INTERPRETATION FOR SCIENCE MUSEUM SPACE: A CASE STUDY OF THE NATIONAL SCIENCE MUSEUM, PATUMTHANI, THAILAND

By
Charnkla Leerakul

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree
DOCTOR OF PHILOSOPHY
Program of Architectural Heritage Management and Tourism
(International Program)
Graduate School
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The Graduate School, Silpakorn University has approved and accredited the Thesis title of “Interpretation for Science Museum Space: a Case Study of the National Science Museum, Patumthani, Thailand.” submitted by Mr.Charnkla Leerakul as a partial fulfillment of the requirements for the degree of Doctor of Philosophy in Architectural Heritage Management and Tourism.

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A science museum has specific functions different from other kinds of buildings. Its architecture, interiors and exhibitions are unique. Museum space follows function and its interior space should respond to and go well with its exhibitions. In addition, the exhibitions, presentations and displays should be interesting and interactive. The architecture should communicate scientific feeling and thought to the visitors. The purpose of this dissertation is to find interpretation guidelines for a science museum and appropriate methods of communicating with visitors via the museum's exhibits, interiors and exterior.

This research reviews museum theory, interpretation and spatial communication as a theoretical framework. The dissertation also focuses on the National Science Museum (NSM), Patumthani, as the sample case study. The necessary data are on museum architecture, interiors and exhibition design. Policy, urban context and nationality are significant issues in this study. The observations and interviews of both visitors and museum officers and questionnaire provide the empirical data, to be integrated with the documentary research. The overseas science museums brought to compare with the NSM are the National Science Museum, Tokyo, and National Museum of Science and Industry, Paris. The researcher focuses on three issues: 1. Site location and urban condition, 2. Buildings, surroundings, and architectural interpretation, and 3. Museum interiors, activities and exhibitions.

The findings suggest that the three National Science Museums have similarities and differences according to their site locations, interior spatiality and exhibitions, and in their architecture, which are iconic of museums. Government policy, history and urban context are the variables for this study. They affect each science museum's interpretations. The solutions are guidelines for science museum design and, more generally, for other kinds of museums.

Student's signature……
Thesis Advisor's signature …….....

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Chapter 1

Introduction

Statement and significance of the problem

Museums are always discussed as a particular set of characteristic attributes of buildings, and especially in terms of interiors or spatial organization. Some museum buildings are designed for specific collections. Others are adapted to buildings which previously had quite different functions. Many collections are housed in former royal palaces or churches, or in defunct train stations, or in other kinds of buildings which no longer serve their original purposes. Many, however, were designed from the start to serve as, for example, a discovery museum, an art museum, a national museum or a science museum.

Different buildings, for many reasons, have different kinds of spaces. This research addresses some of the problems associated with and inherent in museum architecture - particularly with a science museum - problems relating to interiors, exhibitions and displays, interpretation, and the use of space.

Figure 1 *Different buildings bring to different kinds of spaces*
Sources: *www.guggenhien.com*

The way interior spaces are designed in a museum provides information, reflects concepts and is expressive in many ways. Because space is a medium, its use and function requires interpretation. As in a home or dwelling, the interiors of a museum express the notions of the owners and designers. The exhibitions, for better or worse, can express all kinds of meanings and communicate unexpected ideas to visitors.

Generally speaking, museums in Thailand lack innovative management. Interpretation is not very imaginative, and communication with visitors is often either extremely formal, or awkward and lacking in expertise. Museums sometimes give the impression of being neglected storage facilities for collections of ancient miscellany. The old museums lack interesting themes or presentation stories for visitors. As a result, Thai people are accustomed to regarding them as dusty, dark and boring warehouses for irrelevant objects. This completely misses the contemporary spirit and exciting possibilities for museums nowadays.

Museums in modern times have undergone many important changes. Their role has changed from an emphasis on collecting and preserving (storage services) to a different, but equally important educational role, a kind of limitless learning source related with life in every dimension. A modern Thai institution such as the National Science Museum (NSM) in Patumthani strives to offer knowledge with aesthetic quality and value in a lively, entertaining way.

Whether in their architectural design or in their exhibitions, or both, science museums must be sufficiently interesting to stimulate public support. Of great importance has been the elaboration of exhibition techniques. Displays now reflect the methods used at the great international expositions or similar national events. Among the considerable variety of media used, space is a very important one for museums. Although space can be very expensive to utilize effectively, it can provide us with experiences and ideas which other media cannot.

The NSM in Patumthani, offering many useful learning activities for visitors, reflects a movement with many exciting aspects and new dimensions for museums in Thailand. Other museums, as well, are exploring ways to reach out and impress local people. Networks begin to form among government agencies, the private sector and local communities. There are more opportunities for museum volunteers and for youth training. The museum becomes a more active player in stimulating and supporting social development.

A recent ranking survey (Jarujin Nabhittabhata, 2002) has shown that, in terms of progress in science and technology, Thailand is near the bottom among countries in the world and in Asia. The Thai government urgently needs to strengthen the emphasis on knowledge of science and technology in the national development plan for human resources. New educational development plans should emphasize reason and thinking processes rather than rote memorization. What we really need are life-long learning centers in science and technology for our people. This will be one of the most important tasks for the government, to see to it that this idea will become a reality in the near future. Museums are one of these learning centers. There are 300 or more museums in Thailand. Out of this number, about 240 are operated by the government. The challenging question is how to improve and upgrade these museums to international levels, and how to promote them as popular destinations for learning and recreation. It will be the challenge of museum management teams to come up with viable solutions. Museums of tomorrow should meet the following criteria:

- Be lifelong learning centers for students and for the general public. Museums offer special exhibitions and activities to support school curricula. For the public, museums attract visitors with edutainment activities.
- Act as career development centers which provide up-to-date information.
- Be recreation centers for local and foreign visitors.
- Promote Inter-museum cooperation for reference collections to expand use and minimize costs.
- Place greater emphasis on exhibitions.
- Utilize communication technology as much as possible to improve the quality of exhibits, leading eventually to virtual reality museums in the future.
- Provide exhibits with simple, easy to understand story lines which clarify the functioning of complex systems.
- Use aggressive promotion strategies to bring visitors to museums. Popularity evaluations are essential.

museums for tomorrow must be revolutionized in such a way that they utilize modern technology to the fullest. The museum will not only be an educational center but also an entertainment center which promotes edutainment.

The objective of the research will be to analyze, illustrate, and review the operations and interpretative approaches of the NSM, both internally and compared with various science museums abroad. Interpretative guidelines are useful for the design of a science museum. All such institutions seek to become better known, more prestigious, and more useful sources of knowledge to the general public. *The problem for this study is to gain better comprehension and a clearer interpretation of the NSM's interior space and of their exhibitions in the context of the museum's architectural design. The study also aims to make some analyses of the NSM as it relates with Thai government policy, to see how new concepts about the museum's function occur.*

Purpose of investigation and research question

Thai museums can gain from comparisons with similar institutions aboard and from observing and learning from past practices. This includes the technology used to educate visitors. Even so, management continues to be complicated, as are marketing, maintenance and service practices. Activities are needed that will persuade people to come to the museum, but Thailand lacks specialists and technicians in the various fields needed to help the museum bring new ideas and plans to reality.

In Europe, including France and Italy, we find visitors from aboard coming especially to see the art and culture offered in museums. These cultural pilgrims bring substantial income to the countries they visit. Thailand's Tourism Authority should take more active interest in this issue.

One of the most important problems of museum buildings is that reception areas are often not spacious enough for visitors arriving in groups, such as students or tourists. Architects need to plan for multi-purpose reception areas which can also accommodate other activities like temporary exhibitions.

Another very important problem is posed by the variety in age, ethnicity, religion, gender and education of museum visitors. The question of how every visitor can be provided with an understandable tour of the National Science Museum is the primary concern of this dissertation. A pilot survey has identified some problem areas in the National Science Museum, as follows:

a). Spatial communication in exhibitions is difficult for most Thai visitors to interpret. With the exception of the 6th floor, which is devoted to presentations on local technology, exhibitions and presentations do not seem to be comprehensively

relevant to Thai visitors. The museum's exhibitions and spaces fail to communicate as they should.

b). The large scale of the architecture and very large spaces of the museum should be managed in ways which help visitors comfortably understand the contents of the exhibits ahead. At present, the exhibits, including titles and details, tend to lack coherence. While exhibits in different sections on different floors should be clearly differentiated, exhibits on the same floor should be well connected. The varying subjects do not yet achieve a satisfying rationale with a sense of unity and order among the diverse exhibits.

c). Others branches of scientific research, botany for example, are not covered in the exhibits.

In light of these problems, the researcher illustrates and summarizes the research questions for this dissertation under the following headings:

1. ***What is the official policy of Thailand's National Science Museum?*** In other words, what is the present policy, what are the objectives of that policy, and what is the purpose of the National Science Museum Foundation? How do this policy and its objectives transform into themes, displays or exhibitions in the National Science Museum?

2. ***How does the National Science Museum fit in that policy?*** This may not be explicitly stated. Therefore, it may be necessary for the researcher to check what has the NSM done so far to follow the policy?

3. ***How does the National Science Museum fit into the Bangkok Metropolitan Area's regional planning?*** (and that for Thailand generally)? Why has the museum been placed on the outskirts of the city rather than in central Bangkok? Presumably, its location is related to the concept of the 'Technopolis' (Technothani). The Technopolis, of course, is going to have to compete with similar developments elsewhere. How does the museum's location and planning fit this objective? There is also a question of balancing the need to create an "image" for the Technopolis against the need to provide a readily accessible resource for children's education. In other words, the choice of location is necessarily a complex one.

4. ***What are the exhibits in the National Science Museum trying to represent or say?*** The exhibits, displays and experiences offered by the NSM must be understood in light of the above-mentioned, competing objectives. The researcher will present a critical description, with particular regard to *spatial representations,* of the museum's explicit and implicit objectives.

5. ***How are the exhibits used or enjoyed in practice?*** What are the actual *spatial practices*? The answer to this question will be based on actual observations of how people of various age groups move through the museum, what they look at, where they pause, and what they say, etc.

6. ***What are the disjunctions between spatial representations and spatial practices in the NSM?*** Are the museum and its exhibits functioning as they were intended to function?

7. ***What assessment can be made of the success or otherwise of the National Science Museum in the light of national science policy?*** This brings the dissertation back to the original questions posed in items 1 and 2.

After the presentation of the results of data analysis, these seven research questions will be discussed directly in Chapter 7.

Objectives

In this study, the researcher will seek to identify guidelines appropriate to the NSM in interpretation and in the use of space, in its interiors, its exhibitions and its presentations. In this process, new conceptual guidelines for museum design occur. This dissertation includes a comparative study of science museums, both Eastern and Western, their interpretations, their strengths and weaknesses in terms of the use of space, and their interiors, exhibitions and displays. The solutions proposed in this research may be broadly applicable to other museums.

The research objectives for this study can be summarized under the following headings:

1. To study the NSM and its historical background, policy, objectives and purpose, all of which are relevant to government policy and to the expression of that policy in the museum's interior spaces and exhibitions.

2. To construct a theoretical framework concerning museums, interpretation and space, as they pertain to display and spatial representation in the NSM.

3. To design research methods and plans, and to make use of the most suitable research tools to obtain a necessary sampling.

4. To study the relevant contexts of the NSM which affect the museum's space, exhibitions and presentations. The three major categories in this part are museum policy, national identity and urban sociology.

5. To compare the relevant institutions, Western and Eastern, in order to identify useful interpretative notions for museums generally, and for the spaces of science museums in particular.

6. To analyze and discuss the research results in order to identify appropriate new solutions.

7. To outline solutions useful to other science museums and to other public museums, generally. In addition, the researcher offers these solutions as further knowledge to broaden the field of museum studies.

Scope of the study

The focus of this research is the National Science Museum in Patumthani, Thailand. Other science museums abroad also figure in the discussion. Data were obtained from field studies, from the internet, from texts and from various other sources. Documentary evidence, empirical evidence, theoretical justification, and analysis from relevant literature form the framework and foundations of this dissertation. The scope of the data is generally as follows:

1. Only science museums were selected as case studies for this research. In Thailand, the researcher focuses on the National Science Museum (NSM). Some of the field study includes museums abroad visited by the researcher.

2. The researcher will conduct field studies in Thailand's National Science Museum using direct observation, questionnaires and interviews.

3. Other science centers / activities in Bangkok possibly relevant to this research could include the Science Center for Education, the Bangkok Planetarium, the Children's Discovery Museum, and the National Science Week Exposition.

4. In this dissertation, 'museum' refers to museum interiors, exhibitions, spaces or interpretations.

5. This study closely examines the policy of Thailand's National Science Museum and the relevant Thai sense of national identity, the *Technopolis* issue as it applies to Bangkok, and the characteristic urban or social contexts that affect the NSM. These contexts influence the museum's exhibition and marketing profiles.

Methodology

This is a *qualitative research* using the methodology of *documentary research* as the preliminary preparation. The researcher has gathered information from documents and relevant literature and presents an overview in the section

reviewing the literature. Most of the documents used are from libraries and government sources.

