

HYGIENIC BUILDING DESIGN - SITE SELECTION

Huub Lelieveld^{1*}

¹Ensahlaan 11, 3723 HT Bilthoven, The Netherlands

*e-mail: huub.lelieveld@inter.nl.net

Abstract

Before deciding on the site of a new food factory, factors potentially affecting the safety and quality of the food, the costs of building the factory, the factory's accessibility by road, train or water, availability of labour and managerial skills, availability and reliability of essential utilities, waste disposal, factors that have an impact on the local environment, and the likelihood of changes in local zoning, should all be taken into account. Ignoring such factors may prove detrimental, as proven by history.

Key words: *Hygienic, site selection / location, contamination risk, factory surrounding.*

1. Introduction

Selecting the wrong site for a food factory may lead a company into all kinds of difficulties, including bankruptcy. Not all factors that may have an influence on the choice of a site are equally, but all of them should be taken into account. In 2009 American companies ranked the factors influencing their choice of site for relocation of a factory or building a new manufacturing facility as follows: 1. Labour costs; 2. Highway accessibility; 3. Tax exemptions; 4. Energy availability and costs; 5. Corporate tax; 6. Skilled labour; 7. Construction costs; 8. State and local incentives; 9. Information and communication technology services; and 10. Shipping costs, inbound and outbound (24th Annual Corporate Survey Results, Area Development Magazine Special Presentation, Dec/Jan 2010 [1]).

It should be noted, however, that the survey applies to the industry in general and focuses on the situation in the USA. Results might be different for other areas of the world. Below the factors are presented in a sequence that is more appropriate from a point of view of building a new food factory, independent of the country or continent, but self-evidently also covers the points that ranked highly in the survey.

2. Product

The product to be produced plays a crucial role. Firstly, the market for the product needs to be considered. Is

the market for the product local, national, continental or global? For a local market the location of the factory can be very important, but it is actually not always necessary to position a factory near a local market, because the raw materials necessary for the product may be sourced from elsewhere. There are other factors that play a role. The product may be sensitive to odours and hence if the environment has a strong odour, the product may end up smelling of that environment. The smell may also vary with the seasons, e.g. when the source of the odour is a field of flowers. An odour may not be obvious when a site is visited just once, because that may be at a time when it is not in the environment.

Serviceability of essential equipment

Production equipment may be costly, large or both such that it is not realistic to stock spare machines. If so, the service level must be very high, because if it malfunctions, it may not be possible to repair the equipment and quickly return it to effective operation. To avoid interrupting production for too long, repairs must be quick. For instance, a packing machine may have been purchased from a country on the other side of the globe and the service engineers and/or spare parts may have to come from there.

Competition

There is a chance that there might be a factory manufacturing the same product(s) nearby or that there will be one or more in the future. If it is not possible to obtain an exclusivity agreement and this is considered essential, then this is a reason to look for another site.

2.1 Utilities

Amount and quality of water

Although water is actually produced as a by-product in the manufacture of some food products, it is an essential ingredient in most food manufacturing processes.

In addition, the more water the product contains, the more the quality of the product may be affected by the water quality. Water is also needed for sanitary facilities, steam generation and cleaning.

Municipal water may be of varying quality and this may require the installation of equipment for pre-treatment. The amount of water required may not be readily available and drilling a well may have to be considered.

Energy needs

In the food industry an interruption in the supply of energy may cause the loss of entire batches of product. There are countries where the electricity supply is interrupted perhaps once a year or even less often, but elsewhere power cuts happen several times a day. To cope with frequent power failures, generators are needed that are continually on stand-by and powered by another energy source, usually oil or gas.

Oil and gas supplies may also be interrupted. Recent history has proven that in particular gas supplies can be unreliable and subject to political conflicts between countries. Without these sources of energy, a plant would have to shut down.

Type of waste

A new plant should be designed so that waste production is kept to a minimum, but there will always be some to dispose of. If the waste produces smells, on-site treatment may be required, adding to the building costs of the factory.

Waste disposal

If waste is not properly dealt with, the factory may attract animals and insects and conditions may develop that promote the growth of microbes. These may contaminate water and air and contaminate (or re-contaminate) the products produced. Hence a proper waste handling system must be in place by the time a factory is commissioned.

Wastewater treatment

The factory is also likely to produce wastewater and the sewer system available needs to be able to cope with it. If large quantities of wastewater are produced, it may be necessary to build a dedicated treatment plant.

