A REVIEW OF EXEMPLARY SALES PROCEDURES USED BY U.S. INDUSTRIALIZED HOUSING MANUFACTURERS

ENERGY EFFICIENT INDUSTRIALIZED HOUSING
RESEARCH PROGRAM

CENTER FOR HOUSING INNOVATION
UNIVERSITY OF OREGON

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1.0 EXECUTIVE SUMMARY

Since 1989 the U.S. Department of Energy has sponsored a research program organized to improve energy efficiency in industrialized housing. Two research centers share responsibility for the Energy Efficient Industrialized Housing (EEIH) program: the Center for Housing Innovation at the University of Oregon and the Florida Solar Energy Center, a research institute of the University of Central Florida. Additional funding is provided by non-DOE participants from private industry, state governments, and utilities. The program is guided by a steering committee composed of industry and government representatives.

Industrialization of U.S. housing production varies from mobile home builders who ship furnished houses *to* a site, to production builders who assemble factory produced house components *on* a site. Such housing can be divided into four major categories: HUD code (mobile) homes, modular houses, panelized houses, and production built houses. There are many hybrids of these categories. The U.S. Housing industry is highly diverse and categorizations based on *processes used* rather than on *products produced* are not common. This presents special challenges to any attempt to create tools, computer-based or otherwise, which are widely applicable within the industry.

We developed a characterization of sales processes used in the industry through a combination of literature search, telephone interviews, site visits, and on-site interviews. Based on this characterization, two panelized manufacturers were chosen for additional site visit/interviews focusing specifically on: 1) the role of computerization in their current sales processes; and 2) the potential for improvement of these processes through additional appropriate computerization. They were chosen based on their representativeness within the industry in terms of: 1) their focus on energy as a feature of their products; 2) the extent to which they allow home buyers to customize their standard house plans; 3) their sales volume and market niche; and 4) their willingness to embrace computerization as evidenced by present computer-based practices.

The range of sales procedures in the U.S. housing industry reflects the diversity of the industry as a whole. Our analysis led to the following generalizations. The

sales processes of large volume manufacturers are characterized by time-tested "showroom" techniques employing model homes and sales staff who have the kind of relation to industrialized home buyers that car salespersons have to new car buyers. The role of the computer in these processes is task-oriented (e.g. "make a house plan") rather than system-oriented (e.g. "streamline the flow of information between sales, design, and production systems"). Off the shelf software products are the norm at large volume manufacturers. The sales processes of small volume manufacturers are strongly buyer oriented with buyer customization as a particularly compelling sales feature. Sales processes here are characterized by personal interaction with a sales person during the several months typically required to customize, sell, deliver and erect a home. Computer users at small volume manufacturers enjoy a greater degree of system integration than their colleagues at larger volume manufacturers, but here too, computer use is still structured along task-oriented lines. Manufacturer-modified custom-designed software is the norm at small volume manufacturers.

Three conclusions of our analysis and ensuing implications for software development deserve special mention. First, based on our analysis there is currently an inverse relationship between a manufacturer's sales volume and their willingness to allow buyers to customize their products during the sales process. Large volume manufacturers typically generate a smaller profit per home sold and achieve desired total profits by standardizing the homes they sell and maintaining strict control over the manufacturing and delivery process. They are generally less willing to allow buyer customization. Small volume manufacturers typically generate a larger profit per home sold and welcome customers who see the potential to design their own home as one of the compelling qualities of owning an industrialized home.

Given that end users (i.e. home buyers) are the people with the largest stake in the energy performance of housing products, we believe **sales processes which allow/encourage buyers to customize within manufacturer-specified guidelines have great potential to improve energy performance, enhance customer satisfaction, and increase the market share of factory-produced industrialized housing.**

Second, there is an industry-wide reluctance to 'gamble' on increased efficiencies (and the accompanying cost savings) through large scale, system-wide computerization. Several of the manufacturers interviewed made reference to the "reality gap" they have discovered between what a software vendor *says* their software will do and what the manufacturer is able to *get* it to do once it is installed on the manufacturer's computer system. This is further complicated by the need for any software or hardware purchases to be backwardly compatible with all software and hardware currently in use. We believe this leads to a cycle in which **manufacturers will not commit to new computer-based techniques until they have been tested in the market yet such techniques are not tested in the market because manufacturers are reluctant to be the first to try them**. The investment inertia of this problem will be with the industry at least until a new generation of non-hardware specific software and the computer hardware on which it operates becomes the norm within the industry. RISC (reduced instruction set chip computers) and object oriented software programming may promise such a circumstance in the latter half of the decade.

Third, **while there are substantial gains to be made through increased computerization of existing processes, the greatest promise for improvement is in the ways increased systemic computerization provides previously unavailable options for selling, designing, and manufacturing homes**. An example of this is the way computer-based systems can help home buyers customize a manufacturer's standard house plan, visualize the changes made, and then pass this information on to inventory and production managers in a more timely and efficient manner than is now possible. Conclusion two above presents a very real hurdle to achieving this type of promise.

There are important software development implications which arise from the decentralization of housing industry. There are few large companies that can underwrite the cost of sustained research and product development, or vertically integrated companies that can coordinate the development of products and processes necessary to fully exploit computerization. Therefore there is very little software and hardware development in the industry.

Currently, computerization in industrialized housing is characterized by discrete, general-purpose software tools that have been minimally adapted to particular applications. Examples include CAD, CAM, spreadsheet, database and desktop publishing programs. Although software of this type may be customized in-house at some expense, it fails to realize the potential benefits of integrating systems.