Having selected the National Science Museum in Patumthani, Thailand, as the central case study, the researcher undertook *field studies* to observe, question and interview museum users, as follows:

1. Populations and samplings were selected on site at the NSM. Both on weekdays and weekends, the study sampled children and adult visitors, curators, and directors of the museum itself.

2. The tools used to gather data included *observations, questionnaires*, and *interviews*. These tools were tested and pre-tested before use.

3. The collected data are subjected to processes of *deduction and induction*. Induction is the logical process which depends on experience gained in empirical studies. Deductive logic is applied via the interpretation theories which describe the contents of the National Science Museum.

4. The results of the analysis are characterized as general data, contexts, museum interpretation, and discussion of the research questions. This chapter presents only a brief outline of the methodology used. More details of methodology and means to seeking solutions are presented in Chapter 3.

Process of the study

1. For this study, the researcher made a broad overview of critical reviews in journals, relevant websites from the internet, university libraries, etc.

2. Related documentary research and primary sources were collected and evaluated for accuracy. Where primary data was unavailable, the researcher uses secondary documents or the expressed opinions of experts. The directors and curators of the NSM were surveyed, observed, and interviewed to ascertain their impressions as to where these museums fit into broader government policies. This set of information must, in turn, be assessed and interpreted.

3. Urban issues related to the museum under the *Technopolis* idea also come under consideration. How does the museum's location and planning fit such objectives? The NSM is compared with other museums located in central Bangkok, and with museums in other large cities in terms of marketing success.

4. The site of the museum is considered in light of the data collected. Site measurements were taken as well as photos needed to complete the research. The researcher made a fair number of visits to the museum at various times, for example,

on school days, weekends and holidays, in order to observe visiting school and family groups

5. The researcher developed methods of systematically recording observations with a digital camera and multiple copies of maps.

6. The collected data were classified for use as an outline with which to study the museum and interpretation theories.

7. Data were collected from interviews and experts.

8. The data are analyzed and commented upon in terms of architectural criteria, etc., relating this back to the objectives of the museum.

9. The results of the study are presented in the final chapters where the research questions are discussed, and conclusions are drawn.

10. The applicability of the assessment to other museums in Thailand is considered and the broader significance of the research suggested. The policy of the NSM requires broader consideration, with respect to the physical planning of the Bangkok Metropolitan Area and educational practices in Thailand. Some useful observations on these related issues emerge, and recommendations are offered for further research possibilities.

Conceptualization

To sum up, the key concept of this dissertation is its search, in context, for a better understanding and clearer interpretation of the interiors, exhibitions, and architectural design of the NSM. It also aims to study the relation between the NSM and Thai government policy. In making these investigations, new concepts and new museum models occur. This contributes an encouraging sense of constructive purpose to the study and collection of data.

This chapter provides a general overview of the proposal. The priority processes are described as they unfold throughout, up to the conclusion of the study. When new museums and centers are opened in the provinces, this dissertation should be a useful source of relevant Interpretation guidelines. The discussions of spatial media, exhibition techniques and architectural interiors should also be helpful, not only as regards the National Science Museum, but in relation to other museums, as well.

Definition

Technopolis - also dubbed Technothani - this refers to the government's policy to gather together many organizations relevant to science in a Technopolis cluster. These areas are to belong to the Ministry of Science and Technology. The clusters are composed of many buildings dedicated to science and scientific research. This includes the NSM and other museums in the area.

Chapter 2

Theory of Interpretation in Museum Design

In this chapter, the researcher brings together the discussion of museum theory, interpretations, and spatial communication in a review of the relevant literature. The theoretical bases for this chapter are then brought together as a conceptual framework for the dissertation. The contents of the chapter are organized in three main parts, as follows:

Museum theory This section discusses museum theory and definitions, historical background and the various kinds of museums. The survey of documentary evidence focuses on museum interiors, especially the interiors of science museums, as part of the theoretical basis of this dissertation.

Interpretations meanings, definitions, interpretations and their role and application in museums constitute an essential issue of this research. They must form part of any comprehensive analysis of the functioning of the interior spaces of the National Science Museum of Thailand.

Spatial communication. In this study, this refers to spaces in exhibition designs or museum interiors. The research discusses specific spaces, along with theories about media messages in space which invite interpretation. Exhibition, presentation and Interpretation, especially for science museums, are discussed in this section.

These aspects of interpretive theory work together in this study to suggest a larger conceptual framework of interpretation which can be applied to better understanding and appreciation of museum design.

Museum theory

The discussion of museum design includes issues of museum theory, meaning and definition, historical background and types of museums. The purpose of the present study is to investigate science museums in particular. This section discusses the following topics:

Meaning and definitions
Background
Types of museums
Roles of museums
Science museums

Meanings and definitions

The word *'Museum'* comes from the Latin word, '*Muse',* which refers to the nine Greek Muses, the daughters of Zeus and Mnemosyne (Goddess of Memory). Each daughter personified a creative activity: epic, lyric and love poetry; comedy, tragedy, history, choral singing, astronomy and dance.

Muse (Latin) leads to *Museum,* with the suffix -eum creating the word which means, literally, a *place of worship*! In Latin, it means 'Temple of the Muses', honoring the nine gifted daughters of Zeus. Museum denotes a central place for the arts, for seeking knowledge and for inspiration in learning. It also connotes enjoyment and cultivation without anxiety, which gives a certain poignancy to our present understanding of the word "museum" as simply a place for gathering knowledge or spending carefree leisure time.

From the *Longman Dictionary of Contemporary English* (Summer, Della et al, 1995 : p. 938), a museum is a building where important cultural or scientific objects are kept and shown to the public.

Another meaning is: a place where important things are preserved: a building or institution where objects of artistic, historical, or scientific importance and value are kept, studied, and put on display.
(www.dictionary.msn.com/find/entry.asp?search=museum.)

At present, our concept of *museum* still echoes something of the ancient Greek tradition. However, the emphasis is on collected knowledge, art and pleasure. In the time since the first public museums were opened up to the present, many kinds of museum have appeared. The significance, role and the mission in society of these various museums have differed, depending on their particular philosophy and mode of operation.

Many definitions of "museum" can be found. Some widely accepted contemporary views are presented here:

1.) The definition of the International Council of Museums or ICOM (originated by UNESCO as an information exchange center between museum administrators around the world) refers to *places or permanent organizations which are in service to the public without profit and open to the public. The role and duty of the museum is to preserve, research and collect evidence from the natural and man-made spheres for the purpose of learning, studying and entertainment.*

2.) The definition of the Museum Association of the United Kingdom mentions that “a Museum is an Institute which gathers, collects, preserves, displays and interprets a body of evidence for the utility of the public. This includes generally the museum’s basic, systematic organization and the long-term purposes of the institution. Methods of gathering and collecting are selected with the aim of capturing that which is historically significant. ‘Conservation’ is meant to preserve and keep things securely. The displays, in whole or in part, must be open to the public. Museums interpret the content of the various objects which they display. Their research must have tangible attributes, based on reliable and verifiable evidence.

3.) The definition of the American Association of Museums refers to permanently operating institutes and non-profit organizations with enduring collections, displays and exhibits. Museums, are, by definition, tax exempt, and are administered with the aim of providing useful services to the public. The role of the museum is to collect, preserve and conserve human research and to present objects from the natural and man-made spheres which are significant, both educationally and culturally, with the purpose of informing and entertaining the public. Collections for display may include items from any or all the arts, scientific objects (living and non-living things), and historical and innovative technology. This definition of ‘museum’ would therefore include zoological and botanical gardens, historical communities, historical houses, and other historic places preserved and maintained for the above-mentioned purposes.

In short, a museum is a place for gathering and collecting things which have significant cultural or scientific value. It is a place for learning and study. It disseminates knowledge, on an enduring basis, through exhibits and displays presented in an entertaining framework to a visiting public.

Background

The content of this section synthesizes information from notes, lectures and tutorial notes from the course, *265 415 Museum: Contexts and Issues*. Also included are notes from the text, *The Birth of the Museum, by* Tony Bennett (2000):

The first museum appeared in Alexandria, Egypt, around the period 323 - 200 BC. Ptolemy Philadelphus refers to it as the Museum of Alexandria. The place is described as being both 'open and enclosed.' It seems to have been the part of a palace, a hall in which evidence of ancient arts had been collected, and which included a botanical garden and a zoo, as well. There were a number of objectives behind these assembled collections. They touched upon matters of religion, medicine, geology, zoology, philosophy and art. The Museum of Alexandria was a gathering place for men of wisdom, a place where philosophers came to study and learn. It contributed to Alexandria's reputation as an official centre of learning and discussion where honor was paid to the muses and to philosophy as well.

In the Roman period, the idea of the museum was especially associated with palaces. There were paintings or displays, with lights arranged to show off the collections. The Emperor Hadrian had an outdoor museum in which he caused to be reproduced ancient art objects as well as models of famous monuments.

In Europe during the medieval period, curious objects and valuable collections were still assembled, but they took the form of accumulated treasure and collections of antiquities. These private collections often jumbled together strange-looking curiosities, treasures of kings and religious relics. In the late Medieval period and during the Renaissance, however, such hoards and treasure troves gave way, in prestige, to a new focus on the intellectual, cultural or spiritual value of collections. Beginning in Italy, the people of Western Europe started to look to their shining past as a renewed guide to the future.

Lords and patricians possessed many treasures and art objects. They had collections of curiosities of natural history. They kept exotic animals, botanic gardens, and collections of paintings and sculpture. Beginning in the period of the Renaissance, one aspect of the role of respected persons in the secular world was to act as a patron of higher learning.

In the 15th century, the word "museum" appears in Florence, Italy. The treasury of Cosimo di Medici was referred to as a "museum" in 1434. This museum listed many of the treasures of the Medicis, an important family in Florence for several

generations. Among the treasures and art objects noted were paintings and sculptures by Botticelli, Raphael, and Michelangelo.

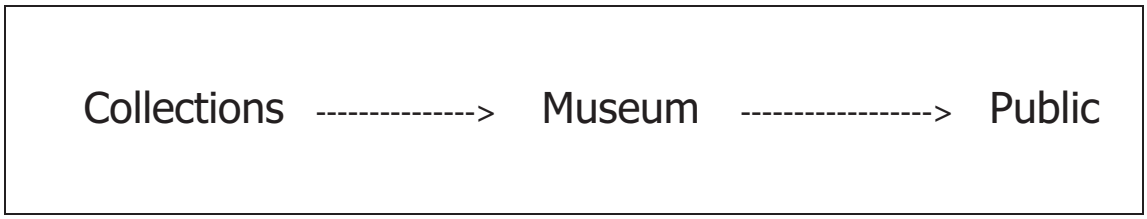


Figure 2 *Presentation of museum.*
Source*: Ajarn Aim "Museum: Contexts and issues tutorial sheets" February 16, 2004*

The family museum of the Medicis 'went public' in a sense, when artists who enjoyed their patronage were given access in order to study the fine works in the family's private collection.

In the 15th century, the start of the Humanistic movement corresponded with the period of the Renaissance in Italy. At that time, there was renewed enthusiasm for collecting antiquities. Most collectors were wealthy members of society's upper class. Demonstrating a taste for ancient art and learning was a way of showing off their family status, confirming their respected social standing. Increased demand among collectors resulted both in pilfering from ancient sites and in the production of many forgeries. Although many ancient Greek bronzes had eventually been destroyed in order to obtain the precious metal, hundreds of marble copies had been made for ancient Roman art markets. These reproductions often survived to provide some hints to the beauty of antique civilization. Although notions of beauty change through time, many models from Hellenistic Greece and ancient Rome came to signify for Europe the value of antiquity and the peak of artistic quality.

From the 15th - 16th - centuries, the concept of the museum spread to the other countries in Europe. The wealthiest benefactors in society competed with one another to gather and collect art works. These collections were called, variously, museum, gallery, closet, chamber, cabinet etc. It was a new period of enthusiasm for Greek and Roman art, emerging from the barbarian taste of the not too distant past. In the new civilization, artistic and aesthetic values were more admired than the price of the materials from which the object was made.

This was a great period of discovery and innovation in many areas. Archeology was becoming an important key in the rediscovery of the ideas and

inventions of ancient Greek and Roman civilization. At the same time, the sciences were bringing about new understanding of the world, the solar system and the cosmos. Explorers were traveling around the world, and Columbus and Vasco da Gama opened the door for later colonial systems on newly discovered continents. Although the business of museums went no further than strictly shared, private collections, collectors were already classifying their interests as in Art, Science, History, Archeology, or Anthropology. There were, as yet, no truly public museums.

The Renaissance was a period of great discovery. In time, however, collectors were no longer satisfied merely to gather more and more antique objects. A growing sense of curiosity about the natural world and human history meant that the character of collecting would also change. Social change in the 16th -17th centuries put pressure on societies to provide broader education for their populations. There was also new enthusiasm for democratic systems and the role of parliament. The nobility declined in power and wealth. Many had to sell their art collections. Ancient art works were scattered from the courts and the households of the old princes and nobles on the Continent and in England, eventually finding their way into the hands of new generations of collectors.

