

# Prefabricated housing to meet the government's housing construction essay



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Prefabrication of mass housing is not a new concept. According to Mole (2001), it is probably as old as the simple tent structures. Major activity in mass prefabrication for system building date back to the early part of the twentieth century. There are many examples of its use however which predate this, such as the first Iron Bridge in the UK, which was built at Colebrookdale in 1779 (Phillipson 2003).

Different sources give different dates for the production of the first prefabricated house. The 2008 New York Museum of Modern Art exhibit Home Delivery: Fabricating the Modern Dwelling identified the construction of the Manning Portable Cottage in London in 1830 for the Australian market as the genesis of the prefabricated home (Lamb 2010). Davies (2005) cites 1833 as the year the balloon frame ( the still-used rectangle of 2 by 4s and 2 by 8s that make up the inside of wall) was introduced to Chicago.

Whatever the specific year, the concept of what constitutes a prefabricated home has seemingly held steady for the past two centuries. The website Prefab Homes gives the following definition for a prefabricated home, which would no doubt make sense to any 1830s craftsman: “ A ‘ prefab home’ refers to several different types of building systems in which a home is partially or entirely constructed, manufactured, or assembled in a factory, assembly plant, or lumber yard.” (Lamb 2010)

Just after the First World War, replacement and renewal of housing was a major issue. This was when the use of pre-fabrication for house building was first seen in the UK in significant numbers. The building industry at the time was seriously affected by a shortage of skilled labour and essential

materials, and there was an acute shortage of housing. The development of new methods of construction was crucial in order to alleviate the problem, including steel framed housing systems and pre-cast timber, concrete and iron construction. Total numbers built between the wars probably still only amounted to 250, 000 of the 4-4. 5 million dwellings constructed during that time (Coombes 2007).

The Second World War brought even greater pressure and demand for rapid construction of new dwellings. During the War the Government set up the Burt Committee to look at the efficiency and speed of construction of all forms of building.

The end of the Second World War saw the re-emergence of prefabrication to provide accommodation and work for returning soldiers, utilising the surplus amount of steel and aluminium left over from the war (McCarney 2010). As a result, many new varieties of concrete,

timber framed and steel framed systems emerged as shown in figure 1.

Fig 1: Nissen-Petren Steel Framed House Fig 2: The British Iron & Steel Federation House

(Coombes 2007)

Throughout the 1940s, 50s and 60s important changes in housing construction took place - the philosophy shifted towards that of industrialised building. This is based on the principle that as much work as possible is transferred from the site to the factory leaving a simple assembly system to be carried out on site. At the time there was a lot of suspicion <https://assignbuster.com/prefabricated-housing-to-meet-the-governments-housing-construction-essay/>

about this form of modern building particularly in relation to system built high-rise construction and following the Ronan Point collapse other serious construction problems were found in other large panel constructed buildings (Coombes 2007).

In total about 1 million prefabricated homes were built during the 20th century, many of which were designed to be temporary. However, problems arose over the quality of

building materials and poor workmanship, leading to negative public attitudes towards prefabrication. Nevertheless it has continued to be used in the UK for hospitals, hotels and schools, as well as for housing in other countries. (Parliament of Science and Technology (POST) 2003).

Prefabrication dominates all forms of construction apart from reinforced concrete and masonry. (Taylor 2002)

## 1. 2 Rationale

The idea behind prefabrication is that time and cost is saved if similar construction tasks can be grouped, and assembly line techniques can be employed in prefabrication at a location where skilled labour is available, while congestion at the assembly site, which wastes time, can be reduced (Ekvent 2010). Prefabricated housing has been used in the UK during periods of high demand, such as after the World Wars and during the slum clearances of the 1960s (Parliamentary office of science and technology (POST) 2003). According to Coombes (2007), the building industry at the time was seriously affected by a shortage of skilled labour and essential materials, and there was an acute shortage of housing. The development of <https://assignbuster.com/prefabricated-housing-to-meet-the-governments-housing-construction-essay/>

new methods of construction was crucial in order to alleviate the problem. In total about 1 million prefabricated homes were built during the 20th century, many of which were designed to be temporary. However, problems arose over the quality of building materials and poor workmanship, leading to negative public attitudes towards prefabrication (Parliamentary Office of Science and Technology (POST) 2003).

