WaKaGaCAR:
*WA*DOKEI *KA*RAKURI *GA*TTAI
*C*ONSTRUCTION *A*UTOMATION *R*OBOTICS

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Abstract:

There is a cultural difference in the perception of robotics. In western culture the society and the human being adjusts itself to to mechanism and therefore fights it. The same happened with religion where christianity overlapped the traditional shamanism in Europe and fought till today with Islam. In Japan Buddhism did not overrun Shintoism and therefore the culture was enriched. The Wadokei mechanism adjusted itself to the japanese agri-culture whereas in Europe the society had to adjust its daily routine to the clock mechanism. Today we still find half of the industrial robot world population in Japan and researchers investigate in esthetic, social, artistic and cultural robotic developments, which appear to westerners as economically unfeasable. Even though in USA and Europe where we take an economic and materialistic appraoch to investment in robotics and automation we still have less robots installed because we prefer human robots due to tradition of slavery since the roman culture which peaked during the slave trades by Britain from Africa to America. Even the early karakuri dolls were built for entertainment of the common people where as in Europe only the aristocrats could enjoy the early automaton. In construction over 100 robots and 20 automated sites had been developed in Japan versus european construction sites with mostly foreign cheap labor. The origin of this special development in Japan can be traced to WaDokei and Karakuri.

Keywords: WaDokei, Karakuri, Gundam, Gattai, Construction Automation Robot

1. INTODUCTION

During the ISR 2005 Conference in Tokio I had a discussion with Joseph Engelberger, Prof. Tesar (UT USA) and Prof. Umetani. The two Americans questioned the economic feasability of the japanese robotics during the ISR conference. I argued that there is no need of showing any economic feasability since more than 50% of all industrial robots world wide are installed in Japan. In my opinion japanese R+D in robotics is already in a different level maybe philosophical, spiritual or artistic level.
Then I talked with Prof Umetani who explained me his recent Karakuri Noh play for a humanoid robot.
Furthermore I discussed during the GAFOES (German American Frontiers of Engineering Sciences Conference in May this year in Murray Hills USA with Prof. George Bugliarello, member of the academy of engineering of USA, about socio technological transformations of societies through technology.

These discussions triggered the following thoughts:

As biologicals beings, mankind in form of a society copied, modified designed and developed mechanisms. This becomes more evident nowadays were half of world population live in urban areas, where technology as a form of mechanism plays a crucial role in the form of water, energy and food supply systems, information and communication systems.

In western culture technology is considered as the process human societies devise to produce and use machines and modify or control nature. This can be seen by the nature modifying activities, such as engineering, medicine and agriculture. Technology requires the synergy of individuals, mechanics and social organizations, which acquire knowledge by understanding nature and using this analytical natural science for the design of mechanisms. Recently we modify the biology by genetic engineering and overcome gravity by space travel. Today most of our life be it agriculture, commerce, education, health care, warfare and industry depends on relations between humans, society and mechanisms.

The social factor responds with a certain inertia to any technological developments and innovations (Jacquard's looms and weaver's protests), which require different organizational patterns, laws, perceptions, training and education and the evolution of new customs. Since humans are prone to comit mistakes under stress and work load, machines can not execute any fault unless they have been ill designed by humans. However mechanics if ill designed can increase the risks during failures. So it depends on the designer how to potentiate the benefits of mechanics in order to augment and facilitate human life and wealth of societies.

2.WADOKEI-A MECHANISM THAT ADJUSTS TO HUMAN LIFE STYLE

Although Hisashige was already a successful inventor, his enthusiasm for invention increased and he continued to develop his skills as a clockmaker. Kiko-do advertising from this time showcases what might fairly be described as Hisashige's masterworks — the *Man-nen Jimeisho* chronometer, *Shumisen-gi*; model of the Buddhist universe, and the *Unryusui* pump. Hisashige also produced many other ingenious mechanical timepieces including the *Makura-dokei*; pillow clock, and *Taiko-dokei*; drum clock. His skills and ideas as a clockmaker were approaching their apogee, and they would soon all be channeled into construction of the *Man-nen Jimeisho*, the finest traditional Japanese-style clock ever built.