The private museum of John Tradescant (the father), a large house in Lambeth, London, was the first museum in England to open to the public. It housed a collection of rare and strange objects, including seeds and bulbs gathered from distant parts of the world, as well as other curiosities of natural history and ethnography. There was, in the same city on the south bank of the Thames, a botanical garden called Tradescant Park. John Tradescant (the son) eventually left his library and museum to Elias Ashmole. That collection became the core of the Ashmolean Museum in Oxford, the world's first university museum. Ashmole's gift to Oxford University in 1677 included both his collection, including antique coins, books, engravings, geological specimens, and zoological specimens, and the collection of the Tradescants. (From Wikipedia, the free encyclopedia)

The University provided a building to house these collections and opened the museum in 1683. Also included were a library and a laboratory. Such bequests encouraged the idea of public assets, i.e. that donors could contribute their resources to be preserved and presented for the use of the general public. In fact, the Ashmolean was so successful that proceeds from entrance fees alone were able to cover the museum guards' salaries.

In 1753, the British Museum was founded. It originated from a library donated to the British government by Lord Cotton. The museum, which also housed many works of Greek and Roman sculpture, put together a number of libraries and other private collections in the new building.

The notion of democracy led to profound political and social change in many countries, and came to include the business of museums, as well. As early as 1776, the Charleston Museum opened to the public in America. Democratic thinking emphasized the need to educate the population. American and French thinkers of that era were enthusiastic about better developing the abilities and intellects of ordinary people: everyone should have a chance to learn. Cultivation, good taste, artistic and aesthetic appreciation need not be the privilege only of the wealthy and powerful. The creation of museums which welcomed the public reflected the growing demand for education. Appreciation of the importance of museums was greatly encouraged by the opening in 1793 of the Louvre in Paris. Nonetheless, museums which opened in the 18th century were still in their infancy, and not prepared to offer many services to visitors.

Many museums opened in the provincial areas of France after the revolution. Archeological and historical museums were as popular as art museums. The popularity of museums spread quickly across Europe. A national nuseum was established in Germany to study history and to celebrate civilization. Museums in buildings which emulated Greek and Roman architecture were established in important cities such as Munich, Cologne, and Berlin. In the 18th century, many countries set up national museums for their national treasures and cultural preservation.

The 19th-century was the period of the Industrial Revolution. Vast expansion took place in communications and industry. These far-reaching changes were reflected in the Great Exhibition, or World's Fair, at the Crystal Palace in London in 1851. Unfortunately, the mass production made possible by industrial development had damaging effects on many kinds of English arts and crafts. Realization of the impending loss of traditional skills and values led to the creation, throughout Europe, of museums dedicated to the minor and decorative arts. In France, an international art exhibition in 1855 led to the founding of a museum dedicated to decorative art. A museum of fabric was established in Lyons, a city well known for the making of cloth. Similar movements took place in Germany.

In the latter half of the 19th-century, in the wake of revolutions and wars, much fine traditional craftsmanship would have disappeared if not for the remnants and records preserved in museums. As technology grew and developed, new museums sprang up, devoted to ethnography, ethnology and folk art. Though technological innovation took place faster than ever, trends to preserve the history of mechanical achievement also gained support. Eventually, museums of science and technology began to appear, like the Science Museum in London.

Museums are not new for Thai people. The first museum was sponsored by His Majesty, King Rama IV, in the Grand Palace.(Sunjai Poonsub, 2003: p.4-5)

The collection included a variety of objects assembled together in the so-called “Prapas Museum” and displayed for His Majesty’s visitors. The opening of a museum for the public first occured on the occasion of His Majesty, King Rama V‘s birthday in 1874. The collection was kept in the Concordia Building, which was opened to the public on His Majesty’s birthday, beginning in 1880. From that time, he supported many exhibitions and even sent his collections for display in other countries. In selecting a collection of items representative of the Siamese people to send for exhibitions abroad, the King chose things such as Bangplee rice, pickled fruit, pearl inlaid furniture and farmer‘s tools. In the period of King Rama VI, there were gatherings of antiques in the Front Palace museum. The role of exhibits changed from simply showing off collections, to attempts at suggesting history and anthropology, which is what most museum presentations generally do nowadays.

King Rama VII established the conventions for a Museum in Bangkok in 1925. He offered the use of the Pra Borworn Palace on the northern side of Rattanakosin Island to house a national Museum and a Pranakorn Library. The site has become today’s Pranakorn National Museum, and has experienced many important changes during its history. The educational revolution going on today has helped transform this museum from a big storage area and put it to better use. The museum today is regarded as a place where learning goes on ceaselessly. It reaches out to every dimension in life - knowledge, aesthetic experience, questions of value and the need for wholesome entertainment. All these have a place in Thailand’s National Science Museum (NSM).

Types of Museums

Museums were first classified into types in the 19th-century. Since then, their growth and development has continued through the modern movements of the

20th and now the 21st centuries, giving knowledge and enjoyment to the public. The field of museums has experienced breakthroughs in growth in many parts of the world, with many different ideologies and formats, and great variety in content and operating style. ICOM categorizes museums in six general categories, as follows:

1). General or Encyclopedic Museums. These are public or national museums. They offer materials in various branches of learning, including, for example, the arts, archeology, science and natural history clustered in one museum.

2). Art Museums. These museums present various kinds of art objects, including, for example, modern, minor, decorative art or applied arts.

2.1 Museums of applied or decorative art, or museums devoted to industrial arts or crafts would be likely to focus on objects which are admired as handicrafts, the works of skilled craftsmen. Such museums might show many kinds of furniture, glassware ceramics, lacquer ware, clothing etc.

2.2 Art galleries or art museums show paintings, sculpture or other examples of Fine Art. They often feature special exhibitions by famous artists, historical or modern.

2.3 Some museums specialize only in modern or contemporary art created in the 20th and 21st - centuries.

2.4 Other modern arts which might be preserved and studied in a museum would include theatre arts, movies, dance and music.

2.5 Artifacts and crafts from so-called 'primitive' societies are displayed and studied in museums devoted to anthropology or archaeology.

3). A Museum of Science and Technology would typically present some rational panorama of the evolution of human development in technical innovation and discovery, as for example, in the history of automobiles, telecommunication, industrial machinery, and in the story of various branches of science and technology. A museum of technology might be categorized quite specifically such as a Museum of Express Trains or Fire Engines or a Transport Museum, Space Museum, etc., It might be called an Industrial Museum or a Museum for the History of Science, etc.

4). Natural Science Museum. This is often referred to as a Natural History Museum. This kind of museum presents themes concerning the nature of the earth, of soil, rock, minerals, human beings, animals and vegetation. Many museums with interest in anthropology take the character of a Natural Historical Museum. Also included in this general category would be Zoological and Botanical Gardens, National Parks, Aquariums and Terrariums, etc.

5). Archeological and Historical Museums include five general types, as follows:

5.1 Historical Museums collect historical evidence on subjects in the area of politics, the military, economics and society.

5.2 Historical Houses refer to buildings which are significant in history and preserve, as much as possible, the original state of the building.

5.3 Ancient remains, monuments and cultural heritage sites which are open to the public might be called *Site Museum*s.

5.4 Historical cities are sometimes conserved as historical parks.

5.5 Museums of History and Archaeology focus on history and pre-history.

6). Museums of Ethnology and Folklore present images and interpretations of the complex spectrum of human societies and cultures.

6.1 Folk Museums gather the tools, crafts and products created by common folk at the grass roots of society. This type of museum might also be called a Regional Museum or City Museum.

6.2 Open-air museums originated in Sweden, with Skansen Park. This museum took in the villagers' houses in their own real environment.

Some texts mention other kinds of museums such as university and school museums, as well as specialized facilities such as children's discovery museum.

This research focuses on the Museum of Science and Technology, a type of museum with specific characteristics, special ways of presentation, exhibition, and interpretation. This is discussed in the next section on science museums.

Roles of museums

To achieve its objectives of informing, educating and entertaining visitors, the museum must find, preserve, research, communicate and present selected objects. The general aim of all display and presentation is education and learning, entertainment, and finally, social development. Museum have five basic roles:

1). *Collecting*. Collections grow by donation or through the explorations of the museum and its search for appropriate objects to display. Well funded and well supported museums can, themselves, find many suitable objects for exhibition or education.

2). *Identifying*, The museum's job is to categorize these objects precisely. This means recording, numbering, and dating the objects, as well as recording the

history of the identification process and how the object arrived at the museum in the first place. Some objects must be passed on to other specialists for proper investigation and identification.

3). *Recording*, Details and evidence, not only about the history of individual objects, but of the collection as a whole, must be provided.

4). *Preservation* The recorded list of objects in the museum's care must be preserved. This is the responsibility not only of the curators but also of the laboratory authorities. Preservation is a way of protecting objects against physical destruction, decay or deterioration. This could include, for example, protection against the ravages of fungus, insects, dampness or aridity.

5). *Exhibition* and *Education*, this is the last process, but it is an important one for curators. Even when museums have good collections, when they are badly arranged, incoherent, and lacking any 'design psychology', the interest of visitors will drift, and the museum will not achieve its objectives. It will fail in its primary purpose of serving the public well. To be really good, exhibitions require the brainstorming of various disciplines which will present the primary objects in an aesthetically and logically appropriate way. Artistic means and appropriate design and technology help assure that the desired communication takes place.

One of the most important missions of the museum is to serve as a reference center, where collections and information about specimens and artifacts in various fields such as the arts, culture, agriculture, industry, etc. can be studied by scholars. The collections are categorized for use by researchers. Findings will eventually be transformed into exhibits for viewing and study by the general pubic. Museums with credibility become symbols of national unity. The collections reflect the past achievements of our ancestors and inspire pride in the nation's heritage. Continuously improving their activities and services, museums typically become gathering places for intellectuals, and for the exchange of ideas which leads to the betterment of society as a whole. At present, the future looks bright for Thailand's more than 200 public and privately owned museums. With greater public interest and better support, museums will fulfill their function as centers of information for all kinds of scholars and as a place for family relaxation.

*Science museum*s

A science museum refers to nature. Whenever human interests turn to nature, they may want to know more about the human body, the physiology of

animals, the composition of plants, the great themes of the planet Earth, water, air, rain, storm, natural resources, everything which surrounds the human body. Science learning is focused on nature. It is actually concerned with very ordinary things, quite close to everyone. Humans are part of nature and must operate within it. Science museums tell stories about nature and the phenomena which shape our daily lives. They provide the visitors with reasonable and reliable explanations about all kinds of phenomena, simple and complex.

Scientific experience helps train visitors to appreciate logic and the need for systematic thought and belief. In scientific thinking, the public is encouraged to work systematically, to accept the reasonable opinions of others, and to make decisions based on facts. Scientific experience is the root of social and economic development, because scientific knowledge is the basis for applied science and technology, which is the root of industrial production. Technology also creates income, which helps the nation grow economically, becoming more secure, wealthy, and developed.

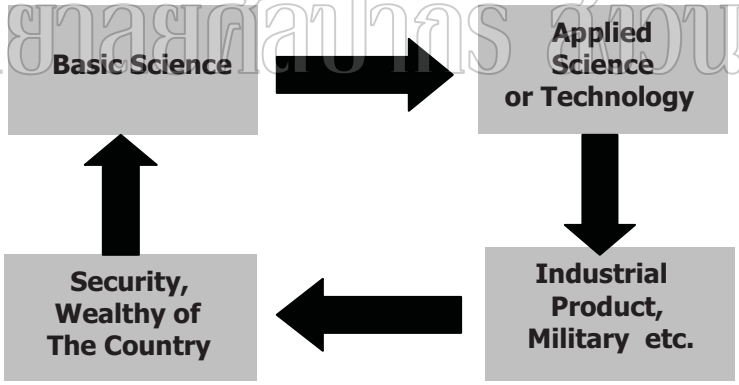


Figure 3 *The cycle of science in economic and social development*
Source: *Rungluk Labpanichayakit,1995*

Science museums attempt to raise the level of scientific knowledge among the general public, but particularly among the younger generation. This is a worthy challenge for any government. Scientific knowledge is certainly the prelude to modern society. Without it, societies languish in backward beliefs, likely to become victims of globalization. Science museums can be a useful tool by which the government can better educate and modernize the people with up-to-date scientific and technological knowledge.

Interpretations

The word 'Interpretation' has been explained in various contexts and different ways. It has also been applied in the area of museums. These various meanings need to be considered, and are discussed under the following topics:

Meanings and definitions
Background
Aims and principles of Interpretation

Meanings and definitions

What is Interpretation? The word is first used in late Middle English, derived from the Old French *interpretation* or Latin *interpretatio (n-)*, from the verb *interpretare*, which means 'explain, translate', from *interpres*, *interpret-* agent, translator, interpreter (Cd-rom i.finger Oxford Dictionary). Generally, the terms can be defined from quotations as follows:

A. From the *Oxford Talking Dictionary* (CD-ROM)

1). The action of explaining the meaning of something, spec., the proper explanation or signification of something. Formerly, also:

a). translation of a book.

b). the technique of obtaining significant information from a photograph.