### **Aim and Objective of the study:**

The aim of the study is to determine the main factors needed for the successful use of prefabrication in the construction industry. As influenced by the main aim of the study, the primary objective of the study is to examine and analyse the main problems that limit the use of prefabrication of houses in the UK and how these problems can be overcome.

In this context the main objectives of the research study could be stated as:

Identify the factors needed for the successful use of prefabrication

Identify factors that limit the use of prefabrication

Develop an explanatory model of the factors regarding the application of prefabrication

Determine the existence and strength of factors in the construction industry

To determine why prefabrication has not been more widely adopted

1. 6 Research Question:

Why has prefabrication not been used more widely by construction companies?

For all the benefits that have been stated before about using prefabrication there must be something so negative about prefabricated that completely overshadows the positives resulting in there being limited use of the construction method.

### 1. 7 Hypothesis:

Prefabrication is not suited to the UK construction Industry

### 1. 6 Research Method

Desk research is also going to be used to collect information for the study. Desk research involves the gathering and analysing of information, already available in print or published on the internet (Business Dictionary 2010).

### 1. 8 Assumptions and Limitations of the study

Several assumptions and limitations pertain to this study. First limitation is the geographical area in which the study is conducted. Due to limited funds for travel on the researcher part, the study is going to be mainly based on housing agents and developers in Essex as opposed to the whole UK.

Therefore there is no evidence that the sample in this study is typical of the broader population.

The second limitation of the study could arise from there being a low response to the questionnaires sent out by the researcher.

The third limitation of this research is the fact that the collection of data took place at a particular period in time. There is no guarantee that the responses received would be indicative of responses solicited and given at another time. There is also a potential that other

factors outside the control of the researcher (recent conflicts) could influence the responses.

The fourth limitation of the study arises from the fact that the study is conducted within a limited amount of time (3 months) so there might not be enough time to explore all areas that relate to the study.

A final limitation is based upon the researcher's lack of experience in conducting scholarly research and evaluating the data.

## Chapter 2: Literature Review

### 2. 1 Introduction

This chapter looks at the literature on prefabrication in the construction industry.

### 2. 2 What is prefabrication?

Prefabrication is defined as the assembly of buildings or their components at a location other than the building site ([www. Britannica. com](http://www.Britannica.com)). It is often referred to by the new term Modern Methods of Construction (MMC) in an attempt that is intended to reflect technical improvements in prefabrication, encompassing a range of on and off-site construction methods (POST 2003).

(Offsite pdf 2004). The term 'modern methods of construction' covers a wide range of products and solutions, encompassing everything from novel individual building components to entire factory-built structures and building modules. One of the most familiar off-site construction solutions is timber framing, used for houses and apartments and accounts for about 13 per cent of homes built in the UK. Light gauge steel frames compete in the same market, complemented by numerous pre-cast concrete systems. Now in regular use are volumetric elements (or 'pods') - such as fully fitted bathrooms or kitchens. The hotel sector has embraced these elements wholeheartedly. We have also seen the emergence of numerous factory-made cladding solutions using everything from traditional bricks to modern composites.

(Offsite pdf 2004)The ultimate example of off-site manufacture is fully volumetric construction, in which buildings are created by fixing together a series of room or

apartment modules that have been built, fitted out and finished in a factory environment. The technique is popular for schools and hospitals, and has recently been adopted for the construction of affordable housing.

## 2. 3 Types of prefabrication

MMC is a broad category that embraces a variety of build approaches including Off-Site Manufacturing (OSM). Whereas all OSM may be regarded as falling within a generic MMC heading, not all MMC may be regarded as OSM. To address this we have set out a range of categories together with accompanying guidance.