A previous EEIH research publication (Center for Housing Innovation, Oct. 1990: 55-60) described three likely short-term scenarios for increased computerization in the housing industry. They are: 1) a *component supplier model* in which suppliers of housing components (doors, windows, etc.) supply software extensions to existing CAD software that are tailored to use with their component products; 2) a *CAD/CAM vendor model* in which existing CAD/CAM software will be elaborated to perform additional tasks necessary within the design and production process; and 3) an approach pioneered by the Japanese in which *large volume manufacturers* with sufficient capital will develop in-house software specific to their marketing, design, and manufacturing needs. These short term strategies will certainly result in significant dispersed, localized improvements in the industry. But based on our analysis they are unlikely to produce industry-wide systemic improvements in the ways computers are used. The diverse nature of the industry, the norm of establishing proprietary control over any software developed in-house, and investment inertia will prevent it.

Investing in strategies targeted at industry-wide improvements in the wise use of computers offer significantly greater prospects for far reaching gains in efficiencies of all kinds. What is needed is a software development environment that can bring together manufacturers, material and equipment suppliers, software developers and university researchers to work on a coordinated set of activities to further the computerization of the entire industry. This new approach to software development can employ a strategy sensitive to the diversity of the housing industry, the qualities which impede investment in new computer-based techniques, and the advantages to be gained from systemic approaches to enhanced computerization.

One potential solution to this problem is the creation of an Industrialized Housing Computing Simulation Laboratory. This software incubator would provide an environment for system-wide industrialized housing software development in which the obstacles now at work in a wholly privatized marketplace would be balanced by tangible, achievable incentives for enhanced computerization. High volume manufacturers could pursue marketing, design, and manufacturing processes which maintain product control but allow buyer customization. Small volume manufacturers could focus on increasing volume while maintaining the personal attention to clients that is their hallmark. Computer software and hardware companies would get a clearer understanding of the market offered by industrial housing manufacturers and could work collaboratively with them to develop appropriate products.

Such an endeavor would combine the advantages of a research laboratory at a university, the research and development arm of several major computer hardware and software corporations, and a representative array of manufacturers from all sectors of the industrialized housing industry. It would involve a substantial amount of research funding at the beginning, but would, in its second and third phases, receive support from computer hardware and software manufacturers as well as housing manufacturers. Successful results could lead to industry-wide improvements in efficiency through computerization and a larger market share for more energy efficient industrialized housing.

2.0 INTRODUCTION

Since 1989 the U.S. Department of Energy has sponsored a research program organized to improve energy efficiency in industrialized housing. Two research centers share responsibility for the Energy Efficient Industrialized Housing (EEIH) program: the Center for Housing Innovation at the University of Oregon and the Florida Solar Energy Center, a research institute of the University of Central Florida. Additional funding is provided by non-DOE participants from private industry, state governments, and utilities. The program is guided by a steering committee composed of industry and government representatives.

This report summarizes Task 2.2C "A Prototype Energy Sales Tool for U.S. Industrialized Housing Producers". The two objectives of this task were to

1. Select two to three U.S. industrialized housing companies with exemplary but different sales procedures giving preference to those already computerized who sell energy as a feature of their designs.

2. Develop a detailed description of the sales procedures used by the selected companies.

This report is organized in four major sections. Section 1.0 introduces the broad research context within which this project was carried out and provides the rationale by which two manufacturers were chosen for detailed study and critique. Section 2.0 gives a general characterization of sales processes used by U.S. industrialized housing manufacturers, then briefly compares and contrasts the two manufacturers chosen for detailed description. Section 3.0 is a detailed description of the sales procedures currently used by both manufacturers. Section 4.0 identifies the potential for improvement through computerization of two categories of sales processes: 1) those which now exist and are in use; and 2) those which do not now exist but could become available through enhanced computerization.

2.1 OVERALL EEIH RESEARCH PROGRAM CONTEXT

There are three broad Task Areas addressed in the overall research program: first, a critical review was conducted of existing industrialized housing, housing products and processes; second, the designing, manufacturing, and testing of energy efficient industrialized homes and their subsystems and components for the 21st century is occurring; and, third, researchers will develop ways to transfer the benefits of this research to the industry at large.

Within Task Area 2, the 21st century home, there are four sub-areas of research: 1) developing architectural designs for energy efficient industrialized homes, 2) developing advanced and innovative design and production processes for such homes, 3) designing and implementing advanced and innovative industrialized home components, and 4) testing the homes, products and processes recommended as a result of the research. The Prototype Energy Sales Tool is one of the advanced and innovative design and production processes currently being developed as part of sub-area 2.

2.2 METHODOLOGY AND RATIONALE FOR MANUFACTURER SELECTION

To gain an overall sense of the sales processes used in the industry as a whole, literature searches were conducted in trade journals, NAHB (National Association of Home Builders) publications, and academic publications. Telephone interviews were conducted with industry analysts, industry experts and more than a dozen industry representatives and manufacturers. To make the task manageable within the allotted time frame it was decided to focus on the largest market segment, manufacturers of panelized homes. Panelized homes are a type of industrialized home in which factory-assembled wall, floor, and roof panels are delivered and erected on site. With all this completed a general diagram (see figure 3.0 - 1) was developed and refined that captures the full range of ways in which buyers and makers of industrialized panel homes interact and conclude sales.