2). An explanation given; a way of explaining

3). (A) stylistic representation of a creative work, dramatic role, etc. according to one's understanding of the creator's idea.

B. From the *Longman Dictionary of Contemporary English*. (Summers et al. 1995, p.745)

1). An attempt to explain the reason for an event, a result, someone's actions.

2). The way in which someone performs a play, a piece of music etc. and shows what they think and feel about it.

C. From the website (www.dictionary.msn.com/find/entry.asp? Search = interpretation)

1). Establishment of meaning : an explanation of the establishment of the meaning or significance of something.

2). Ascription of particular meaning :an ascription of particular meaning or significance to something.

3). Performance of something : the way in which an artistic work, for example, a play or piece of music, is performed so as to convey a particular understanding of the work.

4). Translation: the oral translation of what is said in one language into another, so that speakers of different languages can communicate.

D. From “Heritage and Tourism Interpretation” tutorial notes (Staiff, 2003), Interpretation in the context of tourism experience has come to mean something quite specific. There are various definitions from various writers, as follows:

1). An educational activity which aims to reveal meanings and relationships through the use of original objects, by first-hand experience, and by illustrative media, rather than simply to communicate factual information. (Tilden, 1977)

2). Interpretation is an educational activity that aims to reveal meanings about our cultural and natural resources. Through various media…. interpretation enhances our understanding, appreciation and, therefore, protection of historic sites and natural wonders. Interpretation is an informational and inspirational process.(Beck and Cable, 1998)

3). The educative role of interpretation is not simply to reinforce the familiar or provide the ‘facts’ or ‘truth’ about the past, but to provide an opportunity to encourage the questioning and critical scrutiny of both the past and present (Nixon et al, 1995)

4).The communication process which aims at helping people to discover the significance of things, places, people, events…helping people change the way they perceive themselves. (Colonial Williamsburg USDA quoted by McArthur, in Ecotourism, vol.2, 1998)

5).The process of simulating and encouraging an appreciation of our natural and cultural heritage and of communicating nature conservation ideals and practices. (Queensland National Parks and Wildlife Service quoted by McArthur, in *Ecotourism,* vol.2, 1998)

6). Interpretation is a means of communicating ideas and feelings which helps people enrich their understanding and appreciation of their world, and their role within it. (Interpretation Australia Association, 1995 quoted by McArthur, in *Ecotourism*, vol.2, 1998)

7).Interpretation…describes the process of helping people in the discovery and appreciation of their natural and cultural heritage. Effective interpretation requires the combination of information (about why the place is special), education, entertainment and inspiration. It deals in stories, ideas and experiences which explain, guide, reveal, arrange, question, share and provoke. Interpretation uses a wide range of media as is appropriate to the setting and audience needs…Properly conducted interpretation will not only enrich visitors' experience, but can help achieve other important management objectives, for example: Minimizing human impact on natural resources and facilities and promoting better public perception of management agencies and their objectives. (Australian Heritage Commission, *Successful Tourism at Heritage Places*, 2001)

8). Interpretation….include(s) any form of presentation of factual material and interpreted meaning about a site or other heritage item, whether on site or off site. Brochures, websites, media coverage, and advertising campaigns all involve interpretation...Even in the presentation of a small number of 'facts', in whatever form, interpretation is involved, as these 'facts' have been selected by someone, and presented in a chosen form, using particular words and graphics. Thus, no presentation of material is purely objective or value-free. (Aplin, 2002)

9). Interpretation is not information. It is not a visitors' centre, a sign, a brochure or the pointing out of attractions as they pop into view. It is not a slide show or role-play. These are merely techniques by which interpretation can be delivered. It goes beyond telling people the name of a plant species or the age of a building. Interpretation is a coordinated, creative and inspiring form of learning. It provides a means of discovering the many complexities of the world and our role within it. It leaves people moved, their assumptions challenged, and their interest in learning stimulated. (McArthur, in *Ecotourism*, vol.2, 1998)

E. The root word *interpres*, (cited in Edson and Dean, 1996: p.171) comes from Latin and means *a negotiator or a mediator* between two parties. It is a goal of museums to be the mediators between collections and the public.

F. According to Edson (Edson and Dean, 1996:171), interpretation is the process of making something *understandable* or of giving something a *special meaning*.

From all the quotations, we can conclude briefly that the meaning of 'interpretation' involves the translation, explanation or communication of meaning, information, news, ideas, or concepts, etc. which translators or communicators want to share. However, this word is used more specifically as terminology in the area of the museum and its architecture. For this study, the researcher is concerned with the Museum. In this context, "*Interpretation"* is understood in a straight-forward way, as presenting information to visitors by means of verbal or textual materials included in the exhibits.

Background

McArthur and Michael consider the Interpretation which occurs in the United States. The beginnings were largely stimulated by Enos Mills, who worked as a nature guide in Colorado's Rocky Mountains between 1889 and 1922. Mills developed principles and techniques which laid the foundation for interpretation. He prompted guides to concentrate on inspiring visitors by communicating big ideas rather than masses of details. He was one of the first to write about and teach interpretation, and was instrumental in getting the National Parks Service to license two interpretative guides to serve in the Rocky Mountain National Park. (Regnier et al., cited in McArthur and Michael, 1998, p.89)

Around the same time in Australia and New Zealand, most guides were recreationally focused. It was a journalist-playwright who first brought together the evolving ideas and principles in a publication specifically about interpretation. *Interpretating our Heritage* by Freeman Tilden was the first book written solely to define the profession of interpretation. His work contained two concepts central to the philosophy of interpretation: 'Interpretation is the revelation of *a larger truth* that lies behind any statement of fact', and 'Interpretation should capitalize on mere curiosity *for the enrichment of the human mind* and spirit'. (Tilden, cited in McArthur and Michael, 1998, p.89)

Techniques such as short guides and self-guided trails, outdoor displays and visitor centers became the main focus of park management interpretative programs.

Interpretation in the 1990s used principles similar to those applied in the field of advertising. Both seek to be noticed and to attract attention; both regard novelty and humor as powerful forms of communication; and both accept the demand to be frank and honest, and to 'address the whole picture'.

In the researcher's opinion, knowing the background of "Interpretation" will help the researcher understand its deeper meaning, especially in the context of the museum. The most closely related meaning to the museological use of interpretation is offering an explanation about something, or translating objects and knowledge into a "language" the visitor can understand. Interpretation can be the message which helps visitors gain more understanding. Interpretation can be an effective way of communicating with visitors, as the researcher will discuss under the next issue, *Spatial communication*, which includes fundamentals of museum design, exhibitions and Interpretation techniques.

Aims and principles of Interpretation

The fundamental aim of interpretation is to bridge the gap between form and content (Staiff, 2003). The 'form' is any material object or physical site, whether it be a rainforest, an archaeological site, an historical building, a painting or a piece of technology and so forth. The 'content' is any information that pertains to that material object or to the physical site which has been *designed* or *shaped* for a visitor's viewing or visiting. Equally, 'content' is any *information, memories or experiences* the visitor has accumulated and uses to make sense of their viewing of an object or the experience of a site. (Staiff, 2003)

The attempt to bridge the gap between 'form' and 'content' occurs whether an interpretation program is in place or not. All visitors attempt to find meaning in their experience. However, if *particular meanings* are to be communicated to the visitor, then the provision of a site-specific interpretation program is required, but it is no easy task.

The aims of interpretation have been further articulated by McArthur and Hall (Heritage Management: the Human Dimension,1996: p.88)

- To enrich the visitors' experience.

- To assist visitors to develop a keener awareness, appreciation and understanding of the place being visited.

-To accomplish management objectives through encouraging the

thoughtful use of resources by visitors (for example, the distribution of visitor pressure at a site and/or minimizing environmental impacts on a fragile site.)

- Promoting pubic understanding of related programs.

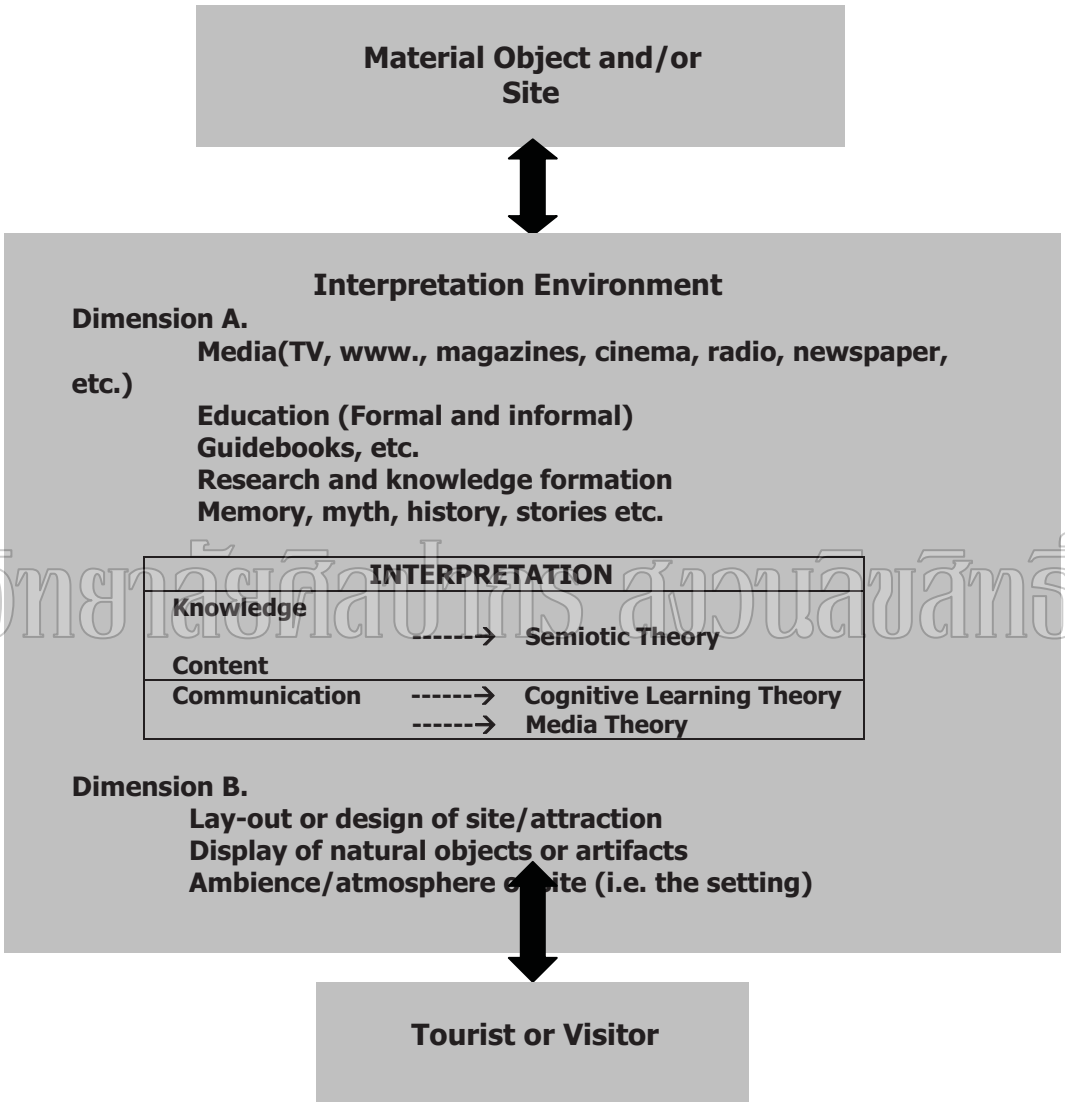


Figure 4 *A model of Interpretation*

Source: *MacCannell and Urry. adapted by Staiff .(July 2003)*

For this example, Staiff adapted a model of Interpretation as in figure 4, a diagram of an interpretation model. Referring to the diagram, the model has four inter-related parts as follows:

1). *The material object and/or site*. These include the material objects or the site that is being visited and/or viewed by the visitors. For this study, these refer to the scientific materials and objects which are exhibited or displayed in the science museum.

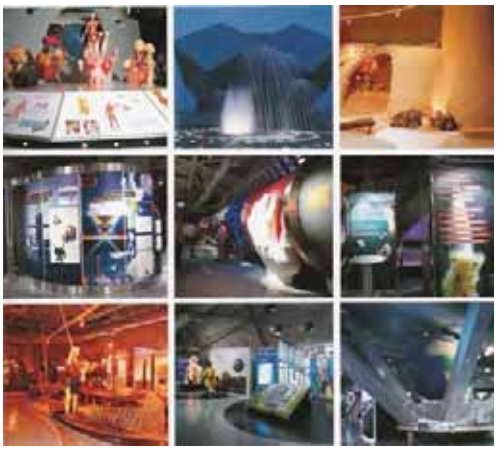


Figure 5 *National science museum material objects*

Source: *Jarujin Nabhittabhata (editor). 2002.*

2).*The interpretation environment.* The interpretation environment includes two dimensions:

a). the socio-cultural context of interpretation. This dimension encompasses all those parts of society that engender the making of meaning, and includes media, education, guidebooks, research (or knowledge formation) as well as memory, myth, history, story, and so forth.

b). the specific visual context within which an object or site is viewed or experienced by the visitor. This dimension encompasses the visual environment within which the visitor experiences the object and/or site. It includes the lay-out or the design of the attraction, ambience, atmosphere, and aesthetics of the site.