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## **OSM – VOLUMETRIC**

According to Alistair et al (2006), volumetric construction (also known as modular construction) involves the production of three dimensional units in controlled factory conditions prior to transportation to site. These units can be made from most materials including light gauge steel frame, timber frame, concrete and composites (Ross et al 2006). Modules can be brought to site in a variety of forms ranging from a basic structure to one with all internal and external finishes and services

installed, all ready for assembly. A family sized dwelling might typically be manufactured in four modules plus roof module(s).

## **OSM – PANELLISED**

Flat panel units are produced in a factory and assembled on-site to produce a three dimensional structure. The most common approach is to use open panels, or

frames, which consist of a skeletal structure only with services, insulation, external cladding and internal finishing occurring on-site. More complex panels - typically referred to as closed panels - involve more factory-based fabrication and may include lining materials and insulation. These may also involve include services, windows, doors, internal wall finishes and external claddings (Alistair et al 2006). Panellised systems are more flexible than volumetric systems and can generally accommodate variations in unit plan and detail design more easily.

(Wetherby Building Systems Limited 2006)

## **OSM – HYBRID**

A method – also referred to as semi-volumetric – which combines both panellised and volumetric approaches. Typically, volumetric units

(sometimes referred to as

‘ Pods’) are used for the highly serviced and more repeatable areas such as kitchens and bathrooms, with the remainder of the dwelling or building constructed

using panels. The hybrid approach is sometimes used to provide added flexibility on complex sites and those requiring additional communal areas.

As with both

volumetric and panellised approaches the degree of factory-based fabrication is variable. (Alistair et al 2006)

## **OSM – SUB-ASSEMBLIES AND COMPONENTS**

This category is intended to cover approaches that fall short of being classified as systemic OSM but which utilise several factory fabricated innovative subassemblies

or components in an otherwise traditionally built structural fabric. Typically, schemes incorporating the use of floor or roof cassettes, precast concrete foundation assemblies, pre-formed wiring looms, mechanical engineering composites, etc. would fall into this category. Traditional constructed schemes utilising manufactured units – such as windows, door-sets, roof trusses, etc, which might otherwise be part of the

fabrication process in the other OSM categories – should not be included as sub-assemblies or components in this category. (Alistair et al 2006)

## **NON-OSM MODERN METHODS OF CONSTRUCTION.**

This category is intended to encompass schemes utilising innovative housing building techniques and structural systems that fall outside the OSM categories. The presence of innovation is an essential feature that might manifest itself through an innovative non-OSM building system, through a building technique familiar in other sectors but new to house-building, or through traditional components being combined in innovative ways. Typically, ‘ TunnelForm’ or H + H Celcon ‘ Thin joint blocks’ would fall within this category. (Alistair et al 2006)

### 2. 4 Prefabrication debate

On an industrial basis it is accepted in civil engineering ship building, car and aircraft manufacture without question. For smaller equipment, including consumer goods and computers, modular methods of design and manufacture dominate. It is only in the building industry, perhaps with its tradition of handcraft work on site, with stone masons, bricklayers, carpenters, etc., that we find resistance to the good sense of its use. (Taylor 2002)

The construction industry is divided on whether or not the increased use of prefabrication can have a positive impact on the supply of housing and the economy as a whole. This is largely due to the benefits of prefabrication in terms of cheaper costs and speed of construction. Some believe it can whilst others like Fulcher (2010) and Hough (2002) do not agree with that view.  
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With regards to prefabrication being the answer to the under supply of housing, they believe that the housing problems in the United Kingdom are down to customer preferences and the planning system not releasing enough land to build on. Fulcher (2010) goes on further to say that prefabrication is not the panacea that is being claimed.