Based on this understanding, profiles were developed for manufacturers to be visited and interviewed in greater detail. Given the diversity of the industry as a whole, the manufacturers to be visited were chosen for their representativeness in four areas: 1) their focus on energy as a feature of their products; 2) the extent to which they allow home buyers to customize their standard house plans; 3) their sales volume and market niche; and 4) their willingness to embrace computerization as evidenced by present computer-based practices. A short list of ten manufacturers was developed. Each was interviewed by telephone and analyzed for conformance with the four categories above. Categories one and four were qualities desired of both manufacturers, i.e. we chose two manufacturers that had energy performance as a feature of their products and were already computerized to some extent, whereas categories two and three address a spectrum within the industry as a whole and we intentionally chose manufacturers at both ends of this spectrum, i.e. one which did and one which did not encourage buyer customization and one with large volume and one with small volume of sales. A brief assessment of the manufacturers appears in section 2.1.

3.0 AN OVERVIEW OF SALES PROCESSES USED BY U.S. PANELIZED MANUFACTURERS

In its present form the panel housing industry is highly specialized, offering many ways for home buyers and home manufacturers to make contact and conclude the delivery of a new industrialized home. Figure 3.0 - 1 diagrams the players and relationships involved. The top portion of the diagram represents manufacturers, the middle portion represents sales staff and the individuals and facilities necessary to support them in making sales, and the bottom portion represents buyers. The sales processes used in the industry vary primarily by the directness of contact between manufacturer and buyer and by the degree of control manufacturers exert over other players in the sales process. Figure 3.0 - 1 abstracts the complex roles and processes at work in the housing industry by characterizing each group by their primary role. Inevitably, a diagram of such a diverse industry requires that less dominant aspects of each group's role are lost and may also obscure the fact that one manufacturer may employ more than one

of these processes simultaneously. We address this later in this report by leaving abstractions and focusing instead on specific manufacturers and their actual processes of making and selling homes.

The sales process described at the left of the diagram is used predominantly by large volume panel manufacturers. In a recent listing of the top U.S. panel manufacturers, five of the top ten sold exclusively through dealers. (Automated Builder, June 1991: 32-33) With this sales process, buyer's contact with the manufacturer is minimal and dealers typically operate independent of manufacturers. This type of buyer/manufacturer relation is more widely familiar as it now exists in the automobile industry.

Moving to the right in the diagram, the second sales process is typified by manufacturers who market their houses in tracts of varying size and use model homes to represent to potential buyers the style and quality of their products. Once a buyer makes a purchase a builder erects the home on the tract lot purchased by the buyer. Builders may or may not be employees of the manufacturer. Sales staff are typically available within the model homes to answer buyer's questions and are employees of the manufacturer. This type of sales process has been employed by non-industrialized housing subdivision developers for many years.

Moving again to the right, this third sales process makes use of a sales office, often on the grounds of the manufacturing plant. Prospective buyers meet with sales persons at the sales office which may also serve as a model home. When the sales office is at or near the factory, this provides for more direct contact between buyer and manufacturer offering greater potential for buyers to customize the manufacturer's standard house plan. This potential is not, however, always realized. In this relation, all parties except the buyers are typically employees of the manufacturer.

The fourth relation diagramed is the most direct contact between buyer and manufacturer and provides the greatest potential for buyer customization. It is more common among smaller volume manufacturers. In this process, sales staff initially travel to meet with buyers and discuss manufacturer's products and buyer's needs. During a later stage buyers may travel to the manufacturer's

headquarters to confirm and approve desired changes to standard house plans. The buyer/manufacturer relation is most involved during the customization and construction phases but ultimately lasts for the duration of the buyer's occupancy of the home.