Regarding the interpretation environment as the context issue of the National Science Museum, the researcher will discuss this in three dimensions, i.e. NSM policy, Thai national identity, and urban context. These are mentioned in Chapter 4 of this dissertation.

3). *Interpretation.* Interpretation as a distinct entity, or activity, occurs within this overall environment or context. Interpretation for visitors is made up of two indivisible parts:

A). Knowledge and Content, which refer to *what* is being communicated to the visitor. The content side of the equation is informed by Semiotic Theory.

B). Communication, which refers to *how* the content is being transmitted to the visitors. Communication is informed by Cognitive Learning Theory and Media Theory.

4). *The visitor.* The fourth part of this model refers to the visitor who looks at the object or experiences the site. Formal interpretation may occur and will exist in a zone between the visitor and the object or site (in models of interpretation and communication).

The interconnecting arrows in the diagram flow both ways. If the material object (or site) has meanings attached to it, these meanings will be bestowed on the object (or site) by what happens within the interpretation environment. Object (or site) and interpretation environment have a symbiotic relationship. And the visitor is not separate from the interpretation environment, but is in fact a part of that environment by virtue of the fact that at least part of the visitor's identity and meaning-making arises within this environment. Visitors are both *producers* and *consumers* of meaning and knowledge. (Staiff 2003)

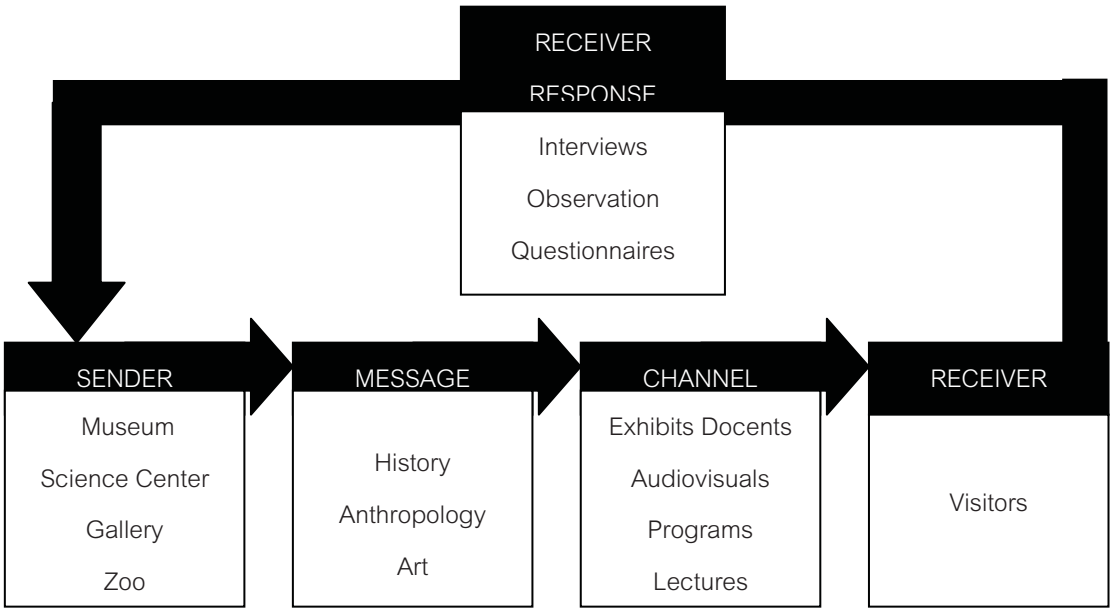


Figure 6 *Interpretation loop*

Source: *Edson and Dean, 1996*

The process of interpretation requires an understanding of the ways ideas and information are communicated (Edson and Dean, 1996: p.171-172). A classic model of the interpretive pathway is illustrated in Figure 6. As illustrated, the flow of

interpretation is from sender to receiver, and back to sender. An important aspect of the process is the way the path turns back on itself. Without this particular aspect of the process, the sender has no way of knowing whether the message has been received. The channels listed are only suggested means of communication. Many different channels may be devised.

The researcher discusses these as interpretations relevant to the museum and to visitors. Each factor supports all the others in the whole aim of interpretation.

In the *Principles of Interpretation*, by the definition of Edson and Dean, the word “interpretation” has three principal meanings. They are:

- To explain or clarify
- To translate (as from one language to another),
- To perform or present according to one’s artistic understanding (as with ‘Interpretive dance’)

In addition, Tilden defined Interpretation as ‘An educational activity which aims to reveal meanings and relationships through the use of original objects, by first-hand experience and by illustrative media, *rather than simply to communicate factual information.’* He also put the six principles of interpretation as follows:

1). Any interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile.

2). Information, as such, is not Interpretation. Interpretation is revelation based on information. All interpretation includes information, but they are entirely different things

3). Interpretation is an art, which combines many arts, whether the materials presented are scientific, historical or architectural.

4). The chief aim of interpretation is not instruction but provocation.

5). Interpretation should aim to present a whole rather than a part, and must address itself to the whole man (sic) rather than to any particular phase.

6). Interpretation addressed to children (say, up to the age of twelve) should not be a dilution of presentation to adults, but should follow a fundamentally different approach. To be at its best, it will require a separate program.

Interpreters often use the term *principles* interchangeably with *hints* or *ideas for improvement*. Uzzell (1994. cited in McArthur and Hall, 1998: p.169) also suggests that the philosophy that underlies interpretive policy and practice needs to be recognized, articulated and questioned:

- What are we trying to achieve?
- What assumptions lie behind our actions?
- What relationships are presumed by the interpretation? (It is too easy to head straight for the interpretative toy cupboard without considering the nature of our relationship to the past.)
- What assumptions underlie the different ways of presenting the past?
- What past is it? (These questions ought to be framed normatively as well.)
- What do we want our relationship to the past to be and what should it be?
- Whose past should we present?

These are not just idle musings of purely academic interest, but fundamental to the practical implementation of any project.

From this point of view, the researcher will look through the science museum project --- their objectives, policies, exhibitions and presentations, including the characteristics of the NSM visitors --- in order to ascertain whether the exhibit solution meets with policy objectives or not.

In response to such questions, Goodey (1994 cited in McArthur and Hall, 1998, p.169) offered the following principles for interpreters as follows:

- Explore the *how* and *why* as well as the *what* and *when* of any particular piece of information;
- Explore the options for an interactive and involving experience; visitors, both young and old, should be able to interact and then learn from one another;
- Have strong human-interest themes - the interpretation should focus on the fact that people are interested in people;
- Provide interpretation at different levels to reflect the interest and readiness of different visitor groups;
- Ensure interpretation is consumer-led as well as resource-led - there should be a balance between interpretation that reflects the interests and needs of the visitor and the range of messages organizations seek to communicate;
- Ensure that the visitor gains some new knowledge and is stimulated to learn more.
- Recognize that there is a limit to how much a visitor can absorb;
- Recognize how unobservant people are - visitors need guidance as to what to look at and what is significant;

- Build on pre- existing knowledge - this will ensure that the interpretation is relevant and meaningful; and

- Provide an overall experience that stimulates all of the senses.

It could said that interpretation is a communication process which aims at helping people (for this study, people means *visitors*) to discover new significance in things, places, people, and events. It helps people, through a greater understanding, to change the way they perceive themselves and their world. In the next section, the researcher will relate spatial communication to interpretation within the theoretical framework of this study.

Spatial communication

Exhibitions, showrooms, theme parks, events, and museums all aspire to present 'experience' to audiences, using space as the stage or medium. Although this 'spatial communication' (Hirano, Akiomi, 2006) is manifest in different ways, the most representative form is the exhibition. The principle of spatial communication is the 'real experience'. The audience wants to see and touch. Capturing attention via the physical senses is a method unique to spatial communication. No other medium can replicate this complete physical engagement, not even the Internet. That is why exhibitions still abound, even as the world moves into the age of broadband. Spatial communication, however, cannot simply be about assembling an audience and releasing a message. Efficiency is a key concern. Information changes rapidly nowadays and audiences have become more selective and skeptical. To compete with other media, one must recognize unique qualities and use them to advantage. This section discusses space communication, including two sub issues as follows:

- Space as the fundamental element of museum interiors.
- The use of interpretation in exhibition space.

Space as the fundamental element of museum interiors.

Space is the prime material in the designer's palette (Ching D.K. 1943: p.10) and the essential element in interior design. Space is a material substance like stone and wood, yet it is inherently formless and diffuse. Universal space has no definition. Once an element is placed in its field, however, a visual relationship is established. As other elements are introduced into the field, multiple relationships are

established between the space and the elements, as well as among the elements themselves. Space is thus formed by these relationships and those who perceive them. The geometric elements of point, line, plane, and volume can be arranged to articulate and define space. At the scale of architecture, these fundamental elements become linear columns and beams, and planar walls, floors and roofs. Interior design necessarily goes beyond the architectural definition of space in planning layout and furnishings. The designer, acutely aware of the architectural character and the interior spaces, must understand how they are formed by the building systems of structures and enclosures. With this understanding, the interior designer can effectively elect to work with, continue, or even offer a counterpoint to the essential qualities of an architectural space. Interior spaces are formed by a building's structural system and by wall and ceiling planes, a recognizable pattern of elements and relations. Each pattern has an inherent geometry which molds or carves out a volume of space to its likeness. It is useful to be able to read the figure–ground relationship between space-defining elements and the space defined. Either structure or space can define this relationship. Whichever appears to be the defining element, we should be able to perceive the other as an equal partner in the relationship.

Bill Hiller (Hiller and Leatherbarrow, 2005: p III) has stated that space can be regarded as either a container into which design is to be inserted, or a void, an area left in between. Yet, in addition to being a void form, space also refers to an entity that relates humans and things, as well as ensembles of architectural boundaries. Thus, architecture can be seen as a spatial creation that relies on the disposition of spaces and forms in response to human action. In other words, we arrive at spatiality through the manifold of material objects, as well as the presence of individuals.

For exhibitions in museum design, space is a kind of medium (Hirano, Akiomi, 2006). It must provide information and a concept which reflects the message being sent. As with other designs, it mirrors the designer's notion or the user's programming. It must communicate the meaning which curators, architects or designers want to impress upon visitors. In this study, the researcher calls the medium *space* or *space media*, *event* or *spatial communication,* which tells the use of space, its function or what it is, for example, the museum, show, theme park etc. Each space has a specific function. Without function, there is no space medium, no communication, and no interpretation.

In museum interiors, events or exhibition designs, the designers or producers must ask themselves what the exhibition interprets to the visitors, who the visitors are, and how they are to be arranged. Some preparations are necessary. Before employing space for efficient communication, it is necessary to identify its fundamental potential, for example:

1). Space can be used to deliver messages or *information*.

2). Space can be used to as a *medium* of communication.

3). Space can be used to stage and *spur activities* or to specify area use.

In museum interiors, events or exhibition designs, space helps achieve the aim or approach the solution. Spatial communication brings in information through the medium and moves toward a purposed aim. It is necessary that exhibition spaces communicate with visitors. Spatial communication also provides a cognitive domain of museum experience. Spaces provide deeper understanding which other media do not have. Other media such as texts or photographs provide information, but not 'real experience'.

Learning from television, video tape or the internet provides us with experience which is unlike working directly with an instructor where the learner shares space in *real time interaction*. In other words, the sender and receiver can actually be face to face, sharing the same space. When learning passes through a screen or video, the atmosphere is different. The television or computer screen or video cannot do real time interaction. It's like the difference between attending a live concert and watching the show on television.

The real time interaction gives a more vivid impression. Being in the same space, with the atmosphere of the sender and receiver sharing the experience, more is gained than when the learning is only one way. Museum or exhibition design is the transferred medium which passes through the air, via mass, area, or space. As they advise, "Don't just sell the steak; sell the sizzling sound and smell of its cooking!" The wonderful fragrance and the tempting sound make it hard for passers by to resist. Spatial communication differs from other media in three points, as follows:

1). *Use of Space.* If we surround visitors with space, they are not limited to looking or reading the plane in front of them. Instead, they become part of the whole space. The relationship will be more inclusive, unlike communication on the internet which spatially is unequal.

2). *Experience*. Spatial communication brings about its own distinctive experience. Even though the advertising and internet are progressive and accessible to all, they do not provide real experience with real goods.

3). *Interactive*. The metaphor is playing catch with a ball from one to another. Even more than in conversation, there must be a physical response from the receivers or visitors.