WaDokei exterior view

Japan's first planetarium, the *Shumisen-gi*; model of Mount Sumeru, was created by Hisashige in 1850 at the request of a senior member of the Buddhist clergy. It was designed to illustrate the cosmology of Indian Buddhism, which places Mount Sumeru at the center of the Buddhist universe. According to the advertisement, the device allows observation of the advance of time over the course of the year in the movement of the constellations, the progress of the four seasons and sunrise and sunset.

I think especially the fact that the clock mechanism is designed by Hisashige in such a way that it adjusts itself to the requirements of the agricultural society with longer days and shorter nights in summer and to all 4 seasons shows that Japanese people are not afraid of mechanism , robots and automation , because they control it by designing it according to the needs of society, culture and humanity.

WaDokei mechanism

Prof. Kato already researched subsystems for todays humanoid robots in the seventies and about 20-30 years later researchers in USA and Europe now tackle similar problems.

WaDokei Kit

While Professor Umetani was researching at Toyota Institute of Technology in the nineties he already showed me research in cooperative or assistive robotics where the robot would share the same space with human without hurting him. Nowadays maybe 10 years later researchers in Europe approach similar tasks.

3. KARAKURI – A MECHANIC DOLL WITH HUMAN WEAKNESS

Robotics in Japan started in the Edo period (1603 onwards), because during the Edo period many Karakuri were made that could move automatically due to strings and mechanism of clockworks and springs. These were popoular with even average people and they were made for pure fun.

Kyudo Karakuri

Hisashige travelled around Japan entertaining people with his inventions and Karakuri dolls. Another different notion of japanese Karakuri and western automaton is that Karakuri dolls had incorporated failure functions. In the Kyudo Karakuri for example one of the arrows did not hit the target. This imperfect mechanism had been designed on purpose and in my opinion proves that Japanese are not afraid of mechanism or present robots, since they know that they can design and control the performance and success of the machine. This unperfect design concept of the mechanism reflects the human nature in machines and common people watching the Karakuri performance feel amused and laugh when the mechanical doll fails.

Chaaibo Karakuri

Western automatons on the other hand moved perfectly which could have caused common people to feel inecure and threatened since the machine never seems to fail.

4. GUNDAM - THE FUTURE SUPER KENSETSU GINOSHA?

The original Mobile Suit Gundam was an animated science-fiction series which debuted on Japanese television in 1979. In this groundbreaking series, the traditional giant robots of Japanese anime were for the first time portrayed as realistic war machines instead of invincible superheroes. The people who used these machines to fight in a futuristic space war were complex characters whose motivations and beliefs didn't break down into simple good and evil, and the story encompassed human drama and social commentary as well as thrilling robot battles. Here again one finds the notion of Karakuri which can fail like a human. The Gundam saga made its North American debut in 1998.

The name Gundam also applies to the mobile suit RX-78 Gundam, the humanoid fighting vehicle which starred in the original TV series. This heroic giant robot, with its distinctive blue-and-white color scheme and V-shaped antennas, has been reincarnated in almost every one of the Gundam saga's sequels and spinoffs. Often, the title of a Gundam story and the name of the featured Gundam mobile suit are similar or identical, which makes it a little easier to recall which mobile suit stars in which story.

