

# Japanese Prefabricators' Means to Commercialize 'Mass Custom Homes' Equipped with Photovoltaic Solar Electric Systems

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## INTRODUCTION

Japanese housing manufacturers have been gaining a worldwide reputation as to their unique design, production and marketing approaches to commercializing 'innovative' industrialized housing, which is often equipped with solar photovoltaic (PV) electric power generating systems today (Noguchi and Elzinga 2004). Their homes are produced based on a system that helps them to correspond with the wants and needs of individuals as well as society. Today's consumers are looking to purchase a 'customizable' house at an affordable price that adapts to the demographic changes of our society with regard to socio-economic profiles (Anderson 1997). In order to satisfy consumers' individual demands for housing, the manufacturers might be urged to apply a new design approach (Noguchi 2003a). On the other hand, as the global awareness of sustainable development, which was first advocated by the World Commission on Environment and Development (commonly known as the Brundtland Commission) in 1987, are elevated, today's society demands the production of sustainable housing from homebuilders. The use of industrialized building techniques that help to reduce the total amount of wastage at the construction stage, and the renewable energy technologies (such as PV systems) that contribute towards reducing CO2 emission, when a house is occupied, can be considered to be effective in meeting such societal demand for green homes (Ayoub, Dignard-Bailey and Filion 2000).

Japanese housing manufacturers developed their own high-tech production approaches that fully rely on computerized design and inventory control systems, assembly-line production, robotics, and research and development (Sackett 1986). Their prefabricated homes are no longer merely repetitive,

mass-produced housing (Davis 1987). Rather, the interior and exterior design compositions as well as the space arrangements are well customized by the end users themselves (Noguchi 2000). In fact, the manufacturers offer a variety of standard volume, exterior and interior design components to their clients, who will in turn be asked to choose them to plan their new home. Today, the manufacturers tend to produce reasonably-priced, customizable homes, which are often equipped with PV systems, in response to both consumer and society demands for sustainable housing (Noguchi 2004). Then, the question arises: how do Japanese housing manufacturers successfully commercialize their 'innovative' housing that the consumers in general are unlikely familiar with?

The following sections attempt to identify Japanese housing manufacturers' design (and production) approaches that help produce their innovative homes, which may also differ from industrialized housing in North America. As well, a 'marketing strategy' that might make the manufacturers successful in the delivery of their innovative housing is examined.

## SHIFT FROM 'MASS PRODUCTION' TO 'MASS CUSTOMIZATION'

Before securing today's position, Japanese housing manufacturers had also experienced great hardships that hindered the widespread public acceptance of industrialized housing in the past. In 1959, Daiwa House Industry Co., Ltd. (1998) first introduced a practical prefabricated home, called "Mizet House" (Fig.1). Since then, Japanese manufacturers have focused on mass-producing homes.

In the 1960s, they initially tried to improve the 'productivity' of their products, while giving little thought

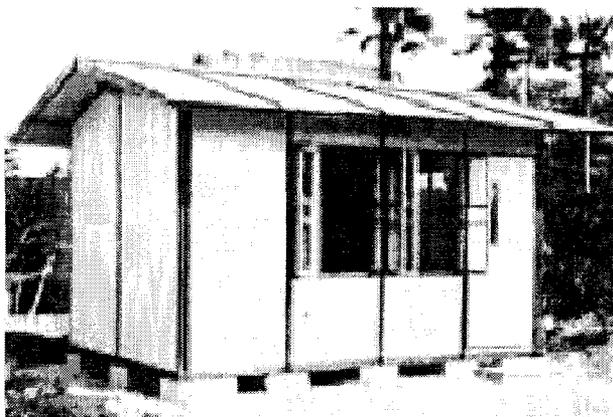


Figure 1. Mizet House  
(Source: Daiwa House Industry Co., Ltd.)

to overall product quality. In consequence, the mass production of housing triggered off a widespread image of 'low quality' associated with industrialized housing (Sackett 1986). In spite of the expectation that the provision of prefabricated homes can be an effective means to meet the demand of affordable homes for moderate-income families, conventional housing was still predominantly preferred by them. In order to turn the masses from the inferior image of prefabricated homes, the Japanese government sponsored a nation-wide competition, known as the "House 55" project, to produce quality affordable homes in the mid-70s (Sackett 1986). Since then, Japanese manufacturers have concentrated on



Figure 2. MU  
(Source: Daiwa House Industry Co., Ltd.)

producing value-added, quality housing, rather than merely increasing the productivity (Noguchi 2000). Essentially, their new 'quality-oriented' way of producing homes might prompt the manufacturers to shift their design and production approaches from 'mass production' to 'mass customization' (Fig.2).