Spatial communication is efficient. It has qualifications which are not found in other media. It can grow and develop with mass media and digital media. The relationship between them is shared and joins competitively as well, since it must also extend to marketing concerns. They compete, but they have different characters. They do not replace each other, for each serves different needs. Hence, the brochure and the poster still have their use, but in their own appropriate capacity. They must not be made to compete, but should be mutually supporting. Everything in exhibition design must be fresh and lively.

The use of Interpretation in exhibition space.

Interpretation is part of the process of production and is relevant to the translation of the design in the final exhibition. This section discusses interpretation, emphasizing the exhibits in the museum. There are two sub items for this section, as follow:

- Exhibition design
- Interpretation and media in exhibitions

Exhibition design

For this topic, there are six separate, relevant issues: *the role of exhibitions, the pattern of exhibitions, exhibition planning and processes*, *lighting in exhibitions, circulation and traffic patterns, learning in exhibition*s. (Somluk Chareonpoj 2004: p.68)

*The role of exhibition*s

Exhibitions serve as a medium in museums. Exhibitions can be compared to movies based on books : the different media share subject matter and both aim to entertain. The enjoyment of the museum visit is a significant experience for the visitor.

However, academic subject matter should be presented at the same time. Exhibitions are not tutorials. They do not replace learning in the class room. The emphasis is not only on entertainment, but on integrating both the academic presentation and the enjoyment offered to visitors. Experience gained from fine exhibitions should resemble watching movies, reading good books, or passing through theme parks. The feelings that we enjoy when exiting from the theatre should resemble the feelings we get as we leave a good exhibition. The experience should be like coming out of a different world, quite unlike daily life. The dreams and imaginings of visitors should come true within the province of the exhibition spaces. This is why the role of exhibitions in museums is threefold:

1). *Object display*. The exhibition is always relevant to the object. It uses objects as the medium of presentation in exhibits. Since exhibits interpret meaning from two dimensions into the three dimensional environmental space that surrounds visitors, they interpret from the abstract to the concrete. Even though exhibits are displays, they do not stand alone. The whole picture in the exhibition includes color, atmosphere, and media that accommodate visitors.

2). *Communication*. Exhibitions are one kind of medium which interpret the museum to visitors. Communication must take place in every part of the exhibition. The exhibit should call for a response from the five senses and the feelings of visitors. With this process, the subject matter understood by the sender (museum) and by the receiver (visitor) should be the same. In other words, both should understand in the same way, with an accurate interpretation. So, it is necessary to know who are the visitors coming to the museum in order to know how to communicate with them.

3). *Learning with experience*. For the visitor, visiting the exhibition is a learning experience in space. The learning that takes place should come from the spatial media and from interaction with the museum exhibit. All that the visitor experiences comes from “feelings” and “mind” in individual perception.

Patterns of exhibitions

Exhibition patterns are categorized in three types:

A).Object-based exhibitions stress objects on display, for example in art museums. These exhibitions may focus only on the aesthetic significance of the object or the relevant background, including religious, social, cultural or historical features and values etc.

B). Demonstration-type exhibitions illustrate the occurrence of natural phenomena such as the generation of electricity, light, sound, wind, heat etc.

C). Topical exhibitions tell stories by transforming theme and content through the use of scripts, as in movies, feature articles, or stage performances. The content is abstract, requiring the use of various media in the exhibit in order to present the whole picture.

Science museums like to include experimental activities, inviting visitors to touch and feel, and to learn through media in exhibits. As visitors are invited to participate and interact with exhibits, science museums can be categorized as type B). However, attributes of all three kinds of characteristics (A, B, and C) could mix and mingle together in science museum exhibitions using various media and adapting to the learning needs of visitors.

Exhibition planning and processes.

Large budgets are invested in exhibition design, especially for permanent exhibitions. Systematic planning and design is needed to make the best of exhibition

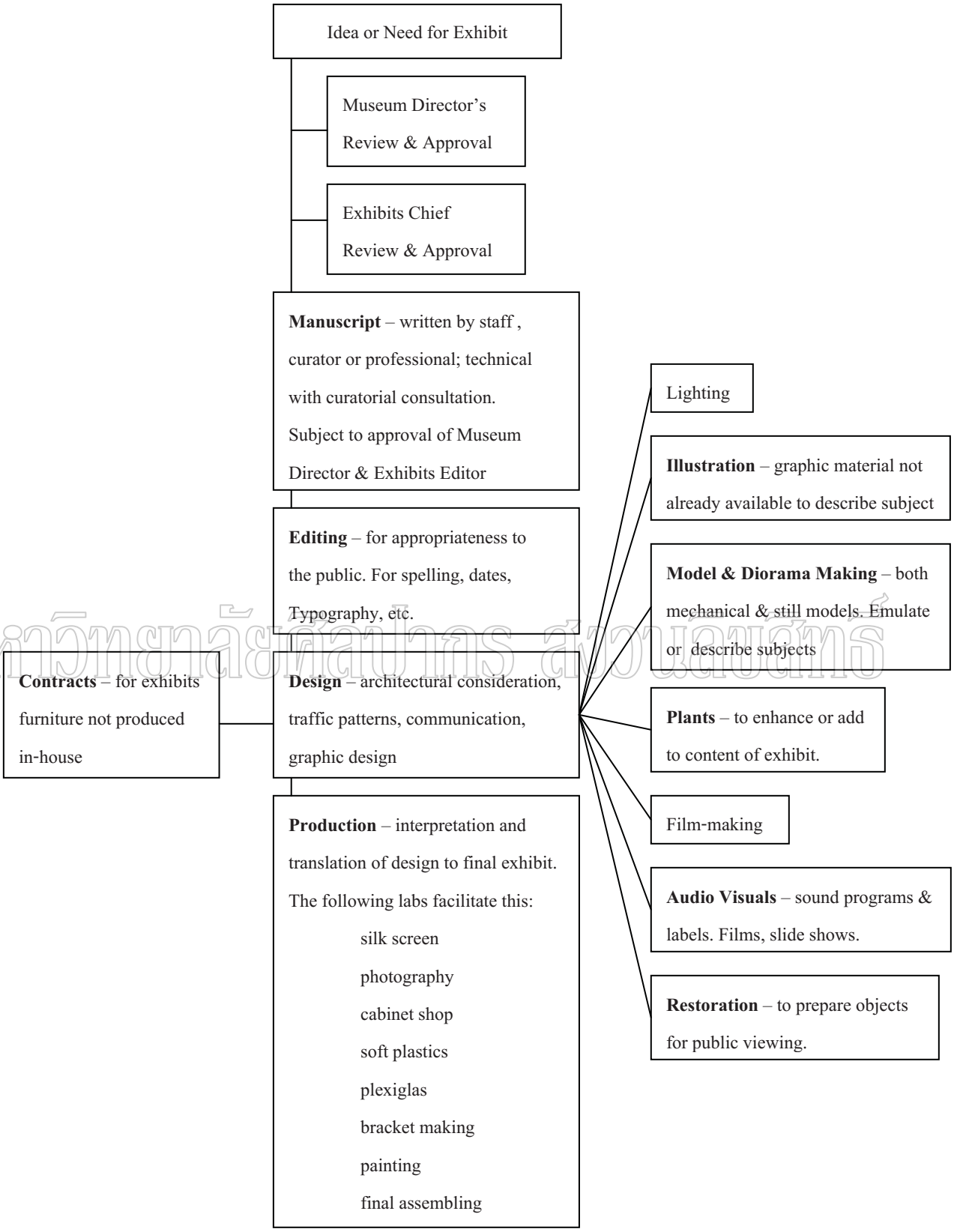


Figure 7 *The processes in exhibit making*

Source: *Smithsonian institute museums, USA.*

budgets. In the process of planning such exhibits, the Smithsonian Institution Museums organized their own system (Figure 7) (Teerasak, 2002: p.104). The diagram identifies four main priorities, as follows:

1). *Objective approval process*. An exhibit proposal must be drawn up with details of the topic, objectives, time scope, costs and budget, as well as outlining each proposal's benefits and merits.

2). *Exhibition guideline*s. These are found in *manuscripts and editing*, in documentary preparation, and in arrangements which process as follows:

a). Size and quantity of the exhibition object.

b). Script and narrative, including exhibit labels and sub topics. In this process, it is necessary to proofread and check content and spelling, etc. Everything must be accurate, complete, and perfect.

3). *Graphics and design*. In this process, these are manipulated by artists, designers and architects working together in the exhibition space to establish color scheme, lighting and graphics, with the following details:

a). Scripts are determined by curators so they will be understandable for visitors and relevant to the objectives of exhibits. Curators and designers work together in this process

b). Graphics and designs should show an understanding of the needs and responses of visitors. Museum curators and designers should know what visitors want, what kind of atmosphere is appropriate, and how many visitors will be using the space.

c).Composition of exhibit spaces and graphics, color schemes and illustrations, exhibit labels, topics and sub topics, and lettering are composed under the supervision of curators.

4). *Building and installation*. Exhibition brochures, or manuals may expand or complete the exhibition.

These four items are part of the planning and process. They help museum curators, designers and architects to develop the exhibition space more easily and systematically.

*Lighting in exhibition*s.

Lighting is one significant element in exhibition space and atmosphere, and in the visitor's interactive experience. Lighting brings exhibit objects to life, illuminating labels, narratives, pathways, emergency exits and practical spaces

generally. Lighting must take into consideration the heat generated in natural and artificial lighting. Planners must avoid and decrease the ultraviolet problem, which tends to cause exhibit objects to degenerate. Lighting is considered in two general categories:

1). *Natural Light* comes directly or is reflected from the sun and from the natural environment. Natural light can illuminate exhibition objects, which is an energy-efficient solution. However, natural light is variable and unpredictable, changing with the time of day and the season. The heat and ultraviolet rays of natural light can also damage exhibition objects.

2). *Artificial Light*, which comes in many kinds, colors and intensities, is created by lamps and by a variety of man-made devices. Interior lighting is a well-developed field which offers many options and creative possibilities to planners. To create an atmosphere, lighting responds to the requirements of each exhibition, the types of lamp appropriate, and the object being emphasized. Artificial lighting must take into consideration the creation or avoidance of heat. There are three types of artificial light for exhibition use:

a). Fluorescent. This kind of lighting is generally diffuse and covers a wide area. It is similar to natural light. Fluorescent light can be cool white or warm white.

b). Tungsten Halogen. This type of lighting can fill space with a flood of light or pierce it with a spot light, either in a cool or warm tone. Some luminance is carefully controlled by using lamps and equipment.

c). Fiber Optic. This type creates neither heat nor ultraviolet impact. It is well suited for use in exhibitions in wired lamps, etc. Fiber Optic lighting can work generally or in spot lights. Though it tends to be expensive and has some intrinsic limitations, this kind of lighting causes less object degeneration.

The art of using light in exhibitions follows various theories which have long been used in museum interiors. Lighting is one of the most significant elements affecting exhibition design. In science museums, lighting should be interactive with visitors, while remaining contingent upon the objective of each part and context of the exhibition.

Circulation and traffic patterns.

The visitors' path way provides a starting point. Visitors' journeys are marked through the museum, and where they complete their visit is an ending point.

These points impact the objectives, processes and planning of all the varied exhibits. They can be categorized as follows:

1). Direct Planning. This is a fixed pathway for visitors, moving them from one priority to another, until the end point is reached.

2). Open Planning. This type of plan is open to visitors, allowing them to grasp the whole of the exhibition space, as in an art museum. This plan makes it difficult to insist upon the continuity of the exhibits.

3). Redial Planning. This type of organization provides an entry point and an exit in the same space. Visitors circulate inside and out. It is easy to identify the serial content and to focus on interesting points in exhibits.

4). Random Planning. The pathway in this approach is not fixed. The grouping of individual exhibits and spaces is unique. Visitors need not visit priority exhibits, since the organization is random. Visitors can search for and explore the things in which they are interested, and do the integration of the whole from the parts by themselves.

For science museums, the use of circulation and traffic depends on each part of the exhibition and its contents. Various methods may be integrated together in a single exhibition, depending on the exhibit and the museum context, etc.

Interpretation and media in exhibitions

Media or interpretation in exhibitions goes on as museums tell stories, carry out themes, explain contents or events, and complete their presentations. The use of media shows how effective the museum is in interpreting and translating the content and subject matter of the exhibition to visitors. Kinds of media differ. Their application depends on exhibition contents, contexts and how these displays interact with various visitors. These media include: (Teerasak , 2002: p.72)

The objects or artifacts interpreted in the exhibition or the emphasis given the content. Some exhibited objects are significant. By themselves, they are capable of arousing the interest of visitors. In other cases, the story being told takes precedence. Then, the object becomes meaningful in the exhibition, but is not of great value, beauty or intrigue in and of itself, alone.

Figure 8 *The objects on 2nd floor of NSM*
Source: *Jarujin Nabhittabhata (editor). 2002.*

Narrative can transform exhibition contents through the use of description which appears in the partitions or the various signs and notations in the exhibit. These could serve to illustrate, explain details, tell stories, show topics or interpret the significance of subject matter. The contents of the exhibit are considered before the narrative is drawn, i.e. what the story is, and who achieved it. The story must be told in an interesting and impressive way. In addition, it is necessary to settle the mood and feeling when telling a story, i.e. will it take an academic tone, or will it be a friendly teaching, or a story from the experience of the interpreter.