ICT (Information and communication technology)

A reliable connection to the internet is becoming increasingly essential. There are large areas in many countries, particularly in places where the population

density is low, where internet connections are not readily available.

2.2 Sources of contamination

It is important to assess the risks of contamination of the product with anything that may make it unsafe. Hazardous contaminants include chemicals, microorganisms and foreign bodies. A production site therefore should preferably not be located near sources of high levels of contamination.

Although many countries have increasingly tougher regulations on pollution of water, soil and air by industry, there are still many areas where such regulations do not yet exist or are not enforced. The same applies to legal waste disposal e.g. in landfills as opposed to illegal dumping.

2.3 Regulations

Whatever the site considered, there will be regulations to meet. It sometimes happens that the relevance of certain regulations only becomes apparent after the building of the facility has started, or even after production has commenced. It is less costly to find out about any potentially relevant regulation before a site is selected. This may require the involvement of a local expert.

2.4 Protection of the environment

It is important to be aware of local environmental laws and regulations because the factory could be closed by the authorities due to non compliance. In many countries, for instance, including those in the EU, severe penalties are certain to be levied by the authorities if non compliance is discovered. It is even advisable to interpret the relevant regulations broadly, in anticipation of more severe restrictions in the future.

Pollution of soil is not yet regulated as widely as pollution of air and water. Nevertheless, it is recommended to take into consideration that soil pollution is not acceptable anywhere and hence it should not be an acceptable consequence of selecting a particular site.

Nowadays, it is likely that there will be restrictions on the noise level produced by a factory and the restrictions may differ depending whether it is daytime or night time. In the case of operations that take place 24 hours a day (e.g. in three or four shifts), this is very important.

There may also be restrictions on the use of lighting during the night. To enhance yield, companies that grow their own raw materials, such as produce (in greenhouses) or algae or plankton (in fish farms) may

use intense lighting during the night, at the same time illuminating the environment.

It is important to realise that discharging clean but warm water into small rivers or streams may be undesirable, even if legally allowed. This is because this may stimulate the growth of algae, undesirable bacteria, and insects, hence having a negative effect on the environment and angering the local population.

2.5 Industrial Zoning

It frequently happens that when an economic activity, such as food processing, becomes the core activity of a populated area, with time the population feels that their quality of life is reduced by that economic activity. They can then cause the authorities to force a company to change its activity or even move its factory. In cases where a company needs room for expansion in any case, this may be beneficial, because the pressure from authorities to relocate may be accompanied by subsidies to move. There are cases where the economic activity in question just stops, because the costs of relocating, in an economically less suitable climate, are too high. It is important to take into account that laws associated with industrial zoning may change and that this may be an important factor in some areas, particularly in economically less-advanced areas

Possibilities for extension

If, as in many cases, it is likely that with time an increase in production will be needed and it will not be possible to achieve this using improved equipment and processing methods, or by increasing the number of shifts, one option may be extending the facility. Although this may seem to be the most economical option, taking into account inward and outbound transport, it may also be that another factory at another location is more cost effective.

Site preparation / archaeological and paleontological issues / explosives from armed conflicts

It is important to consider whether a site is in a condition in which building work can start, and if not, what needs to be done to bring it to this state, how much time will it take and how much will it cost. If a site has not been prepared for building, depending self-evidently on the location and the local regulations, there may be a chance that the site may contain relics that are of historical, archaeological or paleontological importance.

2.6 Financial aspects

However attractive a site may be, building the factory on that site must also be affordable, with or without the

assistance of banks and/or authorities. For the building project to be affordable the total cost should not prevent the company from making a profit and hence it must be calculated how much the entire operation is going to cost per product unit sold.

Construction costs

In addition to the construction costs, provisions should be made for other potential costs, such as those to prepare the site or costs to remedy any of the other issues discussed in this chapter (e.g. costs associated with water treatment, wells, air filtration and deodorisation), electricity generators, waste treatment, cleaning of polluted soil, moving staff, security measures, insurance).

Transport costs

There are always transport costs and these costs will to a large extent depend on the location of the factory. Not only raw food materials, but also packaging materials, cleaning agents, machinery and people need to be transported to the factory. The finished products must then be transported to the customers.

Tax / tax exemptions

Taxes differ dramatically between locations and it should be noted that locations in which taxes are low may quite suddenly turn into locations in which taxes are high, depending on the political situation.