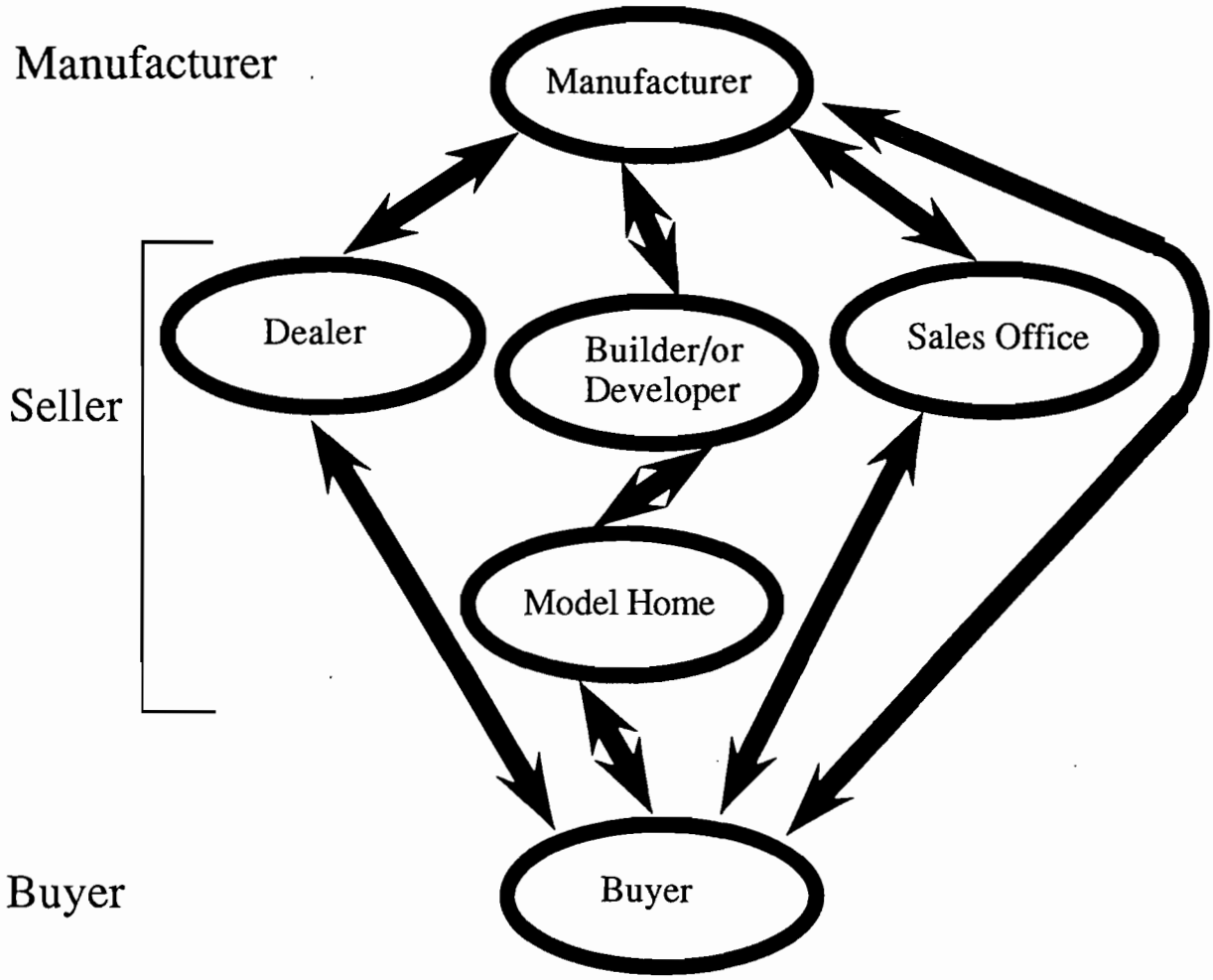

Figure 3.0 - 1

A Generalized Diagram of Manufacturer/Seller/Buyer Relations in U.S. Panelized Housing

It is clear from this that the directness of contact between manufacturer and buyer is part and parcel of how the sales process operates. Indeed, the sales process itself may be thought of as the connection between manufacturer and

buyer. Given that buyers are the involved party most likely to be concerned about the energy performance of an industrialized home, the general nature of this connection and specifically the ways it encourages or discourages customization of standard house plans is an important link in achieving greater energy efficiencies in industrialized housing.

Following is a brief description of each of the ten manufacturers interviewed by telephone to determine which two to visit and interview further.

Manufacturer #1: Located in the Pacific Northwest, #1 is a small volume manufacturer with one plant and significant automation but computerization is limited to CAD. Their sales process fit the model for small volume manufacturers, relation #4 in Figure 3.0 - 1.

Manufacturer #2: Also located in the Pacific Northwest, #2 is a relatively large volume manufacturer selling exclusively through dealers. They have four plants and are not highly computerized. They were considered for further interview as a representative of sales processes which use only dealers, relation #1 in Figure 3.0 - 1.

Manufacturer #3: A small manufacturer in the Pacific Northwest, #3 is known as a leader in the industry for their R/control work. Their sales process fit the model for small volume manufacturers, relation #4 in Figure 3.0 - 1.

Manufacturer #4: A very large manufacturer in the Mid-Atlantic region, #4 was eventually chosen for further interview and site visit. In the body of this report they are referred to as Manufacturer B. More detailed descriptions can be found in sections 2.1 and 3.

Manufacturer #5: Also a large manufacturer in the Mid-Atlantic region, #5 is currently undergoing financial restructuring. A medium sized manufacturer, they are good candidates for increased computerization. They were something of an exception to the norm in terms of sales process given that, even though they are not a small volume operation, they do allow substantial buyer customization. Their sales process is best characterized by relation #3 in Figure 3.0 - 1.

Manufacturer #6: A small manufacturer in the Mid-Atlantic region, #6 is also a strong candidate for increased computerization. A highly competitive market has discouraged this manufacturer from making significant investments in enhanced computerization although they readily acknowledge the potential benefits. Their sales process is also best characterized by relation #3 in Figure 3.0 - 1.

Manufacturer #7: A small manufacturer in New England, #7 was eventually chosen for a site visit and additional interviews. They have one plant and are known in the industry for the high quality of their products and attention to customer satisfaction. They are computerized now, and, with sufficient demonstration, are open to further enhancement of their operation through additional computerization. In the body of this report they are referred to as Manufacturer A. More detailed descriptions can be found in sections 2.1 and 3. Their sales process is shown by relation #4 in Figure 3.0 - 1.

Manufacturer #8: #8 is one of the largest manufacturers in the nation. They make use of highly automated and highly computerized "islands" within their manufacturing operation. Their sales process fits the model for large volume manufacturers, relation #2 in Figure 3.0 - 1.

Manufacturer #9: Located in the Northeast and Mid-Atlantic, #9 is an innovative mid-sized manufacturer. Their sales process has characteristics typical of both large (relation #2) and small volume manufacturers (relation #4). They use computers and are convinced increased computerization will eventually come to the industry as a whole.

Manufacturer #10: Located in the Northeast, #10 is a small manufacturer recognized as an innovator in using CAD as a marketing tool within the industry. Their sales process fits the model of the small volume manufacturer, relation #4 in Figure 3.0 - 1.

3.1 BRIEF DESCRIPTION OF SELECTED MANUFACTURERS

Two manufacturers were chosen for their representativeness in four areas: 1) their focus on energy as a feature of their products; 2) the extent to which they allow home buyers to customize their standard house plans; 3) their sales volume and market niche; and 4) their willingness to embrace computerization as evidenced by present computer-based practices.