A fine narrative in the form of story-telling is like a conversation between the museum and the visitors. The narrative does not only explain through academic description or by detailing the object. The story in the exhibition becomes like a composition in writing, like a short story, or a play. It is about happiness, sadness, excitement or disappointment Such narratives explain, direct, ask questions or provoke the visitors' interest to remain connected till the end of the tale. Narratives should be short, clear and concise in order to be understood in a short time. The narrative may consist of pictures, display objects for a visitor's touch in the form of turning or moving a label or other kinds of media which invite participation.

Narrative is verbal information. The most obvious approach to providing understanding by museum visitors is to present information by means of the verbal material included with the exhibit.

Title
Subtitle or subheading
Introductory text
Group text
Individual labels
Collateral materials

Figure 9 *Level of verbal information*
Source: *Edson, Gary and Dean, David. The Handbook for Museums. P.186*

1). *Titles*, *subtitles or sub headings* in displays serve visitors by facilitating a clear and connected picture of the meaning of the whole exhibit and its parts, what the exhibit is about. The words used should be short, clear, concise, meaningful and easy to remember. The appropriate length of these visible notes is between one and seven words.

Figure 10 *Exhibit title, 5th floor, NSM*
Source: *Jarujin Nabhittabhata (editor). 2002.*

Figure 11 *Introductory text of 3rd floor, NSM.*
Source: *Jarujin Nabhittabhata (editor). 2002.*

2). The purpose of the *introductory text* is to guide the visitors to the start-up information i.e. what the agenda is, what the significance is and what the sequence of the story will be. For example, the relevance of the main topic headings and sub topics in the exhibition is to offer a guideline for visitors as to what they will see next, or what they will find inside the exhibition. These guide-words may bring up the issue of relevance to the visitors, how the contents affect visitors, arousing their interest. Not only in the beginning of the exhibition, but also in the sub parts of the displays, introductions - consisting of from 20 to 300 words - are needed.

3). *Group texts* are narratives which address details in each part of an exhibition. They consist of topics, introductions and short narratives relevant to the objects presented. These group texts - of from 20 to 150 words - share the narrative purpose.

4). *Individual labels* help in the story telling about objects, models or situations and events. They interpret to visitors the significance of an object and how pertinent it is to the exhibit's contents. Whenever visitors are intrigued with an object, with materials or with the situation, they will try to learn a bit more about it. The information they seek must be within their reach, in a heading or short description of between 20 and 150 words. If a specific object is described, the statement must be short, concise and comprehensive - not more than 50 words - so that visitors can read the note within 10 seconds. The lettering must be easy to read and big enough for children and the elderly to grasp comfortably. Labels, headings and descriptions like this should be visible to someone looking at the exhibit from a wheel chair. Lighting is important in this case so that shadows to not obscure the view.

Figure 12 *Group text at 4th floor, NSM.*
Source: *Jarujin Nabhittabhata (editor). 2002.*

Figure 13 *Individual labels at 2nd floor, NSM*
Source: *Jarujin Nabhittabhata (editor). 2002.*

5). *Collateral material*s, such as vinyl stickers and silk screening, etc., enlarge the picture, like lettering on film (called “duratrans”) framed, with lighting behind. This is appropriate for exhibition spaces that cannot be lit from the front of the object, as with under-water world museums.

Figure 14 *Collateral material at science week exhibition Muang Thong Thani, Bangkok*
Source: *The researcher*

Three-dimensional or scale models simulate parts of situations, landscapes or land forms, architecture, people, objects, and materials. Models can replicate, enlarge or decrease, proportionately to scale, with three dimensional attributes. Such representations help visitors to understand with little or no narration. Models are of two main kinds:

- Diminished models transform themes, stories, events, buildings, architecture, and details of sections into a reduced scale. This allows one to see more of the larger picture relevant to the content, when the real thing may too large to show in any museum space, or when the thing could not be seen with all its covering or atmosphere intact. Moreover, diminished models can show more visibly whole objects existing in space, depending on the position of the subject depicted.

- Enlarged models show details more clearly. Such models are useful with small items which are tiny or invisible under normal human circumstances. Enlarging something to bigger than life-size enables one to see details of very small things, for example, molecules.

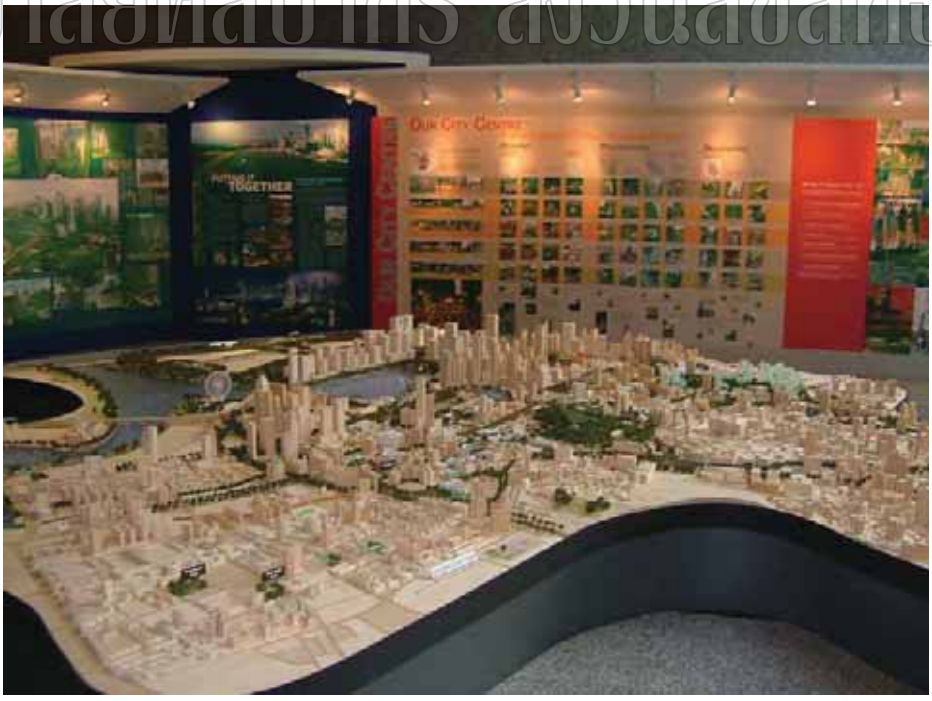


Figure 15 *Diminished model of buildings in URA gallery, Singapore*

Source: *The researcher*

Figure 16 *Enlarged model of King Rama IX 's written book,*
Source: *Exhibition of the sixtieth anniversary celebrations of His Majesty's Accession to the Throne at Muang Thong Thani, Bangkok, Thailand.*

Replicas reduce objects or materials to represent real objects which cannot normally be displayed in size and character. Sometimes, there are no materials, or the existing materials cannot be used because of the great expense and difficulty in finding them. In other words, the real objects cannot be put forward in the exhibit's activities, though we still want to use them to communicate with visitors in a palpable way.

A life-size figure can be used as a medium to show the features, attributes and action supporting the exhibition contents. The object may be used with or without a background screen. Models need not be extremely detailed; all depends on the application. Some details may be eliminated or presented in two dimensions, although the silhouette of the object, at that point, must still communicate what it is.

Figure 17 *Replica featuring an anthill*
Source: *Insect division, Natural and environment, Science Center for Education, Bangkok*

Figure 18 *Life - sized figure of ocean diver*

Source: *Life on earth pavilion, Science Week exhibition, Muang Thong Thani, Bangkok.*

Dioramas are models with realistic attributes in life size (1:1). These show the environment of humans or animals presented as if in their characteristic surroundings. A screen may present a perspective view which gives an illusion of depth and distance. Most dioramas, however, tend to display closed environments, often within a display area seen only from a front view; or, there may be no glass between the models and the visitors. This type is usually used in natural history museums. So-called *mini dioramas* have a similar format, but in much smaller size.

Figure 19 *Diorama technique*

Source: *Tourist information center, Ayuthaya*

Figure 20 *Recreation of Provincial Thailand*

Source: *Exhibition of the sixtieth anniversary celebrations of His Majesty's accession to the throne, Muang Thong Thani, Bangkok, Thailand*

Setting in a realistic atmosphere. Some simulations present realistic situations in three dimensional environments in real scale. This offers a more real experience for visitors, relevant to the exhibition contents.

- *Recreated settings* simulate a real atmosphere. The recreation may not reproduce every detail, but the feeling seems very real, for example, in houses, shops or architectural vistas.

- *Theatrical environment*s are surrealistic situations. An imaginary world is created which invites visitors to experience a fantasy which engages their own emotions and feelings.

- *Restorations* are recovered areas from real buildings which have been moved to museums and transformed into exhibitions. Restoration is a way of preserving an artifact in fine condition and bringing it to exhibit in as realistic a setting as possible.

Audio-visual elements bring sound and moving pictures with recorded tapes and videos in order to explain and describe subjects in more exciting visual detail, sometimes with real sound recordings of subjects as well. The use of moving pictures and sound is a stimulating addition to other kinds of museum exhibits.

Figure 21 *Theatrical environment of plant kingdom ,Natural History Museum, Patumthani.*

Source: *The researcher*

Figure 22 *Restoration setting of a jungle, National Science Museum, Tokyo, Japan*.

Source: *The researcher*

Figure 23 *Audio - visual of the travels of King Rama IX*

Source: *Exhibition of the sixtieth anniversary celebrations of his Majesty's accession to the throne, Muang Thong Thani, Bangkok, Thailand*

Computer multimedia (Edson and Dean, 1996) can also present moving pictures with sounds, but this requires specific programming to be interactive with visitors. There may be a game, for example, operating with a touch screen, tracking ball or mouse. Although varied and colorful in presentations, this kind of medium is high budget in terms of operating and maintenance, and it tends to be less durable. Furthermore, computers tend to function on a one-by-one basis, and are often no more interesting than other kinds of exhibition technology.

Most visitors are more interested in real objects or materials than in computers. Hence, the use of computers is not emphasized. Visitors should not spend more than two minutes reading information. In fact, statistics find that most visitors spend an average of only 30 seconds standing and reading display texts.

For each page of a computer program, one should spend not over 12 seconds. Ten seconds is concise for a single page. Programs must be easy to use and the computer must effectively respond for periods of short use. Visitors should be able to activate the program within 10 seconds. The most important is ease of use. Moreover, the computer must respond to commands immediately - within 1 second.

To provide opportunities and variety to all kinds of visitors, information must be very clear. The narrative on each page of a computer presentation should contain not more than 50 words. Sentences should be clear, concise, and easy to understand. Lettering should be in large, clear fonts, using appropriate colors, with pages free of distracting clutter.

For children of around 10 -12 years, the computer medium will probably be easy to understand. Designers may take age10 as the standard. If a 10-year old can use the program, adults will surely be able to, as well.

The programs must be entertaining, interesting, pleasing and amusing, if they are to attract visitors, make good memories, and impress some information on the user’s mind.

Figure 24 *Computer multimedia technique.*

Source: *Exhibition of the sixtieth anniversary celebrations of his Majesty's accession to the throne, Muang Thong Thani, Bangkok, Thailand*

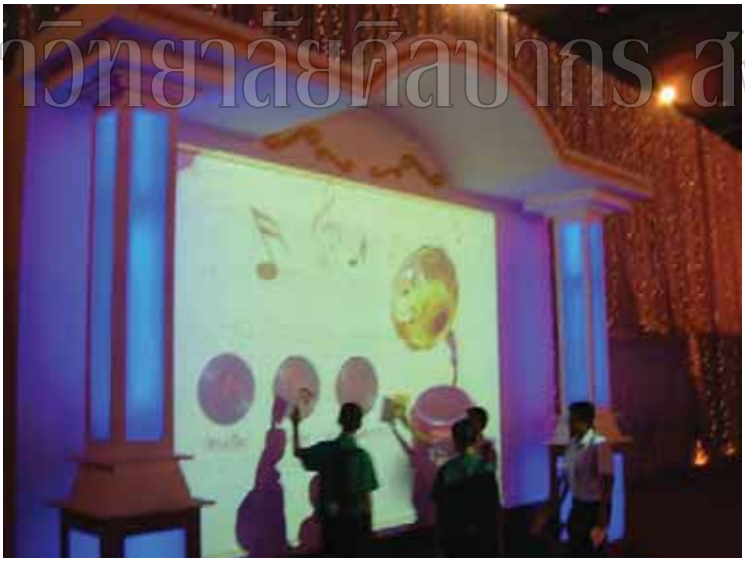


Figure 25 *Computer multimedia technique.*

Source: *Exhibition of the sixtieth anniversary celebrations of his Majesty's accession to the throne, Muang Thong Thani, Bangkok, Thailand*

Hands-on and interactive displays offer media which can be touched or which encourage self-learning, participant activities, play or other kinds of interaction with the exhibition. (Edson and Dean, 1996)

Figure 26 *Interpreter of the exhibit.*

Source: *Exhibition of the sixtieth anniversary celebrations of His Majesty's Accession to the Throne, Muang Thong Thani, Bangkok, Thailand*

Dramatic performance and interpreters. In this approach, an interpreter tells a story, or explains the theme and content of an exhibition. The interpreter is assumed to be in the situation, telling the exhibit story with feeling, about his or her experience. The interpreter may be presented as someone living in the period exhibited, dressed in ancient costume, and telling the story as if about his or her own life.

