IMPEDIMENTS TO THE MARKET ACCEPTANCE OF PREFABRICATED WOOD PANEL SYSTEMS

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ABSTRACT

The object of this study was to identify the obstacles prefabricated wood panels faced in the residential construction market. A literature search showed that recent changes in the panel industry had not be adequately documented. Therefore, the basis of our knowledge of the panel industry was derived through telephone interviews with panel manufacturers and trade groups.

Home builders were identified as the primary target market for panel systems. The home builders' perceptions of wood panels systems were gathered through telephone interviews. These interviews were based on a questionnaire included as Appendix One.

The study then identified several market niches and possible development services the panel producers could provide to supplement their panel product and increase their market share.

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FINDINGS AND CONCLUSIONS

The prefabricated wood panel industry has limited opportunities to expand its share of the low-rise residential construction market. This study concludes that the following are the key obstacles to this market expansion.

1. Home builders perceive these panels as lacking design flexibility.
2. Prefabricated construction has the stigma of being associated with low cost subsidized housing.
3. The value-added component of open, wood panel systems is minimal.
4. The efficient implementation of flexible panel production equipment requires a high level of output to carry capital investments.
5. Existing excess production capacity in the wood panel industry has led to a high degree of intra-industry competition and slim profit margins.
6. The high degree of intra-industry competition contributes to the high exit rate of panel manufacturers from the business.
7. In a depressed housing market, panelizers do not have the flexibility of on-site framers in terms of moving across geographic markets or into other product types.

This study has identified the following as opportunities for wood panel manufacturers.

1. In New England, home builders claim there is a shortage of labor, in particular, a shortage of framers. This could be an ideal market situation for wood panel construction.
2. Predatory pricing may injure the industry in the short-term due to the failure of firms. However, if this sector can achieve a stable state, with perhaps fewer competitors, it should be price competitve and capable of increasing its market share in certain segments of the market.
3. The low value-added component of open, wood panels could encourage the aggregation of complimentary building services within the panel manufacturing industry.
4. Through the education of home builders, many of the "apparent" impediments to increased utilization of wood panel construction could be removed.

INTRODUCTION

The prefabricated wood panel industry wants to expand its market share, likely at the expense of on-site wood frame construction. Wood panel manufacturers have industrialized, offsite, a process which has been traditionally done by on-site framing crews. The materials used (2X4 and 2X6 studs and plywood sheets) for constructing walls are essentially the same in both methods. The difference between industrialized panels and on-site construction is the manner in which labor and materials are combined

The panel manufacturer produces walls in a centralized location with varying degrees of mechanization. The finished wall panels are then shipped to a building site and erected. In on-site construction, labor and materials are combined on the building site with a low level of mechanization. Although these differences may seem slight, panelization is of higher quality and the more cost effective and efficient of the two construction systems. However, these advantages have not been translated into a market preference for panel over on-site construction.

This study will address the lack of market penetration by wood panels and then propose a strategy to increase its market share at the expense of on-site construction. The problem will be examined from four perspectives, each in a

separate chapter. The final chapter contains a marketing strategy and the conclusions of this study.

The first chapter establishes a framework of how innovation enters the marketplace in terms of the factors and mechanisms of change. The second chapter discusses the physical and economic attributes of wood panels. Recent advances in the production of wood panels are also outlined. The third chapter compares wall panels with competing wood construction systems. These systems (panel, modular, and on-site) are first compared in terms of their relative historical market performance; and second, in terms of their physical and economic attributes.

The fourth chapter consists of primary data gathered in interviews with twenty-five home builders. The interviews were based on a questionnaire formulated to do the following: establish the criteria home builders use when choosing a building system; measure their perceptions of wood panel construction; and, discover which construction-related development services builders currently consume, and would like to consume in the future.

The fifth and final chapter takes the reality of wood panels in terms of their actual attributes and compares these to the perceptions and needs of the home builder. This comparison will identify the areas in which home builders must be educated. This comparison will also point out the market niches that panel manufacturers could fill to increase market share.

CHAPTER ONE

Innovations in the Marketplace: A Framework for Change

This chapter examines how innovations in the construction industry are absorbed by the marketplace. The definition of innovation is an idea, process, or product which changes the way individuals think or do things. In the construction industry, innovation takes the following forms: new materials such as structural ceramics, new products such as low emissivity glass, and new building systems such as wood frame foundation systems.

Innovation has two levels of significance. These levels are breakthrough and incremental advances. A breakthrough is an innovation which radically changes the manner in which things are done. An example of a breakthrough is the elevator, an innovation which changed the way buildings were designed and built. The elevator changed the movement within buildings from climbing to riding and emphasized the vertical perception of space.

Relatively few innovations are breakthroughs, however; the vast majority are incremental advances which are evolutionary, rather than revolutionary. An example of incremental innovation is the development of kiln dried lumber. This new product allowed wood frame construction to evolve from balloon to platform construction.

Unlike the elevator, which changed the way buildings looked and worked, platform construction was indistinguishable from balloon construction once the walls were closed.

There are four motivators for innovation: crisis; economics; quality; and increasing productivity. Crisis causes innovation through actual or perceived threat of danger or shortage. For example, the 1973 oil crisis led to innovations in energy efficient combustion heaters and appliances.

Economics as a motivator incites change through the possibility of profit. If a good or service is demanded and perceived as profitable, an individual or firm will supply that good or service. Similarly, if a good or service offers a less costly substitute to one currently employed, the user will change to the less expensive alternative. An illustration of this is the substitution of plywood with structurally equivalent, but less expensive, particle board.

Innovation can also be caused by a need to improve the quality of a good. Quality can be measured in terms of an increased level of amenity, or lower maintenance and operating expenses. Innovations in exterior house paint, for instance, are a function of consumers interest in the choice of color (amenity), and durability (low maintenance/operating expense.)

The final motivator of innovation is the need for increased productivity. These innovations are designed to reduce labor expenses or production time. Increased

productivity has been brought about by innovations in the prefabrication of building components such as prehung doors, prefabricated roof trusses, and wet plumbing cores.

The degree of acceptance for an innovation is dependent on the interplay between affectors (agents for change) and impeders (agents against change.) In the construction industry there are four types of groups which can be either affectors or impeders. These groups are: manufacturers; builders; buyers; and institutions.

There are two sources which describe how affectors cause innovation. The first is "market push" in which a new technology or material is in search of a market. Such is the case when a manufacturer introduces an innovation into the market when no demand is evident. The second source is "market pull" which describes a specific demand which can only be filled with a new material, technology or good. In both situations, there is the expectation of increased profit.

Impeding groups block the path of market push and pull. For example, an institution such as a government can use building codes to block construction innovations. This was the case with 2X4 stick construction when first introduced in Japan in the 1970's. Although this system had been used in North America for decades, the Japanese government impeded the use of 2x4 construction by withholding its approval until 1979. With this approval, 2X4 construction is finding increasing use in Japan.

It is the interplay between affectors and impeders which bring about incremental change over time. Slowing the pace of change can be both beneficial and harmful. At best, the slow and deliberate implementation of innovations can prevent the widespread use of unsuitable materials, products, and methods. Examples of damaging innovation include asbestos insulation; aluminum electrical wiring, and the lift slab method of concrete construction.

On the other hand, the unnecessary impediment of innovation can be similarly dangerous. The use of fire sprinklers for detached houses, for instance, could save thousands of lives a year. However, various impeding groups, such as consumers and builders, have blocked the implementation of this safety device.

Each group which is subject to innovation has a criteria for accepting or rejecting change. In the area of residential structural systems, manufacturers, institutions, home builders, and home buyers, each have their own criteria for judging the suitability of innovation. A manufacturer will affect change if a new technology can be used, or if a demand can be filled profitably. A government with a policy of free trade among countries and sectors will accept a structural system if it does not endanger the public safety. The home buyer will accept an innovation in house construction if the form and quality of the unit is not diminished, compared to traditional methods and costs.

The home builder's criteria for accepting innovation is initially based on the acceptance of that innovation by manufacturers, government, and buyers. After an innovation is made available by manufacturers, deemed legal by the government, and accepted by the home buyer, a home builder will consider change.