Manufacturer A is a relatively small (approximately 100 units per year) open panel manufacturer of industrialized homes oriented toward the upper income buyer. They are located in New England and operate one manufacturing plant. They are a small company, with a reputation for high customer satisfaction and craftsmanship. Their sales process fits relation #4 on Figure 3.0 - 1.

Manufacturer B is a large (approximately 7000 units per year) industrialized housing manufacturer based in the mid-Atlantic region. They operate six manufacturing plants and serve most areas of the continental U.S. They have experience in both open panel and modular industrialized houses. They are a large corporation with close affiliations to other housing and land development enterprises. Manufacturer B is a conservative company, with a reputation for delivering a sound value in upper income-oriented manufactured homes. Their sales process fits relation #2 on Figure 3.0 - 1.

4.0 DESCRIPTION AND CRITIQUE OF SELECTED MANUFACTURER'S SALES PROCESSES

4.1 MANUFACTURER "A" SALES PROCESS DESCRIPTION

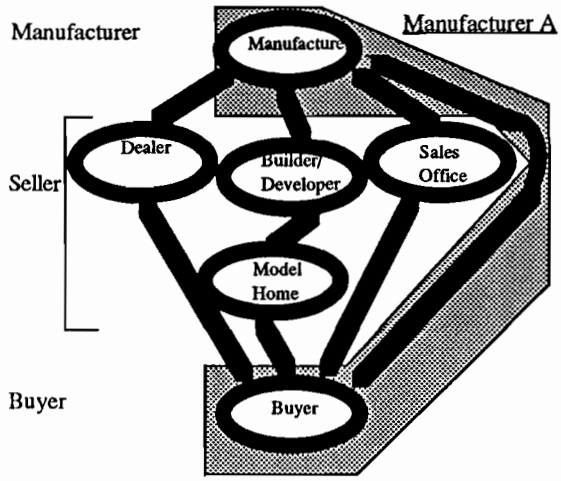

Figure 4.1 - 1

Figure 4.1 - 1 is a diagrammatic representation of the process used by Manufacturer A. Manufacturer A relies primarily on advertising, printed and word of mouth, to reach clients. They place ads in magazines and newspapers likely to be read by potential home buyers. When a prospective client calls, a sample introductory brochure is mailed. If this elicits further interest, the client may purchase a complete catalog showing all types and styles of homes offered as well as profiles of several satisfied customers. Once the clients have narrowed their choices, a meeting is arranged at the client's site with a manufacturer's sales representative. Any client-initiated alterations to the standard house plan from the manufacturer's catalog are then noted in the field by making a tracing paper overlay of the plan from the catalog. This overlay is then sent to the manufacturing plant, the standard architectural plans stored on computer are modified to suit by the architectural staff, drawings are checked by hand for accuracy, a cutting list is generated, the materials are cut, assembled into open panels, floor, roof beams, etc. Then, the house parts are loaded onto a 40' flat bed truck and shipped to the client's site. The client contracts separately with a home builder who, following the manufacturer's detail book and plans, assembles the house on site.

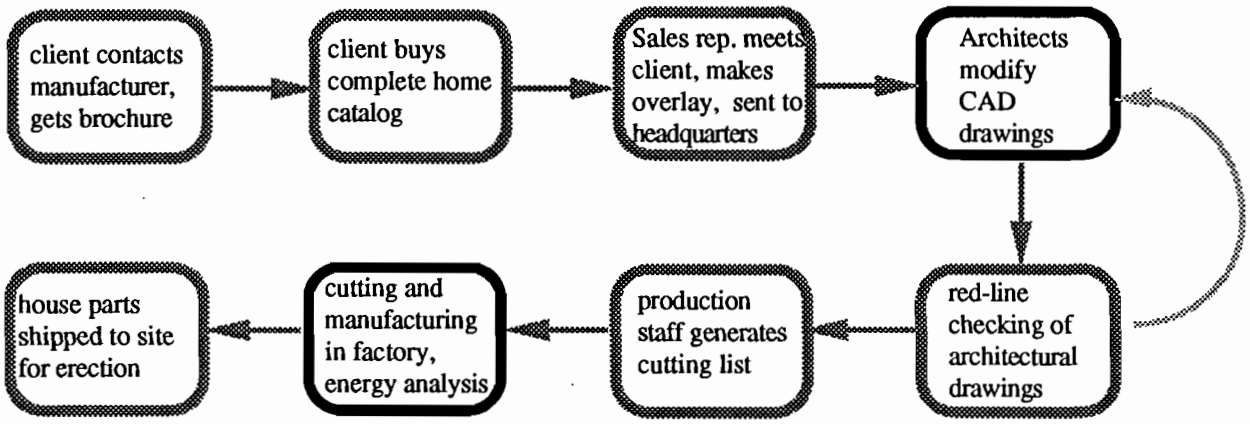

Figure 4.1 - 2
A Flow Diagram of Manufacturer A's Use of Computers
(Black lines represent computerized processes)

4.2 MANUFACTURER "A" SALES PROCESS CRITIQUE

Manufacturer A develops a personal relationship with each of their clients. This, and the attention to architectural craft and detail, are the defining qualities of their reputation. There is strength in this, in that a sales and manufacturing strategy which generates a high profit margin per sale but makes relatively few sales per year is more dependent on word of mouth advertising than a low profit margin/high volume strategy. Allowing clients to customize Manufacturer A's standard house plans is also a logical extension of this strategy. The weakness of such an approach is that long term relationships are time-intensive, particularly for sales people. During the site visit to Manufacturer A, a sales manager commented that sales staff in such a circumstance are in need of ways to more rapidly answer client's questions, but in a manner which does not lead to additional questions. Understandably, commission-oriented sales staff are anxious to spend the minimum time necessary to conclude a sale and then move on to the next customer. The challenge for both the manufacturing and sales staff at Manufacturer A is how to increase volume while maintaining the personal attention to the client and architectural quality that allow a high profit margin and assures their reputation.