## **2. 5 Benefits of prefabrication**

Using prefabrication in a project allows the time spent working on site to be reduced. This means that the impact of the site on the local environment is for a shorter period of time. Site work is traditionally vulnerable to disruption from extremes of weather, by using prefabrication the site will be vulnerable for less time reducing the risk of delay and the requirements for protection needed (Phillipson 2003). Another considerable profit using prefabrication is the energy efficiency. Because the prefab elements of a panelised home are pre-cut, they fit snugly together, making for a tighter edifice. This means less effort for heating and cooling, resulting in lower energy bills (Civil Engineer Link 2010). Prefabrication can offer opportunities for dealing with problems from the declining workmanship standards and skilled labour shortages on site. In factory environments the quality of the finished product is much easier to assure than on site, all that remains is to ensure that the on-site assembly meets the required standards to allow the design to perform to requirements. Careful attention is needed with this however, as it has been a stumbling block in past application of prefabrication systems (Phillipson 2003).

In summary the benefits of offsite production are as follows:

Greater accuracy and fewer defects

Energy efficiency

Shorter build times on site - reducing noise and disruption to the local community

Factory production able to locate where labour force is available and where access to skills is good

Off-site manufacturing lends itself well to flexible construction.

Units can be stacked on top of each other to form three-storey houses and can even be reconfigured internally once the house has been built.

(Coombes 2007)

## 2. 6 Barriers to prefabrication uptake

The Government has recently sponsored a study to examine the potential barriers to use of prefabrication and some of the ways in which these may be overcome . In

particular the study was asked to look at how the potential barriers can be minimised by optimising the social, economic and environmental factors that surround the house

construction process. These are the same generic factors that underlie sustainability within the construction industry (Phillipson 2003) .

The following issues have been identified from the Desk study as barriers to uptake:

### 1. General Image

As previously described, the image of prefabrication is coloured by the experience of

past application, and in particular the results of the 1960s high rise housing systems.

Many of these problems come from workmanship rather than design deficiencies.

These experiences present a barrier to some parts of the construction industry

accepting prefabrication as a viable method of building procurement.

However, this is

now being countered through one-off demonstration systems where close supervision

of site activity should ensure that the end result is a product with workmanship quality

equivalent to that of traditional systems. The quality of assembly is important in

ensuring the long term success of prefabrication systems, the skills necessary for

12 Current Practice and Potential Uses of Prefabrication Project report number 203032 © Building Research Establishment Ltd 2003 Commercial in confidence

successful implementation are central to whether the mistakes of the past are left

behind. The test now for prefabrication is to move from the successful one off

demonstration projects to mainstream developments, which for housing lie in both the

private and social landlord markets. For non-domestic buildings there is a wider acceptance of the use of some prefabrication in the process due to the demands of major clients who want to improve the efficiency and speed with which they procure their buildings.

## 2. Perceived Performance

Much of the prefabricated housing that was built between 1946 and the mid 1970s

has been viewed as having a shorter lifespan than that of equivalent traditional

buildings. The perception that prefabrication offers a non-permanent solution is one

of the potential barriers that exist for its wider acceptance as a mainstream procurement option. In the non-domestic sector the importance of lifespan is mixed. Large out of town retail developments are designed to have a relatively limited lifespan over which the performance of the building can be maintained. The introduction of whole life costing as a tool for looking at the implications of different design strategies will be applied to building incorporating prefabricated systems so that the client can procure a building with known financial implications over its service life. This type of attention is particularly important for PFI procured buildings.

### 3. Customer Expectation

One particular barrier to adoption of prefabrication systems in housing is the perception that the public want traditional brick finished housing. Timber frame

housing systems are usually finished with an outer cladding of brick, other innovative

systems include those which have brick slips mechanically fixed to the outer surface

of the wall in an attempt to mimic the traditional finish. The masonry industry are



developing new factory prefabricated systems that can be delivered to site and which

will allow a further route for delivering housing which maintains the traditional

masonry appearance whilst being delivered through a prefabrication route.

Housing

Associations are beginning to procure multi-unit estates with prefabricated systems,

feedback from occupants has been positive. This is a domestic housing issue, there is a far wider acceptance by non-domestic sector clients for buildings to have innovative and non-traditional appearances(Phillipson 2003).