Home building in the United States is dominated by small firms with limited human capital and minimal funds for investment. Those who actually construct homes learn the trade through on-site apprenticeship. This breeds a conservative outlook toward change since the "how" rather than the "why" of construction methods are taught. The subsequent criteria for change is that an innovation must be simple, not capital intensive, and not radically different from current methods.

Since the acceptance of innovation in home building is largely based on custom, many otherwise suitable technologies and techniques are ignored. Pressure treated wood foundations are an example of a passed over innovation. Wood is not normally considered a suitable material for long-term exposure to dampness, leaving builders hesitant to consider this innovation, despite assurances of the wood's chemical treatment. Builders are not trailblazers. Why take chances today when a cement truck can be on-site tomorrow?

Home builders are able to accept innovation if the change conforms to the criteria of simplicity, minimal capital investment, and use of current construction methods. Particle

board has replaced plywood as a sheathing material because it has met all the criteria for widespread use. It is less expensive than plywood, has comparable structural integrity and uses the same inexpensive application method of hammer and nails.

Prefabricated wood panels have been commercially available since the 1950's. Nevertheless, this innovation has gained little acceptance in the marketplace. The framework for innovation and change outlined in this chapter will allow us to identify the affectors and impeders of wood panel construction.

CHAPTER TWO

The Product and the Production Process: Prefabricated Wood Panels

In their simplest form, prefabricated wood panel systems are physically identical to conventional on-site framing. There are two distinct types of wood panels; open wall and closed wall systems. Both are framed with standard 2x4 or 2x6 studs, as either exterior and interior load-bearing walls or as interior partition walls. They are sheathed in plywood as exterior walls, or in drywall as interior walls. Open wall panels are sheathed on only one side before being shipped to the site for installation of wiring, plumbing, insulation, vapor barrier and the second side of sheathing. Closed wall panels are usually sheathed on both sides at the factory and include wiring, plumbing and insulation. In both systems, manufacturers frame door and window openings and often install pre-hung doors and windows.

Since most building inspections take place on-site, closed wall panel manufacturers must make special arrangements to have their plumbing and wiring inspected in the plant. As there is no national building code in the U.S.,and each locality has its own code and its own inspectors, closed wall panel producers have the additional problem of having to conform to a variety of state and local codes or to limit their market area. This is the likely

reason that, according to Automation in Housing, 90 percent of all panelized housing utilizes uses open wall panel systems.

Wood panel systems can be subdivided again into two types; standardized and custom panels. A standardized panel is designed as a repeatable building module, normally a multiple of 6 feet wide by 8 feet high dimensions. Custom panels are specifically engineered for individual designs. These panels are usually 8 feet high, but can go up to 12.5 feet in height, and can be up to 42 feet long.

The manufacturing of panels can be as simple as a few people in a lumber yard, armed with circular saws and hammers, who set up jigs and frame walls every day. Usually this is done indoors or under some form of weather protection. Since many of these jigs must be set manually, repeatable designs in both panels and buildings are encouraged. To accommodate custom designs, production engineering is required to determine the most efficient layout of panel dimensions. The more complex the plans, the more custom work is required, which increases the time spent adjusting jigs and verifying measurements. One manufacturer stated the need to measure and inspect panels three times in order to ensure that there were no overlaps or shortfalls at panel joints.

Panels are shipped to the site on a large flatbed truck. Because of the weight of larger panels, a crane is frequently required to set the panels on their foundation. After the

panels have been joined and the roof added to complete the shell, the remaining construction is similar to on-site "stick" building.

The capital required for this set-up can be minimal; for example, a jig system costing a few thousand dollars. There are several additional costs associated with the simple panel jig systems. First is the cost of the site and the facilities. Second is the added cost of keeping an inventory of standard panels, windows, and doors to reduce the production time for individual buildings. Third is that the weight and bulk of panels requre special equipment for handling, storage, and shipping.

Unlike other building components, open wall panels have only a small amount of "value added". Value added is the additional worth of a good after it has been assembled or processed from raw materials. Drywall, for instance, replaced the time-consuming process of lath and plastering walls. What used to take five steps plus a three week curing period can now be completed in several simple steps and a few hours of drying time. The value added of drywall is the difference between the cost and time required for both systems. It is because of this "value added" that drywall found market acceptance.

The value added of open wall panels, from simple jigs, is limited to specific situations. A panel producer can provide an erected shell more quickly than a traditional on-site builder depending on inventory, design, and labor factors. If

components such as windows and doors have to be special ordered from manufacturers, delivery can take up to six weeks. If a panel producer inventories these components, the construction time for the shell can be shortened.

The complexity of a structure can reduce a panel producer's efficency. Complex designs require additional production engineering and constant re-adjustment of production jigs. These can add greatly to the time necessary for panel fabrication, which erodes the value added component as compared to on-site construction.

In areas of labor shortage, value added comes in the forms of savings in labor costs and reduced construction time. On-site builders compete for framing crews which can become scarce in "hot" building markets. In these markets, panels are in demand because of theri reduced on-site labor requirements. Since panel producers move the labor component of wall building out of the field and into the factory, they can increase productivity without increasing wage costs.

As was the case with drywall, the cost of panels can be more competitive in a wider set of circumstances, once the necessary volume of production has been reached. But, as will be seen in Chapter Four, consumers must first be persuaded that panels can provide added benefits in cost and quality. New panel production systems can help in that effort.

New Panel Fabrication Systems

Wood panel fabrication systems can be as comprehensive

as a recent introduction which combines an integrated software package with an automated assembly line package. The software package, by Integrated Computer Graphics, Inc. (ICG), includes integrated programs for design, layout, engineering and costing.

After building dimensions have been entered into the computer, the program determines the efficient breakdown and design of the panels. The system produces a plan identifying each framing component, including all sheathing, siding and drywall. With the amounts of these materials precisely known, the cost can be computed from a unit-price data bank.

This package can be helpful to panel producers with simple jigs but its strength lies in its ability to drive a line of automated saws, routers, jigs, sheathers and nailers, such as the one produced by Senco/Carlson. The production line requires ten people to feed wood into the jigs and stack finished panels. The combination of people, computing software and manufacturing hardware can build 2,000 linear feet of 8 or 12 foot high panels of 2x4s or 2x6s a day.

Because the computer-driven system provides added speed in both production engineering and in jig adjustment, it is suitable both for engineering the panels of a more complex design and for building custom panels. One panel producer stated that the design of the structure was unimportant for this system, that it was just as easy to produce a custom panel as it was a standard one.

This quick adaptability allows panel producers to cut their costs as they dispense with the need to inventory standard panels. Additionally, the skills learned by employees in the automated plants are not readily transferable to on-site framing; therefore, panelizers may experience a lower turnover of employees.

The economic advantages and the value added to panels from the automated panel production systems are offset by the higher capitalization costs of such systems. The automated assembly line described above, for instance, costs approximately to $1 million and the computer hardware another $25,000. The software program can be rented for a fee of $900 to $2,500 a month.

A major impact of this new equipment is a dramatic increase in panel manufacturing capacity. This increase comes at a time when the traditional panel producers are already experiencing an excess capacity ranging from 30 percent to 75 percent of total capacity. Not unlike developers in the over-built office market, panel producers will have to try to outbid one another to generate enough business to sufficiently utilize their facilities. Unlike developers, however, the panel producers are faced with more than just their immediate industry colleagues as competitors.

CHAPTER THREE

The Market

Within the residential home building industry, wood panels compete with on-site and modular construction methods. It is assumed that the reader has a general knowledge of on-site and panel construction. A brief discussion of modular construction will be needed to aquaint the reader with this system.

Modular buildings consist of one or more three-dimensional substructures, or modules, which are built at the factory on an assembly line. Typically the modules are complete with plumbing, electrical wiring, insulation, and interior and exterior finishes. Three tractor trailers are required to transport an average sized modular home, broken down into five modules and a roof (truss) package. Once at the site, a crane must be used to lift and place modules onto their permanent foundation.

The remainder of this chapter will look at the market shares and comparative advantages and disadvantages of the three building systems.