4.3 MANUFACTURER "B" SALES PROCESS DESCRIPTION

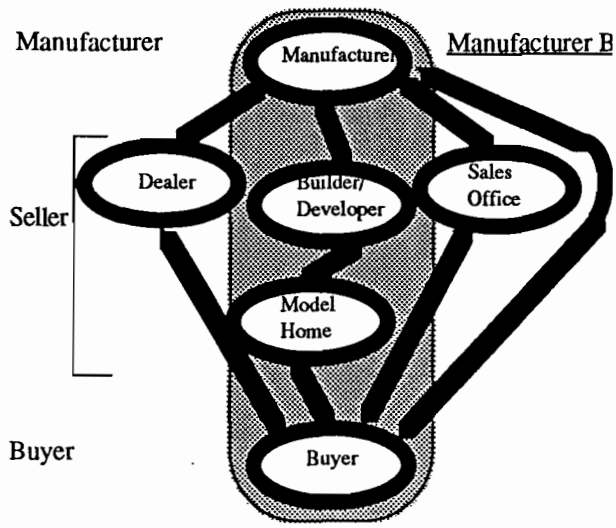

Figure 4.3 - 1

Figure 4.3 -1 is a diagrammatic representation of the process used by Manufacturer B. The sales strategy relies on a pattern of shopping for homes which is well established in the U.S. A prospective client shops for a home by driving through the neighborhoods where they wish to live with an eye for house styles, sizes, and locations which suit their needs. The model home is a time-tested device for attracting buyers and, as employed by Manufacturer B, also serves as a sales office. Once a client arrives at the model home, sales staff are available to answer questions and explain differences among the set of house types and styles offered in the subdivision. A small down payment secures the lot on which the home will be built and initiates the cutting of the house at the factory. No alterations are permitted by buyers which eliminates the need for any revision to the standard house plans stored on the manufacturer's CAD system.

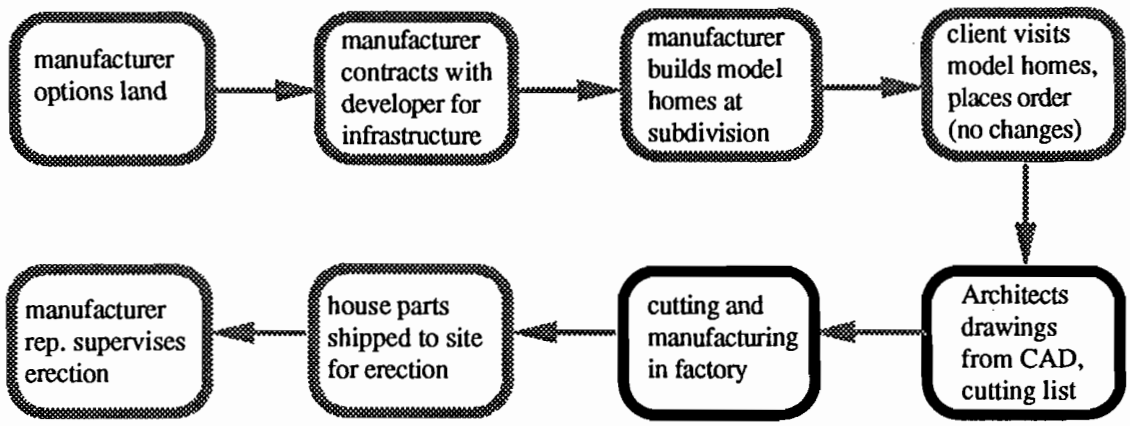

Figure 4.3 - 2
A Flow Diagram of Manufacturer A's Use of Computers
(Black lines represent computerized processes)

4.4 MANUFACTURER "B" SALES PROCESS CRITIQUE

Manufacturer B's sales process is less demanding of sales staff time by virtue of requiring a less prolonged personal relationship with home buyers, and in that sense it is more efficient. This efficiency is facilitated by the "no changes allowed" policy which also gains maximum benefits from standardization of the houses manufactured for a given subdivision through an "assembly line" manufacturing process. The sales process itself functions much like the sales process used by new car dealers. Incentives for performance of the manufacturer's products are primarily responses to mass markets and are difficult to tailor to individual buyers. Energy performance, for example, is only indirectly effected by a particular buyer's wants or needs, and tends to be influenced strongly by decisions made early on in the design phase of the homes destined for a particular subdivision, decisions in which buyers have no input. Manufacturer B's process also places great significance on decisions made by company executives about where to develop a subdivision and which house types and styles to offer there. It is an inherently conservative process with highly concentrated responsibility for success or failure of overall subdivisions.

5.0 POTENTIAL FOR IMPROVEMENT THROUGH COMPUTERIZATION

There are two broad classes of sales processes and activities which stand to benefit from enhanced computerization; 1) those which exist and are currently in use, and 2) those which could potentially exist. We will address them in order.