#### 4. Perceived Value

It has been suggested that resistance to prefabrication, particularly in the housing

sector, is partly caused by the perception that property is an investment and prefabrication is not necessarily seen to be a good investment based on historical

experience. This needs to be considered carefully in the context of the economic

aspects of sustainability. As with perceived performance, the non-domestic client is much more likely to actively evaluate the through life performance of new buildings and have a Current Practice and Potential Uses of Prefabrication

Project report number 203032 © Building Research Establishment Ltd 2003

Commercial in confidence understanding of the investment value of their developments. As with housing the effect of prefabrication on the through life environmental value of non-domestic buildings needs further consideration.

## 5. Industry Culture

One factor that is restraining the use of some forms of prefabrication in housing

applications is the availability of plant for handling the larger prefabricated systems on site. This a problem specific to the house building sector as the use of appropriate

plant is more widespread in the non-domestic market. In Europe the use of cranes on

even modest housing developments is well established and part of site culture, in the

UK lack of this provision makes the installation of panelling systems in housing

developments more difficult. Some manufacturers provide cranes with their lorry

delivery systems to enable the installation of the prefabricated components, however,

where such systems require later adjustment there is a need for site based plant.

Industry is addressing this to some extent by modifying existing plant (usually

excavators) so that prefabricated components can be slung under digger arms for

movement around site. A change in site culture and industry use of plant would

enable better ability for developments to use panel prefabrication systems.

Experience of prefabrication used in even some of the more high profile schemes, for

example the Greenwich Millennium Village Product has been mixed. The attitude of

the construction industry has suggested that the industry is reluctant to try new

methods and believes that off site manufacture will cost more than traditional

methods of construction. Despite evidence to the contrary, this attitude still found in

some parts of the industry is difficult to counter.

## 6. Product Awareness

The procurement of prefabricated components for a project is often a matter of

designers being aware of the availability of a given system. Designers are unlikely to

use a system for which they don't appreciate the benefits for the construction, or for

which they don't understand how the system impacts on the design process.

Manufacturers are producing innovative prefabricated products, they consider that it

is the designers that are conservative and reluctant to try out new systems (Phillipson 2003).

## **2. 7 Outlook on prefabricated buildings**

The impetus driven by Egan and the government sponsored Construction Best Practice Programme has put prefabrication higher on the agenda (Mole 2001).

The recent interest in prefabrication for house building is driven by a growth in the number of households in the UK: demand currently exceeds housing supply. by 2016, on average 230, 000 per year, driven primarily by changing lifestyles as more people live on their own. There is a particular shortage of affordable housing for key workers in south-east England (POST 2003). The Treasury's Barker Review warns of the consequences of poor housing supply in the UK, including fluctuations in the economy and affordability problems. Government is keen to address the shortfall by encouraging more house building, and it is anticipated that dwellings built using MMC could play a role. The Sustainable Communities Plan identified four growth areas: the Thames Gateway, Milton Keynes, Ashford and Stansted-Cambridge. Approximately 200, 000 houses will be built by 2016 in these areas, above those already planned. Parts of northern England, such as Oldham, are also identified for regeneration (POST 2003).

### Chapter 3: Methodology

#### 3. 0 Introduction

This is likely to be a short section giving details of the types of material you have used, books, peer-reviewed articles, grey literature, press reports, internet based materials. It will also highlight any limitations. You need to be aware that some internet sites may be putting forward particular  
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perspectives, so you will need to take this into account in your dissertation. You should also be aware of the limitations of ‘grey’ research (i.e., material that has not been through a peer review process).

### 3. 1 Purpose of the study

The purpose of this study is to look at the increasing use of prefabrication, mainly focusing on the potential impact it can have on the government meeting its housing targets.

#### 3. 1. 1 Research Question

The main focus of this study is to determine whether or not the increased use of prefabrication construction methods can help increase the number of houses built per year and in turn ultimately result in the government meeting its housing targets?