MARKET SHARE AND SECTOR PERFORMANCE

Of the three construction types, panel construction has seen the greatest increase in market share, as shown in Table

1 and Graphs 1 and 2. It has grown consistently, from 26 percent in 1980 to 38 percent in 1986, at the expense of on-site builders. The on-site builders' share has dropped from its 1980 high of 70 percent to its 1986 level of 57 percent. Modular construction has held relatively steady with an average of 5 percent of the market per year.

However, even with the growth in market share and total output, the panel industry shows the highest rate of firms exiting the market. In 1986, 7% of all panel producers closed their plants. Modular builders left the market at a slightly lower rate of 6% during the same year. Production builders had a stable year with only 1% of the builders leaving the business.

A reason for the panel industries' high rate of exit may be due to predatory pricing within the sector. In recent interviews, all but three panel manufacturers refused to quote pricing information out of a fear that competitors would have a bidding advantage if the information were made public. Without hard pricing data, further insight into the competitive nature of the industry may be gained from looking at the change in firm size and output.

The average number of factories per panelizing firm fell from 1.21 in 1976 to 1.09 in 1986. In the same time span, the average output per firm increased 250% from 378 units in 1976 to 950 units in 1986. This indicates that firms are centralizing their production facilitites. Given the geographic limitations of panel markets due to transportation

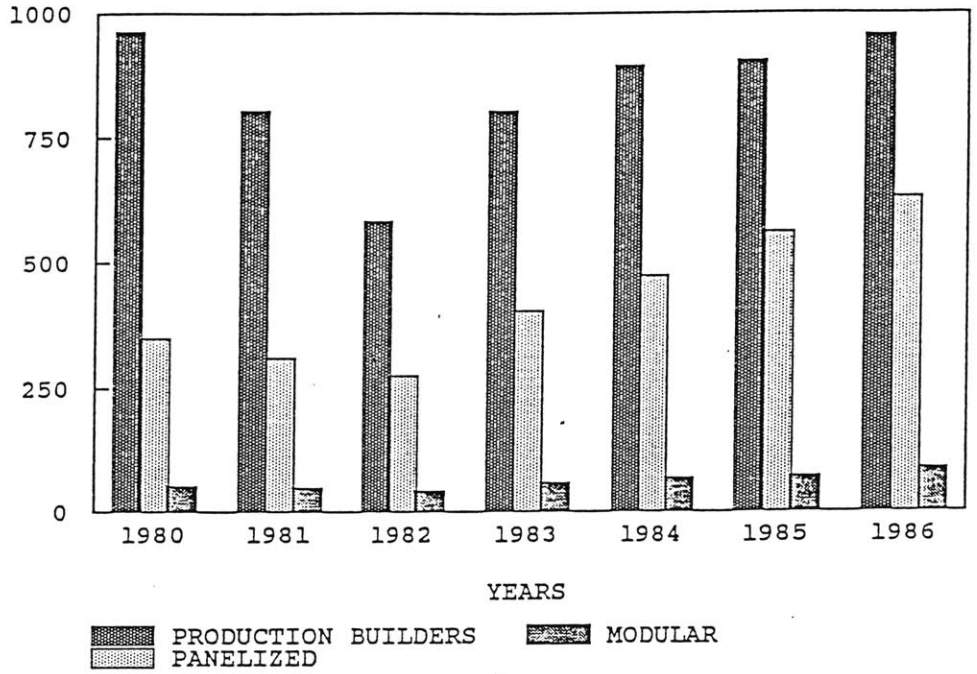
TABLE 1
MARKET SHARE ACCORDING TO PRODUCT TYPE
UNITS IN THOUSANDS

	1980 (000'S)	1981 (000'S)	1982 (000'S)	1983 (000'S)	1984 (000'S)	1985 (000'S)	1986 (000'S)
PRODUCTION BUILD	966	810	586	810	899	909	959
MKT SHARE	70%	69%	64%	63%	62%	59%	57%
PANELIZED	352	315	277	407	476	565	635
MKT SHARE	26%	27%	30%	32%	33%	36%	38%
MODULAR	56	52	46	62	73	77	92
MKT SHARE	4%	4%	5%	5%	5%	5%	5%
TOTAL UNITS	1374	1177	909	1279	1448	1551	1686

GRAPH I

OUTPUT IN UNITS ACCORDING TO PRODUCT TYPE

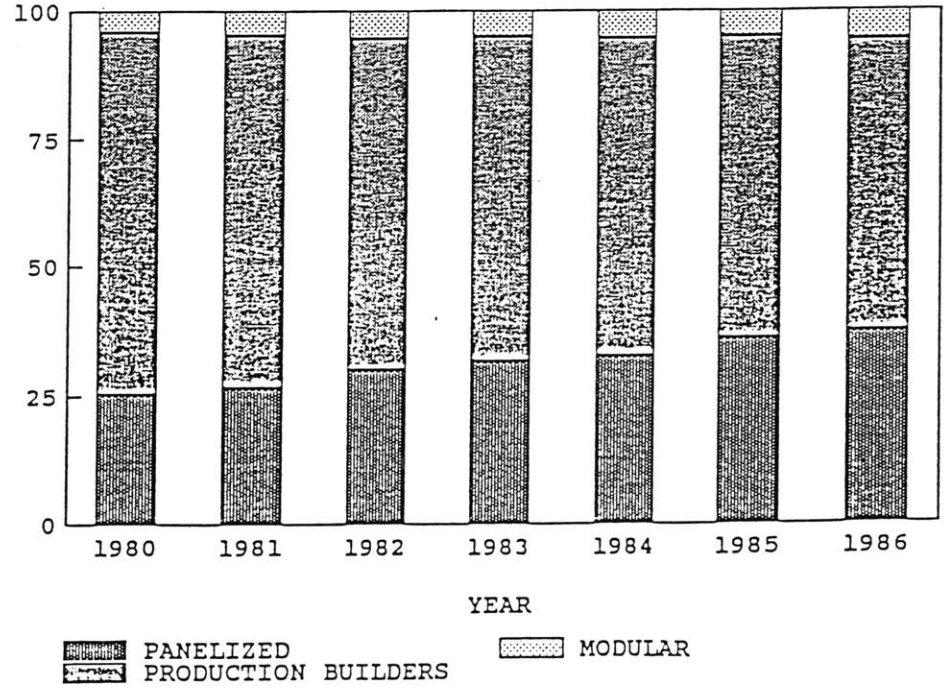
THOUSANDS OF UNITS



GRAPH II

OUTPUT AS A PERCENTAGE OF TOTAL INDUSTRY OUTPUT

Percent



costs, and the higher average output per producer, a smaller number of large companies may control a greater number of specific markets. As the average output of the industry increases, smaller firms are forced out of the market by the relative cost efficency of the larger panelizers. (The economic rationale is that as output increases, the marginal cost per unit deceases as fixed costs are spread out over more units.)

A second possible explanation for the high rate of industry exit may be that local markets are deteriorating and forcing the panel producers to close. (On-site builders would relocate to a better market or move into a related field such as remodelling.)

These points should be given careful consideration by perspective panelizers before they decide to enter the market. There seems to be a minimum hurdle rate of production necessary to be competitive in the market, especially in light of more expensive capital investments, market fluctuations and the need to offer services.

Professional Builder magazine gives data for the "Top 400" builders for 1986 as ranked by volume of gross revenues. These builders accounted for 25.2% of all housing built in 1986 (exluding mobile homes.) Their data indicates that these "Top 400" use panel construction for only 3.6 percent or 16,443 of their total units. If one were to accept the AIH numbers in Table 1, it would indicate that the "Top 400" was responsible for only 2.6 percent of all panelized

construction. This is plausible since the "Top 400" include tract housing developers who generate enough of their own volume to keep stick building prices low. They also include apartment and mobile home builders. If it is true that the larger builders are responsible for just 2.6 percent of the panel production, it would indicate that panels are being used primarily by the smaller housing producers.

Competition Comparisons

Range: Panel and modular builders give an average market radius of 300 to 350 miles from their plants. If the range were increased, companies would be paying their assembly teams for more time on the road and less time erecting structures. The companies would also have the additional expense of housing the teams overnight as they drove to and from the building site.