Today's homebuyers may prefer to purchase indus-

trialized housing because of the superior quality. The Japan Prefabricated Construction Suppliers and Manufacturers Association (JPA) conducts an annual survey of consumer preferences in the purchase of factory-built homes. Their survey carried out in 2003 shows that the perceived 'high quality' of prefabricated housing was the most significant factor attracting potential homebuyers (JPA 2004). In fact, 23% of the homeowners surveyed preferred to purchase industrialized housing because of the higher levels of product quality regarding the durability, insulation performance, and air-tightness—this result somewhat suggests that today's homebuyers regard 'housing sustainability' as important in the buying decision-making process. The second most significant factor was the 'reliability' of the large-scale company, which somewhat reflects the 'brand name' effect on the sales, as 15% of the purchasers replied to this survey. Ranking next to them, 9% of the homeowners responded that they preferred to purchase industrialized housing, whose selling price is 8% on average more expensive than conventional home, because they were convinced by the sales staff's explanation of their product and service. These results indicate that homebuyers tend to consider the 'quality' of housing, which may affect both the amenity and the life cycle cost, to be the top priority, while the selling price is less of consideration. In other words, today's consumers venture to purchase a reasonably priced 'innovative' product, if convinced of the superior quality.

### 'QUALITY-ORIENTED' PRODUCTION

Japanese housing manufacturers often acquire ISO 9000 and 14000 series that certify the quality control of their products, as well as the companies themselves. They set up higher standards than ordinary building regulations, maintaining uniform product quality by strict control over their products (Noguchi 2003b). In particular, most Japanese manufacturers establish their own quality standards in order to improve structural resistance, durability, and amenities. In terms of the structural resistance, their quality standard is based on the Great Kanto earthquake that destroyed houses with horizontal force of approximately 9 tons. Basically, structural resistance is a matter of utmost concern in housing quality in Japan; for instance, on January 17, 1995, a gigantic earthquake with a magnitude of 7.2 battered Kobe, Japan's sixth largest city (1.6

million populations), destroying a number of houses, buildings, bridges, port facilities and other urban infrastructures (Utsu 1995). The 20-second quack killed over 5,500 people, becoming the worst in Japan since the Great Kanto earthquake in 1923 when 142,807 people lost their lives. A house must protect not only the homeowners' lives but also their property. For instance, Misawa Homes, which obtained the 2004 Good Design Award issued by Japan Industrial Design Promotion Organization (JIDPO), produces modular homes that can resist 1,000 gal (28.7 tons) in horizontal force (Misawa 1995). As well, Sekisui Chemical (2004a), another large-scale modular housing manufacturer in Japan, recently introduced a new commodity, called "GRAND TO YOU," which uses 2 x 6 in. studs for the exterior wall framing, rather than 2 x 4 in., and the house is designed to resist even 1,600 gal of peak in horizontal force. Most leading housing manufacturers reported that none of their houses built in Kobe were fatally destroyed by the 1995 Hanshin Great earthquake (Daiwa 1999; Misawa 1998; National 2001; Sekisui Chemical 2000).

Japanese housing manufacturers adapt resource-saving strategies. Toyota Motor, which also produces modular homes in Japan, advocates that the durability of housing should contain structural durability, design durability and flexibility that help adapt to the changes in homeowners' lifestyles, while Misawa Homes attempts to produce homes that can be used by several generations over 100 years. Surprisingly, the lifespan of housing in Japan is regarded as shorter than in other advanced nations (Matsumura and Tanabe 1996). In 1993, there were in total 45,940,000 houses, and of this number, only 2,150,000 were pre-war houses. The legal lifespan of wood-frame housing is said to be 30 years in Japan; however, 10% of wood-frame housing statistically vanish within 18 years after the home is newly built and almost half of wood-frame houses are destroyed within 33 years. Japanese manufacturers have been aware of the short durability of housing today, educating the public that factory-built homes are structurally, environmentally and economically durable. The manufacturers claim that they have been producing 'better-quality' homes for about the same price as conventional ones, giving their houses the higher levels of amenities that facilitate the home not only as a mere shelter but also a living environment, where room temperature, air-cleanliness and soundproofing in

the house are well controlled (Sekisui Chemical 1998). The manufacturers compete to produce 'better-quality' homes that satisfy 'consumer demand' for quality housing.

