-man work system lead him to Volvo's plant in Uddevalla where he taught Volvo how to introduce the system to their factory. The workplaces with no conveyer belt and with a one-man or with teams with the small number of workers are now termed the "Cell Work System" in Japan.

2 PARTICIPATORY ERGONOMICS

Partcipatory ergonomics (PE) which means participation from the bottom was first proposed by K. Noro and K. Kogi and has spread throughout the world. Nagamachi's work in Japanese industries involved redesigning the workplace

following the principles of ergonomics. Bent posture became a thing of the past in the assembly lines of Daikin and in Huji heavy industry the assembly line was changed to the one-man assembly system using participatory ergonomics. Mitsubishi Motors Kyoto plant improved many jobs by the PE procedure. Improvement of the workplace following PE is shown everywhere in Japanese factories and this procedure led to the continuous improvement of Toyota production system seen nowadays.

Participatory ergonomics was successfully transferred to civil engineering in the construction of bridges, dams, and river, as well as public roads. In this area, PE is termed public involvement (PI) and the Japanese Government recently decided that PI should be introduced into all infrastructure construction.

3 SAFETY MANAGEMENT USING THE BRAIN MODEL

When working at the University of Michigan, Nagamachi began studying driver anticipation. He thought that if a driver is able to anticipate the next hazard he is likely to meet in his driving, he could potentially prevent an accident. However, this anticipation would be impeded if the driver is frustrated or irritated. Nagamachi then constructed the brain model of behavior such that a worker performs a safe behavior as long as he uses his new cortex, but it is very dangerous if he falls into the old cortex in the brain. This is called the Nagamachi style danger anticipation model (NKY) resulting from the brain model. The NKY safety training method has spread out in Japan and the number of accidents decreased in all industries.

The Kawasaki Mizushima plant, where 20 000 workers made steel established a world record with no accidents in a year by introducing NKY. Dr. Andrew Imada has contributed to the reduction of accidents for USA industries using NKY.

4 KANSEI ENGINEERING/KANSEI ERGONOMICS

Nagamachi has been active in total quality management (TQM) for many years and his principles are quite different from Japanese style of total quality control (TQC). During this time, he noticed that the Japanese style of TQC did not consider customer satisfaction and all manufacturers stood on the side of a "product-out" strategy, which means company-oriented product development. He thought that all manufacturers should conceive a "customer-oriented strategy" to produce products which lead to customer satisfaction (CS). Nagamachi started research into kansei engineering, in which kansei implies a customer's psychological feelings towards a new product. The kansei, Japanese has vague and fuzzy characteristics, but it is measured using the appropriate procedures. If a customer tastes a new dish, he says "delicious," and the saliva in his mouth increases and his stomach becomes active, much more than another when he sees another dish. In this case, we can measure the customer's feeling of "good taste" using words as well as physiologically. Then, if a female customer wants to wear a beautiful and graceful brassiere, we can produce a beautiful and graceful one from her estimation of several different brassieres and from analysis of these different materials.

Nagamachi created many of the kansei engineering techniques to find numerical data which were transferred to the design specifications. He helped Mazda create a new sports car, named "Miata" and Mazda was successful, selling it over a long period. Miata was designed with whole parts, including the engine, the exterior, and the interior from the viewpoint of kansei ergonomics. He taught Wacoal, a famous lingerie maker, to produce a kansei brassiere, named "good-up bra," which also has a long sales record, and this new kansei product provided profits to the Wacoal company.

Nagamachi worked hard for kansei engineering technology to be accepted in Japan as well as in the whole world, and the name of knasei engineering is now well known worldwide. He contributed to changing the design of a construction machine through the Komatsu Construction Machine Company. He taught kansei engineering to Sharp and he promoted it to produce a new style of refrigerator through Sharp's kansei team. The team created a completely different style of TV camera, named the Crystal Liquid Viewcam, which was a leader in the present design and style of digital cameras.

In the cosmetic field, Nagamachi created in association with Milbon a new kansei shampoo and hair treatment, named Deesse's, which brought the company considerable profits. He is interested in elderly people and produced a handrail, staircase, bath tub, and recently a toilet, named TRRES, fitting to the ergonomic characteristics of the elderly people.

Nagamachi has traveled extensively to teach ergonomics, safety, and kansei engineering. He frequently visited China, Korea, Malaysia, and Indonesia to support the advanced technology including manufacturing system and robotics. In Sweden, he is involved in a joint research project with Linkopin University and is currently in contact with the University of Leeds in the UK. His teaching and support to other countries are another important activity. He is still teaching ergonomics and kansei engineering at Hiroshima International University.

AUTHOR QUERIES

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