Panel producers also set limits on trading areas according to the cost of the equipment used in transporting and erecting the unit. A truck and trailer runs approximately $350 a day with driver. Truckers are limited by the hours they are allowed to drive at a stretch. If the distance to and from a site exceeds this limit, an additional day of truck costs is incurred. Thus transporting a house 400 miles may cost twice as much as shipping 350 miles.

Another way panel producers price transportation services is according to opportunity cost. If a unit uses transportation and erection equipment for two days, a

panelizer must either buy additional equipment or delay deliveries of other units. Conversely, as the unit output of a manufacturer increases they must either acquire additional transportation and erection equipment, or reduce their trade area in order use existing equipment more efficiently. Therefore, even though panel producing machinery may be underused, increasing output is not necessarily cost free due to the additional transportation and handling equipment needed to deliver the additional units.

As mentioned above, closed wall panel systems have difficulty with building inspections. Where interstate agreements do not exist, sales can be difficult and can effectively cut a producer's market range.

Site Delivery Requirements: As components increase in size, they become more restricted by transportation requirements. Materials for a "stick" built structure are limited in size not because of transportation requirements but because of handling requirements. Small construction crews need to have materials that can be handled by one or two people.

As panels are usually stacked like sheets of paper, the height of a panel, when laid horizontally, must fit the width of the truckload. Since the height of a panel is usually determined by ceiling heights for the building, and since the average residential ceiling height is 8 feet, most panels fit well within the 14 foot width limit for trucks. Panels which exceed 14 feet in height are set at an angle on the truck bed

with other components stacked efficiently around them. Panel length is limited to 42 feet. The materials for two average panel houses can be delivered in one truckload.

Modules are the most constrained by transportation requirements since they are three dimensional substructures which must fit within the 12.5 foot height, 14 foot width and 42 foot length restrictions. An average modular house would require three trucks to carry five modules and a roof (truss) system.

Erection Requirements: "Stick" built housing is erected with the aid of simple tools. Panel construction can be done by hand if the panels are small and light enough to be easily maneuvered. Otherwise, they, like modules, require a crane to unload and place them on waiting foundations.

Construction Quality: Three factors contribute to the increased quality of panel and modular construction over on-site construction. First, materials for prefabrication are kept under cover, out of the weather. Most on-site builders have no means of protecting their materials other than covering them with plastic sheeting. Second, the panel and module manufacturers purchase in bulk which allows them to be more selective in the wood they use. A "stick" builder has a limited supply of wood at the site. If he finds poor quality lumber, he must decide if it is worth ordering more, knowing the delay could slow or idle his work crew causing

him to lose time and money. Third, the better quality of panels and modules is reflected in the high tolerances that can be achieved with the assembly jigs. These ensure tighter fitting joints and more rigid structures.

A potential construction problem for both panels and modules is site erection. If the erection is not properly handled, if joints are poorly finished, the entire system can be deemed a failure despite all of its finer points.

Scheduling: Because panels and modules are built indoors, they are not as susceptible to weather delays as on-site construction. As one panel builder commented about winter construction in a recent article, "By the end of today, we should have accomplished what it has taken them two and a half weeks to do by stick-building. That house won't have a roof for another week. Until it's on, they'll have to spend a half a day shovelling off the deck every time it snows. We'll have this house closed in in a couple of days."[1] By using panels, home builders can construct more houses through the winter and gain an edge on the spring selling season.

With the production engineering that is required for modules and panels, problems are discovered and worked out on paper before they can reach the building site. This saves on delays in the field where carpenters and sub-contractors' work can be stopped until the problem is resolved.

Materials Costs: Materials costs for both panel and module manufacturers is lower than it is for on-site builders due to economies of scale in purchasing materials. However, there is a real cost in keeping inventory. If a panel producer uses standarized plans and components, just-in-time inventory techniques can be used to reduce the amount of capital stock tied up in non-producing assets.

If a manufacturer produces customized units, a wider selection of components must be inventoried in order to keep a short delivery period. However, to be able to afford the expanded inventory, a panelizer must have a higher output of units in order to maintain the same marginal cost. The capital tied up in inventory varies inversely to the time it takes to deliver a unit from the date of order. The more components have to be specially ordered, the longer it takes to deliver a unit. The custom panel producer is faced with the problem of finding his optimal output/time ratio given the amount of capital that can be tied up in inventory.

Capitalization Requirements: An on-site builder's strong advantage over both modular and panel construction is his low level of capitalization. It allows the "stick" builder to move in and out of the market easily, to adjust to fluctuations in housing demand. The capitalization required

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[1]Canine, Craig, "The Ultimate Prefabs: Exploring the World of Assembly-line Architecture" Harrowsmith, The American Edition, Vol.2, No.9 May/June 1987

for a panel producer is higher and can vary greatly,depending on the panel production system used. Modular manufacturers have the highest degree of capitalization to accommodate their more intensive operations. The more that is invested in a system, the larger the amount of building volume that will have to be generated to carry the system's costs. As the demand for housing fluctuates, this becomes more difficult.

Image: The image of a product relates to its physical appearance and its structural integrity. On-site building does not present an image, per se, in that any design can be built and its structural integrity is dependent on the contractor. Because of its limitations and its association with mobile homes, modular construction has an image of uninspired design and cheap housing. According to executives at Cardinal Industries, U.S. Home and the Ryland Group, most modular construction is now directed toward the low-end and subsidized housing market niche.

Panel construction is caught between these two. Because it has been historically more expensive to build with much architectural detail, panel construction also has an image of uninspired design. Consequently there is a tendency to lump both panels and modules together as "pre-fab" housing. With the move toward faster, more adaptable processes, however, panels will be able to improve their image and break from their negative association with modules.

As is evident in this material, the panel producers contend with complex problems as they attempt to increase their market share. What follows is a brief exploration of the attitudes of twenty-five home builders towards prefabricated construction. As can be seen in the following two tables, the home builders are primarily from New England, with a few from the strong markets in New Jersey and District of Columbia. Their sizes, according to unit volume, range from one company which built two single family units up to a firm which built 410 single family and 1,100 multi-family units. Price ranges for units range from a shell for a single family unit for $15,000 up to a multi-family unit priced at $800,000 (Tables 2a and 2b).

Table 2a (Descriptive)

Study of Types of Companies, and their Residential Volume

25 respondents, 25 answers

Respondent	Company Type	Market Range	State(s)
A	development	Holly	NH
B	development	Essex County	MA
C	lumber/panel manu/builder	Cape Cod, Islands	MA
D	construction/development	Hartford	CN
E	development	Southeast MA	MA
F	construction/development	Western suburbs & west of 495	MA
G	construction/development	Salem & Andover	MA
H	construction/development	"W/in spitting distance of Lexington"	MA
I	savings bank	Fall River	MA
J	construction/development	Haverhill	MA
K	development	East of the Mississippi	East
L	construction/development	Taunton	MA
M	development	Western suburbs & St. Thomas, VI	MA, V.I.
N	development	Arlington, Woburn, Wakefield, Lexington	MA
O	construction/development	New Jersey Region, Florida	NJ,PA,NY,FL
P	construction/development	Southern NH, Central MA	NH, MA
Q	construction/development	30 mile radius of Nashua	NH
R	construction/development	Virginia to Canada	East Coast
S	development	2 hour radius of Boston	MA,CN,ME,NH,RI,VT
T	construction/development	Roxbury, Mattapan, New Bedford	MA
U	construction/development	Northern New Jersey	NJ
V	construction/development	Washington DC	DC
W	development	2 hour radius of Boston	MA,CN,ME,NH,RI,VT
X	development	Northeast	Northeast
Y	development	100 mile radius of Boston	MA,CN,ME,NH,RI,VT

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* S = small, 1-100 units per year
  M = medium, 101-300 units per year
  L = large, 301 or more units per year

Summary of Company Types			Small Companies	% of 12	Medium Companies	% of 7
cnstrctn/dvlpmnt	13	52%	6	50%	4	57%
dvlpmnt	7	28%	2	17%	3	43%
savings bnk	1	4%	1	8%	0	0%

Summary of Geographical Range		Large Companies	% of 5
Mass.	12	3	60%
More than 1 New England state	4	1	20%
Northeast/East Coast	3	0	0%
N.H.	2		
N.J. area	2		
Conn.	1		
Washington D.C.	1		