#### 3. 1. 2 Hypothesis

Prefabrication is not suited to the UK construction Industry

#### 3. 1. 3 Research method

There are two types of research strategies, namely, ‘quantitative research’ and qualitative research. Deciding on which type of research to follow depends on the purpose of the study and the type and availability of the information which is required (Naoum 2007). Quantative research involves amounts, which are usually cast in the form of statistics, whereas qualitative research does not involve amounts in any strict sense (Murray et al 2008).

Another major difference between the two according to Colorado State University (2010) is that qualitative research is inductive and quantitative research is deductive. They believe that in qualitative research, a hypothesis is not needed to begin research. Whereas, all quantitative research requires a hypothesis before research can begin. By nature, quantitative research is confirmatory and deductive whilst qualitative research is more exploratory and inductive (Trochim 2006).

### 3. 2. 1 Qualitative research

Qualitative research is 'subjective' in nature. It emphasises meanings, experiences (often verbally described), description and so on (Naoum 2007). It is all about exploring issues, understanding phenomena and answering questions (Ereaut 2007).

This view is supported by Mack et al 2005, who goes on to say that it seeks to understand a given research problem or topic from the perspectives of the local population it involves. Qualitative research is especially effective in obtaining culturally specific information about the values, opinions, behaviours, and social contexts of particular populations (Mack et al 2005).

The information gathered in qualitative research can be classified under two categories of research, namely, exploratory and attitudinal (Naoum 2007). According to RDSU (2003), There are four main methods for collecting data in qualitative research which are:

Focus groups

Direct observation

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## In-depth interviews

### Document review

#### 1) Focus group

A focus group is a carefully selected group of people brought together in the same place to discuss a particular topic or issue relevant to them. They tend to be used in marketing research, action research and for research on social issues. Multiple responses are usually unstructured and therefore can create difficulties in transcribing recordings (Hart 2008).

#### 2) Direct observation

Researchers use direct observation to learn about the normal behavior of people in their natural environments (Thomas 2008).

#### 3) In-depth interviews

An in-depth interview is a qualitative research technique that allows person to person discussion. It can lead to increased insight into people's thoughts, feelings, and behavior on important issues. This type of interview is often unstructured and therefore permits the interviewer to encourage an informant (respondent) to talk at length about the topic of interest. The in-depth interview uses a flexible interview approach. It aims to ask questions to explain the reasons underlying a problem or practice in a target group. You can use the technique to gather ideas, to gather information, and to develop materials for drug use interventions (Murray 2008).



#### 4) Document review

Document review is a way of collecting data by reviewing existing documents. The documents may be internal to a program or organization (such as records of what components of an asthma management program were implemented in schools) or may be external (such as records of emergency room visits by students served by an asthma management program). Documents may be hard copy or electronic and may include reports, program logs, performance ratings, funding proposals, meeting minutes, newsletters, and marketing materials (ETA 2009).

#### Advantages of qualitative research

The strength of qualitative research is its ability to provide complex textual descriptions of how people experience a given research issue. It provides information about the “human” side of an issue – that is, the often contradictory behaviors, beliefs, opinions, emotions, and relationships of individuals. Qualitative methods are also effective in identifying intangible factors, such as social norms, socioeconomic status, gender roles, ethnicity, and religion, whose role in the research issue may not be readily apparent (Mack 2005).

#### 3. 2. 2 Quantitative research

Quantitative research is ‘objective’ in nature. It is defined as an inquiry into a social or human problem, based on testing a hypothesis or a theory composed of variables, measured with numbers, and analysed with statistical procedures, in order to determine whether the hypothesis or the

theory hold true. Quantitative research is selected under the following circumstances:

When you want to find facts about a concept, a question or an attribute.

When you want to collect factual evidence and study the relationship between these facts in order to test a particular theory or hypothesis

(Naoum 2007)

According to Davies (2000), questionnaires are the main data collection method for quantitative research. He goes on further to say that questionnaires are ' administered to a stratified or random sample of a populatio