5.1 EXISTING SALES PROCESSES AND ACTIVITIES

A comparison of Figures 4.1 - 2 and 4.3 - 2 shows that existing computerization at the two manufacturers visited is task-oriented and isolated from many other aspects of the sales and manufacturing process. Many manufacturing and information management processes and tasks which are not now computerized could be. One of the key questions for manufacturers considering additional computerization is not *if* tasks can be computerized, but what the marginal benefit would be if computerization *were* increased. Particularities among diverse manufacturers in the process of manufacturing houses, the components used, and the process of erecting houses make universally applicable answers to such questions difficult. These particularities of the U.S. industrialized housing industry are unlikely to go away. As it now stands, manufacturers rely primarily on software/hardware vendor's benchmarks for computer performance information and on trade publications and conferences for new software/hardware developments. With the exception of CAD, commercially available software that is specifically tuned to the needs of housing manufacturers is rare. The obstacles preventing housing manufacturers from investing in computerization enhancements, (see Executive Summary) coupled with the absence of a uniform, recognizable industry-wide software niche for software vendors to fill, lead to a kind of software development gridlock. Until this gridlock is loosened, computerization enhancements will likely be limited to task-oriented improvements within types of tasks (e.g. word processing, inventory management, scheduling of material and labor, etc.) that software vendors can recognize and design for. Within the sales portion of the overall process, three distinct existing sales tasks could be targeted for increased computerization; client visualization, energy analysis, and sales staff training. Each will be briefly described.

Visualization is an area of computing which has made significant gains in the past half decade. Widely accepted within the scientific and academic community, computer-based tools which allow customers to personalize and "see" the product they are about to purchase are appearing in commercial markets from greeting cards to house paints. This is clearly a software type better suited to housing manufacturers allowing buyers to customize their products, but it could also help convince clients of companies which do not allow customizing by giving clients more vantages from which to see the inside and outside of their prospective home. One advantage of this computer enhancement is that it could be added as a module to many existing CAD software packages.

Energy analysis is currently a selling point of several of the ten manufacturers shortlisted during our initial telephone interview. In some cases the energy analysis was required for local building permits and thus was more a necessity than an option for manufacturers. Software which permits clients to understand the energy performance implications of house plan changes could, if properly designed, be an asset to sales staff in addition to meeting building permit requirements.

Sales staff in the industry typically require considerable experience with a particular manufacturer to fully understand the products to be sold and the processes by which these products are made. Appropriately designed computer-based tools could serve as training tools for new and current sales staff to keep them abreast of product and process changes. Such training tools would need to provide essentially the same information to train sales staff as to educate clients about an industrialized home, thus combining many of the visualization tools mentioned previously with additional information on manufacturing and delivery processes.

5.2 POTENTIAL SALES PROCESSES AND ACTIVITIES

The housing industry is very decentralized. There are few large companies that can underwrite the cost of sustained research and product development, or

vertically integrated companies that can coordinate the development of products and processes necessary to fully exploit computerization. Therefore, as described previously, there is very little software and hardware development in the industry.

Currently, computerization in industrialized housing is characterized by discrete, general-purpose software tools that have been minimally adapted to particular applications. Examples include CAD, CAM, spreadsheet, database and desktop publishing programs. Although software of this type may be customized in-house at some expense, it fails to realize the potential benefits of integrating systems, from sales to production. Impediments to such integration include incompatibility of data and hardware, difficulty in moving between applications, and discontinuities in the available range of software.

Investment in strategies targeted at industry-wide improvements in the wise use of computers offer significantly greater prospects for far reaching gains in efficiencies of all kinds. What is needed is a software development environment that can bring together manufacturers, material and equipment suppliers, software developers and university researchers to work on a coordinated set of activities to further the computerization of the industry.

5.2.1 A Computing Simulation Laboratory for Industrialized Housing

The scope of such an endeavor could be broader than the sales processes which are the focus of this report. Figure 5.2 -1 is a conceptual diagram showing a possible overall configuration for an industrialized housing computing simulation laboratory.