Table 2b (Descriptive)

Continued Study of Types of Companies, and their Residential Volume

25 respondents, 25 answers

Respondent	# of units single family	# of units multi-family	total # of units	size	price range s.f.	price range m.f.
A	2	0	2	S*	$500,000 +	$0
B	5	0	5	S	$550,000 +	$0
C	65	0	65	M	$15,000-$70,000**	$0
D	0	75	75	M	$0	$200,000
E	0	75	75	M	$0	$60,000-$200,000
F	0	75	75	M	$0	$160,000-$185,000
G	0	63	63	M	$0	$175,000-$500,000
H	0	40-80	40-80	M	$0	$180,000-$400,000
I	0	60	60	M	$0	$90,000-$235,000
J	0	40-50	40-50	M	$0	up to $250,000
K	0	20	20	S	$0	$550,000-$800,000
L	0	40	40	M	$0	$150,000
M	86	100	186	L	$400,000-$500,000	$270,000 avg.
N	8	150	158	L	$160,000-$200,000	$150,000-$350,000
O	410	1100	1510	L	$175,000-$300,000	$100,000-$250,000
P	200	200	400	L	$110,000-$300,000	$95,000-$300,000
Q	120	220	340	L	$140,000-$240,000	$90,000-$190,000
R	130	70	200	L	---	---
S	0	600	600	L	$0	$90,000-$500,000
T	0	300	300	L	$0	$87,000-$220,000
U	0	200	200	L	$0	$150,000-$300,000
V	0	300	300	L	$0	$500,000-$800,000
W	0	200	200	L	$0	$200,000-$300,000
X	0	450	450	L	$0	all ranges. (rental)
Y	0	-^-				
	1026	4298 +	5324 +			

* S = up to 25 units per year
M = 26 - 100 units per year
L = more than 100 units per year

**This company often produces shells only

-^- = "private information"

Summary of Company Size by Volume

small	3	12%
medium	9	36%
large	12	48%

Summary of Product

single family only	3	12%
multi-family only	16	64%
both single and multi-family	6	24%
build to suit	2	8%
spec. built	22	88%
both bld to suit & spec.	1	4%

Summary of Price Ranges

		% of 23
single family		
$100,000-$250,000	4	17%
$250,000 +	5	22%

		% of 18
multi-family		
$87,000-$149,000	7	39%
$150,000-$250,000	15	83%
$251,000 +	10	56%

CHAPTER FOUR

Home Builders' Perspective

Demonstrated Construction Preferences

Based on the questionnaire sent to twenty-five home builders, the most utilized residential construction system was 2x6 stick building. Seventy-six percent of the twenty-five used this system. Just 4 percent were using modular construction; 8 percent were using panels.

In the opinion rating of different construction systems, the home builders again demonstrated their preference for 2x6 construction. It garnered a "good" rating from 89 percent of the respondents. Both panel and modular construction earned "good" ratings from a third of the home builders. An additional 44 percent said they were indifferent to the use of both panel and modular systems for residential development (Tables 3a and 3b.)

Apparently home builders have an interest in panel and module systems but are not yet convinced of their usefulness. To determine what kept the home builders from using either system, they were asked to give their perceptions of the advantages and disadvantages of prefabricated systems.

Table 3a (Perceptions)

Study of Reactions to Different Residential Construction Types
25 respondents, 25 full answers for "construction type used",
9 full answers for remainder

Respondent	Construction Type Used	2x4 construction	2x6 construction	masonry construction	C.M.U. construction	Pre-fab modular	Pre-fab panels
A	2x6	indifferent	good	good	good	indifferent	indifferent
B	2x6	indifferent	good	good	good	indifferent	indifferent
C	2x4*/2x6-pnls	good	good	good	bad	indifferent	good
D	2x4	indifferent	good	bad	bad	bad	bad
E	stick	---	---	---	---	---	---
F	wdframe	---	---	---	---	bad	bad
G	wdframe	---	---	---	---	---	---
H	wdframe*	indifferent	good	good	good	---	---
I	br,stl,cmnt	---	---	---	---	---	---
J	2x6	---	---	---	---	---	good
K	slab conc	indifferent	good	---	bad	good	good
L	wdframe-pnls	indifferent	good	---	---	---	good
M	2x6/cmu**	---	---	---	---	---	---
N	conc plnks	bad	---	---	---	---	---
O	2x4/2x6	good	good	good	indifferent	good	good
P	2x6	good	good	indifferent	indifferent	good	good
Q	2x6	indifferent	good	good	indifferent	indifferent	indifferent
R	2x6	indifferent	good	indifferent	---	indifferent	good
S	2x4	indifferent	indifferent	indifferent	bad	bad	bad
T	2x4	good	good	good	good	---	good
U	2x6/2x4	good	---	good	indifferent	good	good
V	frame/conc.	indifferent	---	good	good	bad	indifferent
W	2x6/2x4	good	good	indifferent	indifferent	good	indifferent
X	2x4/2x6/stl&cmpst	---	---	---	---	---	---
Y	stick/modlr***	---	---	---	---	---	---

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*2x4 with 1" rigid insulation added
**cmu on one project, wdframe on two others
***modular for low end only

Summary of Wood Construction Types

wdframe/stick	6	24%
2x6.....	6	24%
2x4/2x6..	4	16%
2x4.....	3	12%
sub-total	19	76%
wd-panels	2	8%
modular..	1	4%

Note:
10 developers preferred 2x6 construction over 2x4 construction because of its higher insulation potential.

Table 3b

Continued Study of Reactions to Different Residential Construction Types

Summary of Ratings of Construction Types			% of 9	good + indif.
2x4				
	good	4	44%	
	indifferent	4	44%	
	bad	0	0%	89%
2x6				
	good	8	89%	
	indifferent	1	11%	
	bad	0	0%	100%
masonry				
	good	5	56%	
	indifferent	3	33%	
	bad	1	11%	89%
C.M.U.				
	good	2	22%	
	indifferent	4	44%	
	bad	3	33%	67%
modular				
	good	3	33%	
	indifferent	4	44%	
	bad	2	22%	78%
panels				
	good	3	33%	
	indifferent	4	44%	
	bad	2	22%	78%

Perceived Advantages and Disadvantages

The home builders had mixed views about cost. Cost-savings, mentioned by 40 percent of the respondents, was the most frequently cited advantage to prefabrication. (Of the ten citing it as an advantage, five based their claim on experience.) Four areas of savings were identified. Five home builders said prefabrication was less expensive, presumably on a square foot or hard cost basis. Four described the savings as coming from prefabrication's shorter construction time. Two home builders, who have had no evident experience with prefabrication, considered it less expensive when used in regularized, repetitive construction such as one would use on large, flat sites for tract-home building. One experienced home builder found prefabrication reduced the costs of site theft. With construction moved off-site, there is no inventory of materials on-site which may be stolen. Once the building is in place, it is quickly closed and locked to protect any materials or tools needed to complete the job.

Higher costs were cited by 28 percent of the respondents, but none indicated specific reasons for it. Of the seven home builders with this perception, only two appear to have had recent experience with prefabrication.

Home builders considered prefabrication as an advantage in providing time savings to builders. Faster erection time on the site as well as easier scheduling for the construction phase of the project were the two particular attributes.

Home builders' perception of quality, like their perceptions toward cost, were mixed. Twenty-eight percent considered prefabrication to be of higher quality than "stick" building because it fell under more strict quality control, and because it was built under better indoor conditions. Of the seven with this impression, five could be identified as having some direct knowledge on which to base their views.

Four of the home builders thought prefabrication was of poor quality. They expressed a skepticism about workmanship that could not be checked as construction progressed. None of them could be identified as having had experience with panels or modules.

Prefabrication had the disadvantage of poor adaptability in both product and production process, according to 36 percent of the home builders. Six of them specified the product's lack of design flexibility and variety. One had a concern over prefabrication's ability to adapt to the needs of different sites. This, he stated, was particularly important in New England, with its few remaining building sites and its uneven terrain. Two home builders found the process a disadvantage in that all changes had to be made before plans could be sent to the factory floor. Unlike conventional building, prefabrication does not allow on-site adjustments.