On the other hand, today's society demands the production of sustainable homes from homebuilders

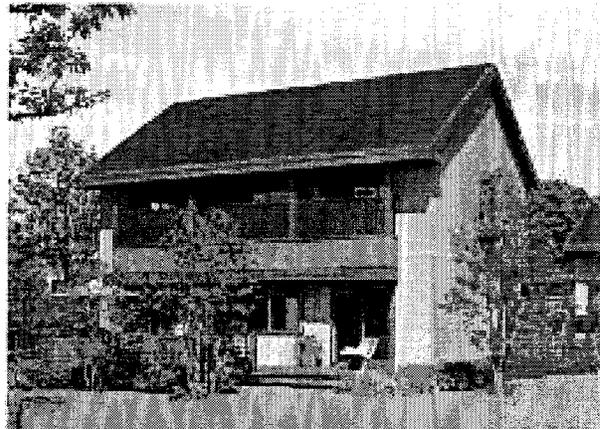


Figure 3. Misawa Home Z  
(Source: Misawa Homes Co., Ltd)

in response to the global awareness of the depletion of the earth's natural resources. In addition to the improvement of product durability, Japanese housing manufacturers began to install a renewable solar electric system, producing PV solar homes (Fig.3).

In fact, since 1999, Japanese housing companies have introduced 168,628 installations (622.8 MW) of their PV systems mounted on energy-efficient houses to the market to date. In Japan, the residential PV systems overwhelmingly dominate the overall PV market with 85 % of the share. Today, the leading manufacturers create a new market for residential PV systems, developing all-electric houses equipped with PV systems. In their 2004 annual report, Sekisui Chemical (2004b) explained that the production of "zero utility expense" homes equipped with PV systems, which were launched in January 2003, helped to increase their total housing sales and the orders grew 7% in comparison to those in the last fiscal year. Also, Sekisui Chemical indicates that they began to install PV systems (as well as a hot water unit with CO2 heat pump) as 'standard equipment' rather than options.

Japanese housing manufacturers' 'quality-oriented' production approach reflects their 'cost-performance' marketing strategy, which may be consid-

ered as the essence of their business success in commercializing 'innovative' industrialized housing, in response to market demands for sustainable housing development, which is aimed at tackling the economic, social and environmental problems that arise today.

### **COST VS. PERFORMANCE**

According to a housing survey conducted in 1997 by the Government Housing Loan Corporation () in Japan, the construction cost of a conventional home was estimated at 175,404 yen (US\$1,652) per square meter. A prefabricated home was at 190,033 yen (US\$1,790) per square meter (Noguchi 2000). These results indicate that Japanese manufactured housing is about 8% more expensive than the conventional one. There is a tendency for Japanese manufacturers to compete to improve the housing quality, as described above, rather than reduce the selling price of their products. At the marketing stage, the manufacturers offer a personal consultation service to their clients, in order to educate them to appreciate the distinguishing features of their high 'cost-performance' housing, in which a variety of amenities (including PV systems today) are installed as standard features (Sekisui Chemical 1998). 'Cost-performance' marketing strategies can be also seen in the automobile industry. Even though today's automobiles can be produced with lower production costs than those in the past, their selling price does not seem to be affected dramatically by higher productivity, and new cars are still generally regarded as expensive. However, the list of items now offered as standard in new cars, such as air conditioning, a stereo set, airbags, remote-control keys, a power steering, power windows, and adjustable mirrors, were offered only as expensive options in older models. Clearly, the quality of newer models is much higher than that of older models. The same is true for the housing industry in Japan. Their quality-oriented production contributes towards the delivery of high 'cost-performance' housing, in which high-tech modern conveniences that are installed as options in conventional homes are available as 'standard equipment'.

### **CONCLUSION**

Japanese housing manufacturers have been suc-

cessful in designing, producing and marketing their high 'cost-performance' housing, in response to the wants and needs of individuals, as well as society. The manufacturers shifted their design approach from 'mass production' to 'mass customization' while their 'quality-oriented' production approach led their business operation to focus on the supply of high-quality housing, rather than the cheaper, low-quality house. In addition, the manufacturers developed their own communication approach that helps their clients to understand the significance of their high 'cost-performance' housing, drawing the potential homebuyers' attention to the product quality that potentially affects the life cycle cost, rather than the initial cost.

In response to Japanese housing manufacturers' marketing strategy that essentially influenced the development of their design, production and marketing approaches, the prefabricated homes had evolved from low 'cost-performance' *mass-produced* houses into high 'cost-performance' *mass-customized* houses within which a variety of housing components that help to drastically improve the product quality are installed as standard equipment, in order to satisfy consumers' demand for quality homes. Furthermore, the manufacturers today tend to pay more attention to the delivery of green homes with due consideration of the global awareness of sustainable development and began producing PV solar housing that the homebuyers (i.e. users) are also allowed to customize the volume, exterior and interior design arrangements according to their needs, desires and expectations for the new home. In fact, Japanese housing manufacturers are at the forefront of commercialization of 'mass custom homes equipped with PV systems' that truly meet today's market demands for sustainable housing, *only* if the selling price is less of consideration.

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