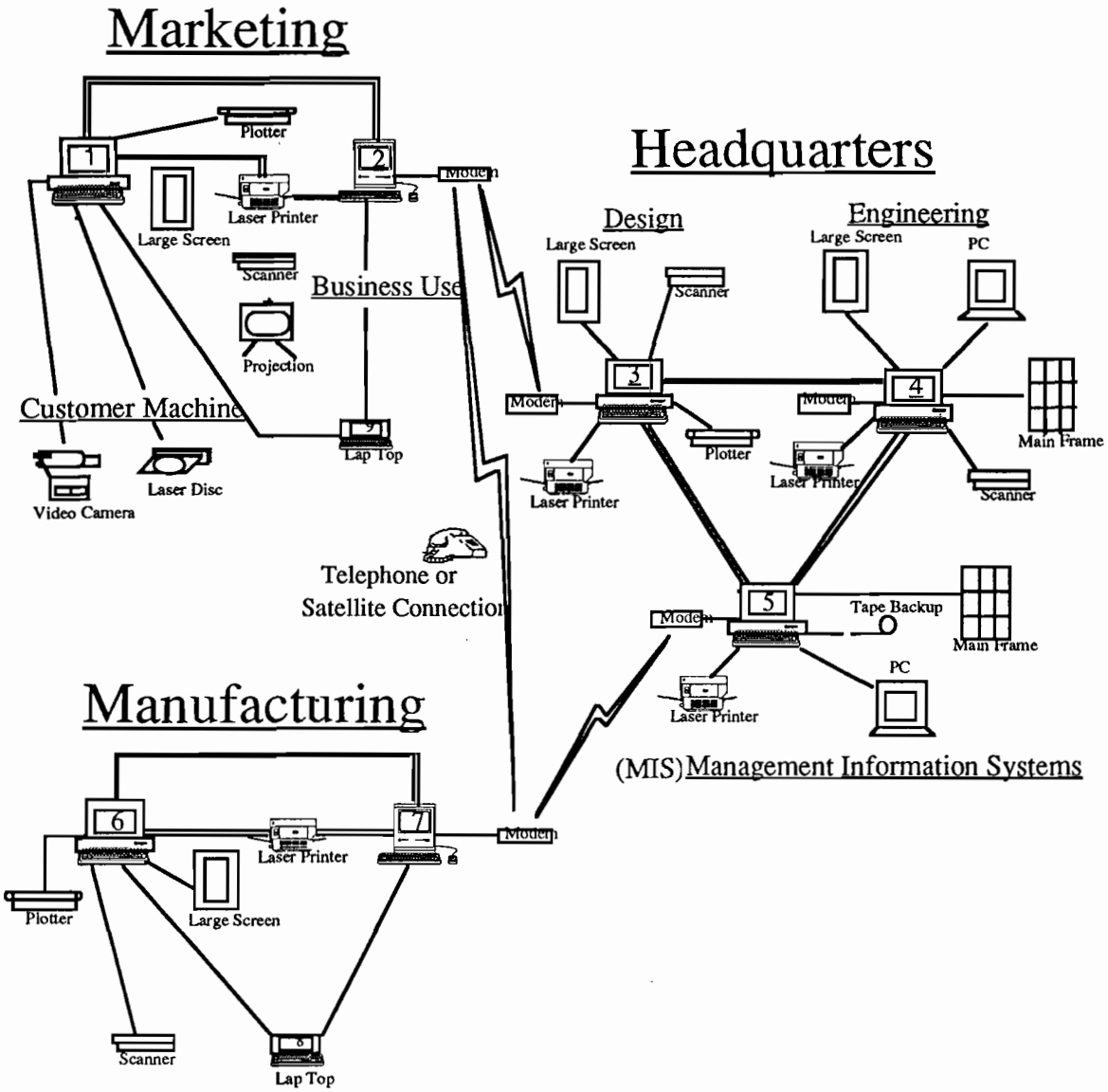

Figure 5.2 -1
A Conceptual Diagram of an Industrialized Housing Computing Simulation Laboratory

One of the keys to designing new computerized design and manufacturing tools is being able to simulate their operation before they become fully operational. Simulation methods are especially important because production process innovations and product innovations need to occur simultaneously; thus neither can remain constant while the other is being developed. Computerization of the design and production process is seen as one of the primary means to insure that buildings are produced and perform as economically and energy efficiently as possible. The following research methods could aid this project.

A critical review of computer use in industrialized housing provides the base information on which to develop new computer aided design tools. This has been done for software currently in use for design tasks and for production. In addition models have been developed of the industrialized housing process that identify when decisions are made and who makes them; hardware and software criteria for new design tools have been developed; as have some conceptual software prototypes.

Experimentation with hardware configurations will determine compatibility between diverse hardware and data transfer capability between different software applications. As investigators create hardware environments, software concepts will be developed which outline possible approaches to the major software components -- interface, database, processor, and output.

Investigators will create software mockups using screen flow charts based on the user interface. Screen trees provide a visual means of viewing the flow through a program. Based on evaluation of these mockups, we will use computerized non-functioning prototypes to simulate the program in operation.

Using the evaluation of this prototype, investigators will prepare software specifications for development of a functioning prototype. The next step in the evaluation process will be to allow a wide range of potential users to test the functioning prototype. After each satisfactory prototype is created, extensive testing for errors, usefulness, and compatibility will occur. Then, documentation will be created for the software in conjunction with the software itself and then these will be tested in parallel.

In some cases, the Laboratory could carry software development from concept to commercialization. In many cases, the Laboratory, working with corporate computing and manufacturing staffs, could provide only one or two of the steps mentioned, with the remainder being completed by the sponsoring company or agency.

5.2.2 SYSTEMIC IMPROVEMENTS TO SALES AND MARKETING PROCESSES

The remainder of this report will consider systemic computerization enhancements to sales and marketing processes which could realistically be achieved within the next five to seven years.
An integrated computer-based system of marketing will meet the needs of sales staff and provide for a smooth transfer of information with the manufacturing process. If appropriately designed, such a system will have the capability of responding quickly and flexibly to different scenarios encountered in a sales environment: retail/customer sales, dealer showroom sales and sales field representatives. With such software/hardware in place, the following scenarios can be achieved using current technology :

Showcase available merchandise using 3-D scanned images, and illustrate on the computer screen from video disk or other technology.

Design, manipulate, and alter existing models as customer requests.

Conduct energy and cost analyses.

Place orders to the production/manufacturing division via network link by satellite or other telecommunication system.

Operate a remote or lap top system for full service capability to field sales representatives.

Communicate/transfer information directly between sales operations and other parts of manufacturers operations.

Beyond the short term, there are some likely innovations which stand to influence the industrialized housing industry and its market share. With the assistance of a facility such as the computing simulation laboratory, additional systemic improvements could occur which not only integrate tasks within systems but across systems as well. Technological advances such as interactive television and the kinds of commercial exchanges it allows will provide the framework for delivering catalog browsing and customization capabilities to a prospective client's home. Without the type of systemic improvements to computerization described previously, the housing industry will be poorly positioned to take advantage of such opportunities.

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