2.7 Personnel

Despite the fact that much can be automated, it is hard to operate a factory without skilled personnel. This applies particularly to food factories, where safety and quality of the product are essential requirements and creating and judging these two properties usually requires human intervention. Operating the factory requires operators, fitters and managers and often also engineers, microbiologists and others. It would be beneficial if the personnel required are available in the area, because moving staff from elsewhere may be costly.

2.8 Security

Flooding, fires

Companies do not want to be confronted with the sudden destruction of a factory. In some areas this may happen due to unexpected circumstances and it seems to happen nowadays in areas that were traditionally considered safe from disasters. One of the main causes is flooding, often not because a river flows over its banks, which is something that may be foreseen and

against which control measures may be taken, but because of sudden excessively heavy rainfall that creates rivers of mud that destroy everything in their path. Another security issue is fire. There are three main issues to look out for when assessing whether fires may be a threat: forests nearby having a reputation for catching fire frequently, neighbouring factories that have a high risk of catching fire because of the products they make or stock or their construction not being fire resistant or retardant and, finally, a high crime rate, especially the existence of pyromaniacs, actively and frequently trying to set buildings on fire.

Earthquakes

Building a factory in an area of frequent and intense seismic activity is usually not recommendable; if nevertheless desirable, measures may be taken to avoid or limit the damage in case of such activities. There are many web sites showing where earthquakes are likely and their typical intensity, frequency and severity (e.g., <http://earthquake.usgs.gov/earthquakes/>).

Crime rate

In some areas the crime rate is high and a factory or its employees could become a target for (professional) criminals. It is important to gather information about the crime rate with local authorities as well as through other sources. The information should also provide information about the type of crimes and any violence involved.

Insurance

If the risks are high, so will be the insurance costs and it may be that insurance companies are not prepared to cover all types of risks. It is recommended to ask insurance companies for quotations before deciding on a factory site, unless it is certain that the company can easily cover any eventuality with respect to security, as some very large companies do.

2.9 Access

Access to the factory is essential, because employees, suppliers and distributors must be able to reach the factory in a reliable way without losing an unacceptable amount of time. If vehicles are delayed for hours every time to try to reach the factory, it means that more vehicles and drivers are needed, so transport costs rise. The company should make certain that the required infrastructure exists or will exist before production starts.

Roads, railways, waterways, airports

In the vast majority of cases, the desired access is by roads only. In some cases, however, it may be desir-

able to also have railway connections. The track may actually extend to within the factory site, depending on whether there is a need for bulk raw materials to be transported from distant areas. A third option can be access by waterways, either by using a nearby harbour or in some cases by having a harbour on the factory site itself, if the site borders a canal, river or bay. For companies with frequent visitors from faraway places, a nearby airport may be desirable.

2.10 Climate

The climate may affect a food factory in several ways. A warm and humid climate, for instance, is associated with larger concentrations of insects, insect predators and in turn also their predators. None of these should be present in the factory and the more of them there are around, the more difficult it is to keep them out. Flying insects and birds are difficult to control and so are certain crawling animals.

Sunshine

Sunshine may be nice for employees who need to work outside, but sunshine also has a heating effect. If departments or stores have to be kept at low temperatures, intense, full-day sunshine may make this costly. It may be necessary to have no windows or investigate options to control the intensity of the light passing through the windows.

Precipitation

In areas of heavy precipitation, there may be a need for extra measures to ensure that materials remain dry and in extreme cases those windows are resistant to hail. Also, roofs may have to be reinforced to deal with heavy snowfall.

Wind

Finally, with respect to the climate it does not need explanation that the risk of heavy storms and tornados should be taken into account.

3. Conclusions

It may be surprising how many aspects can play a role in the selection of a proper site for a new food factory and the list of factors covered in this chapter may even seem exaggerated. Every year, however, companies go bankrupt because they are not located on a suitable site and a disaster occurs that could have been predicted by people with experience.

Acknowledgment

This article is a shortened version of a chapter © Woodhead Publishing and will be published in the third book on hygiene in food manufacture, produced in cooperation with members of EHEDG, titled "Hygienic design of food factories", edited by two members of the Executive Committee of EHEDG.

See for details: <http://www.woodheadpublishing.com/en/book.aspx?bookID=1572>. Accessed June 2011.

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Additional Literature

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