Close to a quarter of the home builders agreed that prefabrication had a bad image. They stated that prefabrication had a stigma from either its widespread use in low-end and subsidized housing or from the common perception that its design is dreary and uninspired.

One home builder was concerned about jeopardizing his long-term relationship with a general contractor. He questioned how he could use panels or modules and not weaken that relationship.

The following table summarizes these results (Table 4.)

Potential Services

With an expectation that panel manufacturers would have to provide services to their customers, information was collected to identify areas of need.

The first study, as seen in Tables 5a and 5b, looked at the in-house staff of the home builders in general and by size of the firm. Panel producers have an opportunity for providing both design and engineering services, as eighty percent of the home builders had neither an architect nor designer in-house and sixty-seven percent had no engineer on staff. The likely explanation for this is that most home builders do not have enough work to employ designers and engineers on a full-time. It is more cost effective to use consultants, as required. As the results indicate, this is particularly true for the small builders. Sixty-seven percent of the home builders did retain marketing consultants

Table 4 (Perceptions)

Study of Perceived Advantages and Disadvantages

25 respondents, 25 answers

Summary of Advantages & Disadvantages of Pre-fabricated construction

Advantages:			
cost	D,H,K',O',Q,S',T',U,V,W'	10	40%
less expensive	K',Q,T',U,V	5	20%
cheaper: time = $	D,O',Q,W'	4	16%
regularized construction for repetitive uses	H,S	2	8%
cuts down on vandalism/on-site theft	T'	1	4%
time	A,C',D,F,G,K',R',T',U	9	36%
faster erection	A,C',D,F,G,K',R',T',U	9	36%
makes scheduling easier	A	1	4%
quality	A,C',G,K',L',P',W'	7	28%
quality control giving higher quality	A,C',G,K',L',P',W'	7	28%
bldg inside so good conditions	P'	1	4%
takes thought out of process	B	1	4%
design to it well	R'	1	4%
Disadvantpoor adaptability	G,H,K',O',Q,T',W',X,Y'	9	36%
lacks design flexibility	G,H,K',Q,T'	5	20%
all changes must be made before plans go	H,O'	2	8%
ability to adapt to site	X	1	4%
insufficient engineering	W'	1	4%
closed wall - hard to install plumbing/elec	Y'	1	4%
higher price	C',E,M,R',S,U,X	7	28%
poor image	B,J,P,S,W',X	6	24%
buyers leary/stigma/lower end/subsidized	J,P,S,W',X	5	20%
"looks like shit"/"doggy-looking"/"crappy"	B,X,W'	3	12%
bad quality - can't be checked	D,F,J,Q	4	16%
size limit due to transportation	C',W'	2	8%
no one person accountable/liability	Y'	1	4%
GC would not take to it	Y'	1	4%
can't have production volume in NE	X	1	4%
Don't know	I,N	2	8%

' = based on experience

Developers with experience using pre-fabrication

modular	D,P,W,X?,Y	5	20%
panelized	C,J,L,R	4	16%
both	K?,S,T	3	12%
	total	12	48%

Table 5a (Services)

Study of In-House Staff for Residential Developers

25 respondents, 15 full answers

Respondent	Architects	Designers	Engineers	Value Engineers	General Contractors	Construction Managers	Marketing Consultants	Total	size
A	0 *	0	0	0	0	1	0	1	S
B	0	0	1	--	0	0	0	1	S
C	0	1	0	0	0	0	1	2	M
D	0	0	1	1	1	1	1	5	M
E	--	1	0	0	0	0	1	2	M
F	0	0	0	0	--	0	0	0	M
G	0	0	1	--	1	1	1	4	M
H	1	1	0	--	1	1	1	5	M
I	0	0	0	0	0	0	0	0	M
J	1	--	0	--	1	1	--	3	M
K	0	0	0	0	0	0	1	1	S
L	0	0	1	1	1	1	1	5	M
M	1	--	0	0	0	0	1	2	L
N	1	0	0	0	1	1	1	4	L
O	1	1	1	--	0	1	1	5	L
P	0	1	1	0	--	1	1	4	L
Q	0	1	0	0	0	1	1	3	L
R	1	1	1	--	1	0	1	5	L
S	0	0	0	0	0	0	1	1	L
T	0	0	1	1	1	1	0	4	L
U	0	0	0	0	1	1	1	3	L
V	0	0	1	0	1	1	0	3	L
W	0	0	0	0	0	1	1	2	L
X	0	0	0	0	0	0	0	0	L
Y	0	0	0	0	0	0	1	1	?

---

* 0 = no, 1 = yes

Summary of In-house Staff		% of 15
Marketing Consultants	10	67%
Construction Managers	9	60%
General Contractors	6	40%
Engineers	4	27%
Value Engineers	3	20%
Designers	2	13%
Architects	1	7%
1 of the 7	4	27%
3 of the 7	3	20%
2 of the 7	2	13%
5 of the 7	2	13%
4 of the 7	2	13%
none in-house	2	13%

Summary of In-house Staff		% of 15
No arch or desgnr	12	80%
No engr	10	67%
No CM's or GM's	6	40%

Table 5b (Services)

Continued Study of In-House Staff for Residential Developers

Small Companies		% of 2
Marketing Consultants	1	50%
Construction Managers	1	50%
Engineers	0	0%
Value Engineers	0	0%
General Contractors	0	0%
Designers	0	0%
None in-house	0	0%
Architects	0	0%
No arch or desgnr	2	100%
No engr	2	100%
No CM's or GM's	2	100%

Medium Companies		% of 4
Construction Managers	2	50%
General Contractors	2	50%
Marketing Consultants	3	75%
Engineers	2	50%
Value Engineers	2	50%
Architects	0	0%
Designers	1	25%
None in-house	1	25%
No arch or desgnr	3	75%
No engr	2	50%
No CM's or GM's	2	50%

Large Companies		% of 8
Marketing Consultants	4	50%
Designers	1	13%
Construction Managers	6	75%
None in-house	1	13%
Architects	1	13%
General Contractors	4	50%
Value Engineers	1	13%
Engineers	2.	25%
No arch or desgnr	6	75%
No engr	6	75%
No CM's or GM's	2	25%

on staff, possibly indicating a need for closer control of that portion of the process.

As may be seen in Table 6, a second study asked for opinions about the marketability of package offerings. These included a portfolio of house designs by name architects and an interior design package. Sixty percent of the home builders thought the designer home portfolio would be an advantage to a construction firm. This is particularly useful for the panel producer who is dependent on the repetition of designs. Seventy-two percent of the home builders thought it worthwhile for a construction firm to offer interior design packages. The options they most frequently offered their homebuyers included up-grades in carpeting, flooring, appliances and fixtures. Panel producers should understand the amount of effort a home builder spends in assembling options packages for his projects. The panel producer can provide this service far more efficiently than the home builder because of the larger volume of product he sells. The panel producer can thus make the building process simpler for the home builder.