The original creators of Gundam were director Yoshiyuki Tomino and the mysterious "Hajime Yatate" (a pen name reflecting the collective contributions of the Sunrise staff). Character designer Yoshikazu Yasuhiko and mechanical designer Kunio Okawara also played a large role in the original series's success.
The original Mobile Suit Gundam story took place in the same setting, a futuristic space age called the Universal Century.
Mobile suits are the humanoid fighting vehicles - in other words, giant robots - which are the standard weapon of war in the Gundam saga. Mobile suits typically range in size from 15 to 25 meters (50 to 80 feet), and are usually operated by a single human pilot. Their versatility and high maneuverability make them superior to any conventional tank or space fighter. The technologies used in these mobile suits, and the history of their development, are different in each of the Gundam worlds. In most cases, they are said to be military versions of worker machines which were previously used for space construction. These worker machines are in turn descended from the space suits and maneuvering gear used by modern-day astronauts, and it's from these that the "suit" nickname is derived. In the Gundam series, the space suits worn by human characters are often referred to as "normal suits" (or "astro suits," in Gundam Wing) to distinguish them from their robotic descendants.

The mobile dolls seen in Gundam Wing are computer-controlled mobile suits which do not require a human pilot. Though they rely on human commanders to tell them which enemy units to attack, mobile dolls are otherwise fully capable of maneuvering, fighting, and executing missions without human guidance.

The first production model, the OZ-12SMS Taurus, can also be operated by a human pilot, but the later OZ-02MD Virgo doesn't even have a cockpit. Despite their complex humanoid forms, mobile suits are controlled almost entirely by computer software, so they're no more complicated to operate than conventional vehicles like automobiles or aircraft. Although the movements of the mobile suit's limbs can be manually controlled when necessary, for the most part the human pilot's tasks are limited to steering and shooting.

Like modern-day aircraft, mobile suits are operated using joysticks and foot pedals. The cockpit is equipped with monitor screens which display the surrounding environment as if the pilot were sitting in the mobile suit's head. In more advanced mobile suits, the pilot is surrounded by a 360-degree panoramic monitor rather than simple flat-panel displays, but otherwise the basic operation is more or less the same. Here there are similar concepts transferred to early construction automation and robotics.

In the SSR 4 fire protection spraying robot the operator teleoperated the spraying process from safe distance. In the automated building construction sites one supervisor like a Gundam pilot or an air traffic controller supervized a whole construction site.

Gundam the future super kensetsu ginosha?

5. GATTAI-
A NEW CONSTRUCTION MACHIMERY CONCEPT

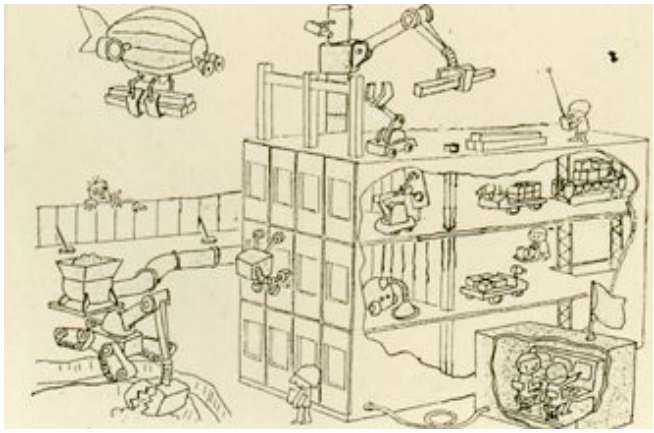
In the kensetsu Gattai concept the construction equipment could adjust to different construction tasks. The kensetsu gattai would change its form and function to excavator, crane, truck or tunneling machine.
The advantage would be that the investment in construction machinery could be used more efficiently. Due to varying market demands in construction industry we can learn from the Gattai concept . In construction it means increase wealth for society compensating labour costs through mechanization.

Kensetsu Gattai

Gattai which is one of my favourites toys next to Karakuri and Gundam. I think Gattai is inspiring young people to think of metamorphosis and continuous hansei and kaizen. These ideas we all find in robotics and in one of future 9 million service robots in the year 2008.

6.KENSETSU MANGA

In the seventies and eighties of the 20th century many ideas and visions had been developed.



WaKaGaCAR in Building Construction
Since we live in a changing world of globalization we need these type of visions when our advanced societies transform itself towards the socio psycho society according to the Kondratieff cycles.

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