A third study, summarized in Table 7, was made to assess the current labor situation in New England. Ninety-one percent of the home builders reported labor shortage difficulties, with finish and rough carpenters being least available. Although panels replace framers on-site for the construction of walls, panel producers might consider

Table 6 (Services)

Study of Opinions of Marketability of Package Offerings

25 respondents, 25 full answers

Respondent	would designer houses portfolio sell?	would interior design package sell?	do you offer Options' Package?	offering what?
A	1	1	-na-	-na-
B	1	0	0	-na-
C	1	1	1	22 standard homes
D	0	1	1	3 interiors packages
E	-na- *	1	1	flooring & carpeting
F	1	1	1	strm drs,loft,1/2 or 3/4 bth, up-grade appliances, carpeting
G	1	1	1	up-grade in appliances, fixtures, carpet
H	1	1	1	interiors, finished bsmt/attic
I	0	---	1	up-grade carpeting & carpeting to tile. crdt for appliances
J	0	---	1	up-grade carpeting
K	---	1	1	up-grade to "designer" package or customize to bldg allowances
L	1	1	1	country or European cabinets, floor tile types, carpet color
M	0	---	1	up-grade tile, appliances (3 options)
N	1	1	0	comes up-graded. will provide credits.
O	0	---	-var-	showrooms of packages for larger sub-divisions
P	1	1	1	3 coordinated bathrooms & kitchens
Q	1	0	0	one-on-one basis
R	1	-na-	1	kitchen & bath, decorative trim
S	1	1	1	bathrooms, etc. 200-250% mark up
T	1	1	1	minimum
U	1	1	0	no money in it
V	0	0	0	---
W	1	1	1	---
X	0	1	1	kitchen cabinets, carpet, fixtures.^
Y	0	1	1	cabinets, fixtures

---

*-na- = not applicable

-var- = varies with market

^considering loft & other structural variations

Summary of Opinions

"designer" home package		
yes	15	60%
no	8	32%
no opinion	1	4%
interior design package		
yes	17	68%
no	3	12%
no opinion	5	20%
Firms offerring "options" package		
yes	18	72%
no	5	20%

Types of Options Offered			% of 18
appliances/fixtures	F,G,M,P,R	8	44%
carpeting/flooring	E,F,G,I,J	8	44%
cabinets	L,X,Y	3	17%
interiors package	H,K,O	3	17%
will credit	I,N	2	11%
1/2 or 3/4 bath choice	F	1	6%
loft	F	1	6%
finished bsmt/attic	H	1	6%
will customize to allowance	K	1	6%
22 standard homes	C	1	6%

Table 7 (Attributes)

Study of Labor Supply

25 respondents, 22 full answers

Respondent	Market Range	State(s)	trouble finding labor? (which?)
A	Holly	NH	frmng,rfng,fnsh
B	Essex County	MA	fnsh,spclty
C	Cape Cod, Islands	MA	frmng
D	Hartford	CN	subs
E	Southeast MA	MA	---
F	Western suburbs & west of 495	MA	---
G	Salem & Andover	MA	subs
H	"W/in spitting distance of Lexington"	MA	yes
I	Fall River	MA	no
J	Haverhill	MA	---
K	East of the Mississippi	East	yes
L	Taunton	MA	yes
M	Western suburbs & St. Thomas, VI	MA, V.I.	yes
N	Arlington, Woburn, Wakefield, Lexington	MA	no
O	New Jersey Region, Florida	NJ,PA,NY,FL	frmng,fnsh,sht rck
P	Southern NH, Central MA	NH, MA	frmng,fnsh
Q	30 mile radius of Nashua	NH	fnsh
R	Virginia to Canada	East Coast	yes
S	2 hour radius of Boston	MA,CN,ME,NH,RI,VT	fnsh,msnry,sht rck
T	Roxbury, Mattapan, New Bedford	MA	frmng,fnsh,msnry,sht rck
U	Northern New Jersey	NJ	yes
V	Washington DC	DC	msnry
W	2 hour radius of Boston	MA,CN,ME,NH,RI,VT	msnry, subs
X	Northeast	Northeast	yes
Y	100 mile radius of Boston	MA,CN,ME,NH,RI,VT	yes

Summary of Labor Shortage		% of 22
yes	20	91%
no	2	9%

Which Specialities		% of 12
finish	7	58%
framing	5	42%
masonry	4	33%
sheet rock	3	25%
subs	3	25%
roofing	1	8%

providing erection crews as an added service to their customers.

A fourth study asked home builders what would sway them to use prefabricated panels (Table 8.) The most frequent response was for the panel manufacturer to show the home builders a completed, operating project. Other requests included demonstrating the cost effectiveness of panels, providing quality erection crew services, and providing marketing materials. The next chapter combines these ideas with other results from the study to form a stratagy for increasing the market share of wood panels.

Table 8

Study of Potential Marketing Ideas

25 respondents, 12 answers

Summary of Suggestions by Developers			% of 12
show construction to leased or sold project	A,B,D,N,T	5	42%
show how it is cost effective	N,Q,S'	3	25%
supplier also should erect w/ quality crews	B,W',P'	3	25%
provide marketing materials	A,D,N	3	25%
have brochure,etc	A	1	8%
have films with mode of construction	D	1	8%
provide seminars	N	1	8%
have models geared toward developers	N	1	8%
provide adaptability	B,T'	2	17%
shouldn't look like panels/should have curb appeal	B,T'	2	17%
show design articulation/flexibility	B,T'	2	17%
allow fine-toothed quality check	D	1	8%

Summary of Situations for Which Developers Might Use Product			% of 12
if having labor force problems	P',Q	2	17%
for specific applications like a bath-house	B	1	8%
might use it for factory-type project	H	1	8%
might use it for R & D/industrial project	M	1	8%
for production volume on large, flat sites	X'	1	8%

' = has had experience with panels or modules

CHAPTER FIVE

Strategies for Increasing Market Share

Based on the information presented thus far, it can be concluded that there are still significant impediments to the advancement of prefabricarted wood panel systems in the home building industry. Closed wall panels are impeded because they vary too much from usual construction practices. Closed wall panels do not fit easily into the government's framework of localized building codes and on-site construction inspections. Without regulatory impediments, these panels could challenge to the usual practices of the on-site subcontractors. Since closed wall panels provide greater "value added", it would be worth pushing to gain increased acceptance, but this will be a slow process. The main focus should fall on open wall panels.

Impediments to open wall panels include their inherit low "value added", and consequently, a limited interest by builders. Homebuyers impede the use of panels by retaining their perception of prefabricated housing as bland and boxy.

Further impediments include the over-capacity of the industry, which increases competition between panel manufacturers in the short-run. (If the competition leads to predatory pricing, it may help the industry gain market share in the long term.) High capital costs limit entry into the panel market and require manufacturers to maintain a high

volume of business to cover carrying costs of capital expenditures. Their on-site competitors, conversely, have a low capital cost which allows them to move freely across markets and into related fields when the housing market softens.

In short, prefabricated wood panel systems fall within the "technology push" framework. Panel manufacturers have the product but not the market. The following recommendations address this situation.

MARKET TARGETING: Panel fabricators have three principle residential markets to explore; the institutional market, the homebuyer market, and the home builder market.

Institutional markets could include contracts for institutional housing, service buildings, school classroom buildings and small dormitories. Panel producers should look at philanthropic and non-profit groups which have special projects such as low-income housing, housing for the elderly or shelters for the homeless.

In the homebuyer market, a panel producer can offer the first-time homebuyer a ready-to-assemble building shell or a completely erected shell, leaving the responsibility for the remaining build-out of the project with the homebuyer. For the move-up, second home (and vacation home) markets, panel producers should offer turn-key services, or delivery of a fully constructed house.

The largest target for the panel producer is the home builders market. This broadly includes single and

multi-family home builders, and may be as specialized as developers of congregate care facilities or retirement villages. Panel producers should seek out projects for which their product is particularly well suited, such as urban infill projects. In this, the panel systems address two particular needs; since the building is constructed off-site, there is no need to squeeze construction materials onto the already constrained site and since the building is quickly closed in, there is little opportunity for site theft.

In targeting any of these markets, panel manufacturers should realize that, as in automobile sales, the greatest amount of profit comes from selling "options" along with the product. For the panel producer, the options are the interior finish package. The panel manufacturer can assemble packages of carpeting, flooring, fixtures, appliances, etc., thus adding to the value of his product. Panel producers should give this suggestion strong consideration.

EDUCATING: Panel manufacturers are faced with the need to educate their buyers, particularly to dispel misconceptions about image, design flexibility and cost benefits.

The bad image associated with prefabrication can best be displaced by a product which demonstrates design flexibility. Manufacturers should aggressively advertise the new design, engineering and manufacturing technologies that make up the production process. The key points to be

emphasized are the following:

1. Panels can be customized to each home builder's designs. This is especially important to home builders who want their units to fit the architectural context of the site.
2. With the improved panel production systems, the more complex the design, the more "value added" is built into the panels. While the production systems quickly adapt to complex designs, the on-site builder, even when experienced, will be slowed by each additional joint to be made or wall to be laid out.

In addition to stressing design flexibility, panel producers must sell the cost benefits of panel systems. These may be in the form of monetary and non-monetary benefits. Obviously, if the product is less expensive on a unit basis, the point should be clearly made. It should be included on every piece of paper leaving the office. When a panel system is more expensive than on-site construction, however, non-monetary savings should be emphasized. Primary among these are the following:

1. Costs, whether competitive or not, can be accurately determined with computer modeling. Providing guaranteed maximum costs will pay the home builder in terms of reduced risk. It will lower his risk/return requirements and may provide for more favorable interest rates from lenders.

2. Schedules can be guaranteed due to the controlled environment of the factory. This may be extremely important in areas where construction is delayed due to a tight labor market, as is currently the case in the New Jersey/New York region where projects are 12 to 18 months behind proforma completion dates.
3. Year-round construction is possible since units are built in a plant and can be erected in a few days even in winter weather. This gives home builders increased phasing flexibility and an edge on the spring selling season.
4. Reductions in site-theft can provide considerable savings, particularly in urban sites. A recent Melior Group study showed that 85.7% of the builders who used components considered the reduction of site-theft as one of the top five reasons to use them.

Homebuyers and home builders can most easily be reached with marketing materials designed to promote panel system benefits. For homebuyers especially, however, a stage has to be set before the particulars can be illustrated. The Japanese panel producers, for instance, focus their brochures on the lifestyle and image that their targetted homebuyers look for. Only in the last few pages of a brochure do they give detailed or technical information. While home builders may be able to use brochures to sell units to their

customers, they expressed more interest in learning about the production process.

A polished presentation of the product and manufacturing process would be best shown on video cassette. The cost of blank video cassettes and postage may actually be less than the printing costs of a published brochure. Video marketing material has a higher impact since it is still unusual, and is thus less likely to be thrown away as junk mail. Plant tours or films of the process could be instructive not just for the home builder but also for his insurance representatives and his lenders.

To further convince buyers of the benefits of panels, manufacturers should consider a "model project". Home builders are not known for their desire to break new ground. They remain skeptical until someone else has tried a new product or technique first. Panel producers should search out a project for which panel systems are well suited. The project should be able to demonstrate as many of the attributes of panels as possible. If the project builders cannot be swayed to use the panel system, the panel producer should be willing to cut his prices and consider the project a "lost leader". It is important to have a successful project to show home builders the possibilities.

SERVICES: To augment the "demand pull" for prefabricated wood panel systems, panel manufacturers must provide services which make it easy to use the product. Production

engineering is critical to the use of panels, but other services can be just as crucial.

Design services are of significant interest to homebuyers and home builders, as demonstrated by the questionnaire. The panel builder has several options; he may assemble a portfolio of designs or provide designers to work with customers.

To assemble a design portfolio, the manufacturer could contract with one or several architectural firms to produce a set of designs, or he could issue a Request For Services (RFS), asking architects to submit their designs for consideration. The home builder benefits from a decrease in the costs of architectural services as a percentage of hardcosts, due to "volume designing". He is further relieved of the job of managing the design standards and budget of his architect. Instead, a home builder can go to a panel producer's catalog and pick out a design with a guaranteed fixed price. This cuts down on some of the guesswork, and thus, also some of the risk of development.

The manufacturer's other design option is to include the homebuyer or home builder in the design decisions by providing a designer to work with them. With the availability of relatively inexpensive computer assisted design (CAD) equipment, the panel manufacturer can offer "design studios" in which a home can be designed from scratch or from the adaptation of a set of existing plans. For a home builder who is developing lots, a "studio" could be set

up on-site in which homebuyers could "customize" their own homes and thus relieve the home builder of building speculatively. (The panel manufacturer should benefit in this with a grant of exclusive building rights within the development.)

Panel manufacturers should provide either panel erection services or training for outside contractors. The success of a panel system is dependent not just on the quality of its construction in the plant but also on the attention given to its erection on-site. If quality is not maintained through each step, the entire system will be deemed a failure. (This may gain added importance if energy costs increase and the efficiency of buildings again captures the interest of homebuyers). Panel producers should further offer product performance quarantees for their work.

Panel manufacturers provide a "service" to which their on-site competitors are not subject; the carrying costs required for the materials, labor and capitalization of the equipment for the production of panels. Unlike the on-site builder who is paid as the project is built, the panel builder is faced with lenders who will not allow construction loan draws until materials have been delivered or improvements have been made on-site. These carrying costs are ordinarily worked into the price of the panels but this makes them less competitive in a tight marketplace. The panel producer should therefore bid as though he has the same benefits of construction loan draws as the on-site builder.

If a home builder's bank is unwilling to permit a draw, the panelizer should then add the cost his carrying the materials and labor until the panels are delivered and a draw is permitted. Separating this carrying or float cost from the actual panels allows the panel producers to be more competative with on-site builders. Furthermore, if a home builder recognizes that his bank is causing additional expenses, the home builder will lobby for construction draws. Hence, the home builder will become an affector for panels which will counter the impeding of the banks.

As a note, panel producers should take particular care to vest their interest in a job before the units/components are fabricated. A Notice of Commencement may have to be properly recorded or posted on the property in order for the panel manufacturer to have priority in the event that he must later file a mechanics lien on the property.

As a final strategy point, even with an optimistic outlook on the future of prefabricated panel systems, it would be unwise for panel producers to expand to the point of over-capacity. It would be more prudent to add shifts to the production schedule. This requires having good workmen in the plant who could become supervisors for the added shifts. Concentration should therefore be put on the hiring and retaining of good staff.

With the highly competitive market and the cyclical nature of the housing industry, prefabricated panel manufacturers will have a challenge in expanding their market share. They must operate efficiently and respond to market demands quickly to get an edge on their on-site competitors. Particularly with the current over-capacity in the panel sector, producers must be open to possibilities and recognize opportunities.

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APPENDIX ONE

Home Builders' Questionnaire:

1. How many single family residences do you develop a year?
2. How many multi-family residencs do you develop a year?
3. How many different models do you build in a given subdivision?
4. What kind of construction do you use primarily?
   Who decides which type of construction is to be used?
   (ie, contractor, architect, builder)
5. What price range do you build for?
6. What geographical range do you build in?
7. Which, if any, of the following do you have on staff?
   - -Architects
   - -Designers
   - -Engineers
   - -Value Engineers
   - -General Contractors (G.C.s)
   - -Construction Managers (C.M.s)
   - -Marketing Consultants
8. Do you sub-contract those not on staff?
   How much do you spend on them?
9. Who manages the sub-contractors on your jobs?
10. What are the duties of the project managers?
11. What are the duties of your marketing staff?
12. Which of the services in Question 7 is most important?
13. What is your opinion of a contracting firm that can provide all or some of these services?
14. Do you have trouble obtaining skilled construction labor?
15. Does this affect your ability to phase projects?
16. Do you have a minimum/maximum number of units you build as a phase?
17. What problems do you face with build-to-suit projects?
18. What problems ahve you encountered with pre-sales?
19. Would you have an interest in construction loans or gap financing provided by your construction company?
20. How important is the willingness of your construction company to provide comsumer services and warranties?
21. Would you pay for these services?
    How much?
22. Do you see an advantage to a construction firm offering a portfolio of homes designed by name architects?
    an interior design package?
23. Do you offer "options" packages with your units?
    in what areas?
24. How important is the energy efficiency of your units?
    What insulation do you use? (R-factor?)
25. Does some other aspect in the building hold more importance?
26. How important is the "quality" of your product?
27. Why is "quality" important?
28. Can you describe what "quality" implies for you?
29. How do you measure it?
30. Describe the image of your product.
    of your company.

31. What is you assessment of each of the following for residential low-rise construction: (good, indifferent, bad)
    A. 2x4 construction
    B. 2x6 construction
    C. Masonry construction
    D. Concrete masonry unit (C.M.U.) construction
    E. Prefabricated modular construction
    F. Prefabricated panel construction
32. What do you see as the advantages and disadvantages of prefabricated construction?
    any problems selling it to the ultimate owner?
33. Do you differentiate between:
    A. Prefabricated panels/on-site assembly
        1. open wall panels
        2. closed wall panels
    B. Prefabricated modules/on-site assembly
    C. Mobile homes
34. What is your weak point as a developer?
35. What is your strong suit?
36. What professional periodicals do you read regularly?