Figure 27 *Natural feeling in exhibits.*

Source: *Exhibition of the sixtieth anniversary celebrations of His Majesty's Accession to the Throne, Muang Thong Thani, Bangkok, Thailand*

Multi - sensory systems are integrated with figures, tastes, scents, sounds, and textures or movements. All five senses are appealed to in order to replicate a real situation and impress visitors, for example, with the birds and insects in a jungle atmosphere, or the use of smoking incense in a place of worship, or the smell of things in an oven in a presentation on baking or cooking in a kitchen. Visitors would be able to handle the equipment and taste the things prepared there.

To sum up, this section addresses interpretation techniques and media used in exhibitions in museum design. Designers must be concerned with relevant contexts for the use of particular techniques. Science museums, especially, should be interactive. Integrated media are necessary in exhibitions in science museums. Information is also necessary, but how it is passed to visitors is the more significant issue. The sender and receiver should respond, as in a football game. Whenever visitors achieved information, they will gather it together, synthesize it and come to a cognitive understanding. This happens in spatial communication. If there is no response from the visitor, it is like teaching in a classroom, trying to put information into the heads of visitors. They will not be impressed.

Chapter 3

Research Methodology

The aim of this research is to investigate interpretation guidelines for “national science museums,” to identify the most appropriate ways of creating exhibitions in terms of themes, museum interiors, spaces and displays, and to investigate just how visitors perceive, understand and interpret science museum exhibitions. The research methodology is based on documents and case studies concerning science museums both in the East and the West. Data were gathered from museum visitors, administrators, curators and architects. Case studies are compared with the situation of Thailand’s National Science Museum (NSM) in order to suggest some guidelines for science museums. The reliability and logic of the conclusions are based on the methodology and appropriately connect the various data. Seven research questions are posed in Chapter 1. They can be briefly stated as follows:

1. ***What is the official policy of Thailand’s National Science Museum?*** What are the objectives of the National Science Museum Foundation? How does official policy translate into the museum’s themes, displays and exhibitions?

2. ***How does the National Science Museum fit in that policy?*** This may not be explicitly stated. Therefore, it may be necessary for the researcher to check what the NSM has done so far to follow the policy.

3. ***How does the National Science Museum fit into the Bangkok Metropolitan Area’s regional planning*** (and that for Thailand generally)? Why has the museum been placed on the outskirts of the city rather than in central Bangkok? Presumably, its location is related to the concept of the *"technopolis" (technothani).* The *technopolis*, of course, is going to have to compete with similar developments elsewhere. How does the museum’s location and planning fit this objective? There is also a question of balancing the need to create an "image" for the *technopolis* against the need to provide a readily accessible resource for children's education. In other words, the choice of location is necessarily a complex one.

4. ***What are the exhibits in the National Science Museum trying to represent or say?*** In light of the complex and possibly competing objectives of the NSM, what can be said about the exhibits, how they are displayed, and the

experiences they intend to provide? The answers to these questions, looking particularly at *spatial representations*, will be mainly descriptive, but critically written in order to bring into sharper relief the museum's explicit and implicit objectives.

5. ***How are the exhibits used or enjoyed in practice?*** Actual *spatial practices* can be studied by observing how people in various age groups move through the museum, how they behave, where they pause, what they look at, and what they express, etc.

6. ***What are the disjunctions between spatial representations and spatial practices in the NSM***? Are the museum and its exhibits functioning as they were intended to function?

7. ***What assessment can be made of the success or otherwise of the National Science Museum in the light of national science policy?*** This brings the dissertation back to the original questions posed in items 1 and 2 above.

Six priorities are suggested regarding the research methodology by which answers to the above seven questions will be sought.

Research planning
Variables
Population and sampling
Instruments
Data collection
Analysis

Research planning

The research was planned in fourteen steps**.** (Figure 28)

1. A preliminary study determines the conceptual profile of the NSM, the development of its policies and goals, and the points at which these intersect broader government objectives.

2. The survey aims at locating problems and identifying the notions behind the National Science Museum by examining the museum's physical characteristics, exhibitions, displays, and interpretations for visitors. The field study includes the use of a digital camera, project mapping, and data collection by participant observation.

3. The urban context of the NSM is a central concern. The researcher studies the whole idea behind *technopolis* as a new urban development. The

research gathers data to document the impact on the museum of the varied characteristics of this new kind of city.

4. The research includes a study of the literature relevant to the museum as well as interpretations of the theories used as the research framework, Data are brought together from various relevant researches and articles from many sources, both from texts and websites.

5. Case studies of science museums from some of the world's mega cities such as Tokyo, Paris are taken into consideration in the documentary research. The selection of cities for review was based on their international context, high standards of living and good business climates. The researcher had the good fortune to be able to visit some of these museums in person.

6. Secondary data collection (documentary research) helps fill in the overall picture of the Science Museum, its exhibitions, displays and interpretations. This process is the basis for developing the research instruments described in the next step.

7. Research tools used for in-depth research include, for example, structured observation, questionnaires for visitors, and interviews with the architects, designers and staff of the NSM.

8. Using these instruments in field studies, the researcher made empirical observations at the NSM and collected primary data.

9. - 12. Analyses of the data cover matters of policy and exhibition, and the impact of 'national identity' on the NSM. Further analysis is then made of the *technopolis*, i.e. the urban context in relation to the NSM. The last part addresses the museum's exhibitions and spatial planning.

13. Diverse interpretations of the NSM emerge from the study and from the analyses in the first 12 steps. These interpretations invite further analysis.

14. The conclusions of the research include discussion of possible guidelines for museum interpretation, especially for science museums. Various urban factors and issues of interior space are addressed.

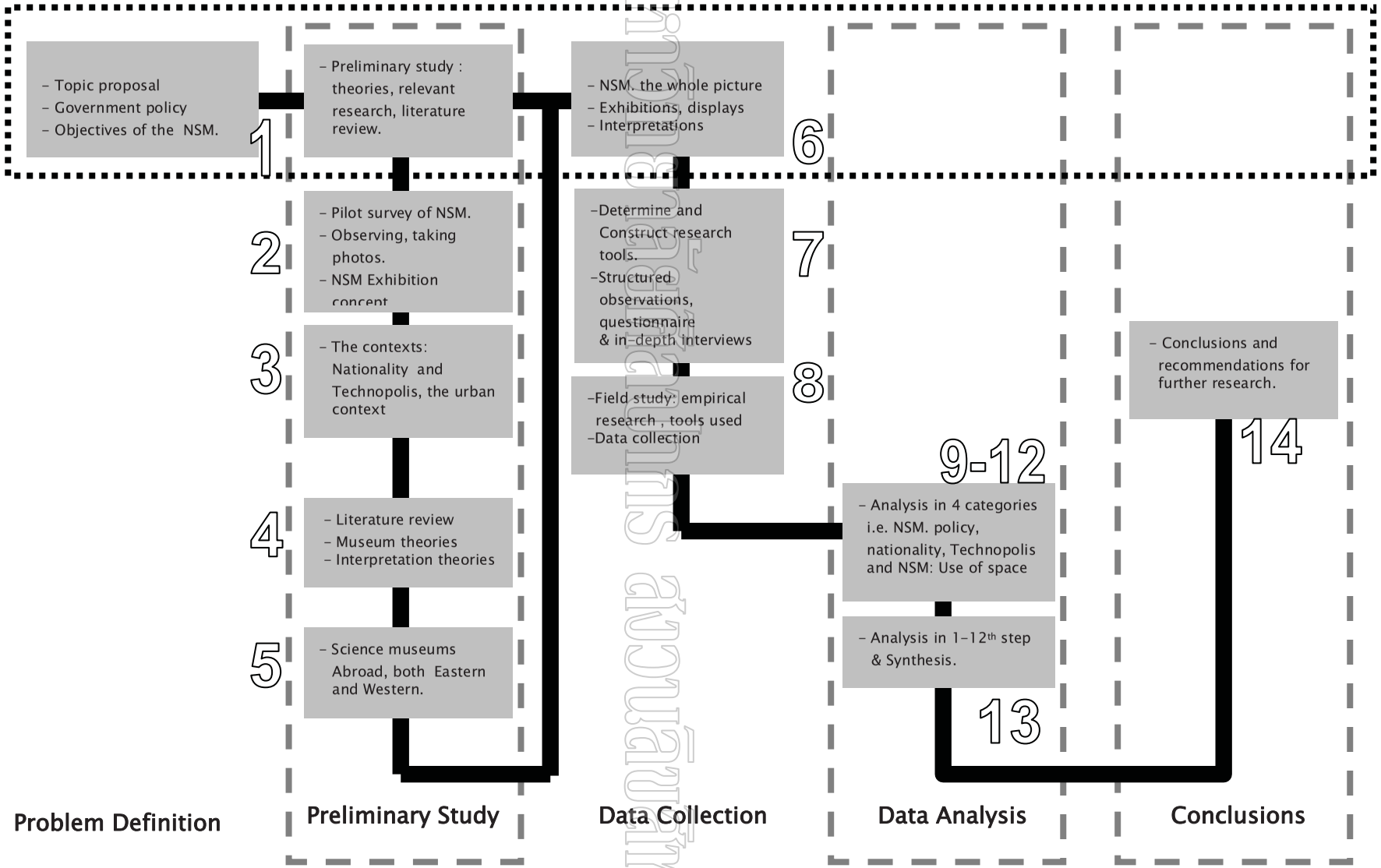


Figure 28 *Research Planning*
Note: The small dotted line refers to the review of literature, which was carried on throughout the research period.

Variables

This study of museum interpretation in relation to the National Science Museum has five major independent variables and two dependent variables. Independent variables are of interest to researchers because they are always very stable and easily verified. Most independent variables are selected from economic, social, and population data such as gender, age, occupation and marital status. By contrast, dependent variables register the effects of other variables and are subject to change for many reasons, relative to independent variables. The **five independent variables** in this research are prioritized, as follows:

1. *NSM policy*. This variable represents the policies of the National Science Museum, or of the government, with respect to museums.

2. *National identity*. This variable refers to the character of the science museum.

3. *Visitors*. This refers to the characteristics of visitors, i.e. their qualifications, differentiation in terms of age, gender, education, knowledge and background. Such characteristics affect visitors' interpretations and perceptions of NSM exhibitions.

4. *Museum spaces*. This variable represents the effect of size and space on the contents of exhibitions, displays and interpretation in science museums.

5. *Urban context, site or location*. Although the location of the museum may not directly affect museum interpretation, it does have an impact on visitors traveling to reach the site.

The first four of these independent variables have an influence on *NSM exhibitions and interpretation*s. The fifth variable affects *travel and marketing considerations*. These are the **dependent variables** of interest in the research. (Table 1)

Independent and dependent variables are inter-related. If the science museum changed its policies or its spaces, exhibitions and interpretations would change. The image and character of the museum would change. If the NSM had a different location, visitors' travel time would be affected, with impact on the museum's marketing strategies.

Table 1 *The relation of variables as the conceptual framework*

Independent variables	Dependent variables
NSM policy	NSM Exhibition & Interpretation
National identity	
Visitors	
Museum spaces	
Site location	Visitors' traveling & Marketing

Population and sampling

The sampling for the research is taken from the following population groups:

1). Child visitors. Most of the visitors to Thailand's National Science Museum are children and youth between the ages of six to eighteen years. Young children are an important target group for museums and have therefore been included in the survey. Children as young as six can read and write, and can respond to questionnaires. In their childish way, they are able to categorize environments, organize priorities, understand comparisons, draw reasonable opinions from their experience, and develop an idea of a whole concept (Sirilak Keawkramkrun, 1988: pp.20-22).

The National Science Museum has six floors. The researcher selected ten children from each floor for a total of sixty children.

2). Adult visitors. The adults include visitors aged 19 years and up, selected equally from all six floors of the museum. Because so many adult visitors

bring children to see the exhibitions, this sample group consists, for the most part, of parents, teachers and other caretakers. The researcher selected ten adult visitors from each floor for a total of sixty adults also.

3). Officials of the NSM. Oral interviews were conducted with the museum's curators, architects and designers. The researcher selected fifteen for this sampling population group.

Instruments

In collecting primary data, the researcher used three major tools, as follows:

1. Structured observation. More in-depth data were collected via structured observations, including indirect and participant observations with digital camera, and projective and cognitive mapping. (Appendix A.)

2. Questionnaire. Children and adult visitors to the museum were surveyed in questionnaires designed to obtain data in the following areas:

a) General personal information on gender, age, education, etc.

b) Interpretations and perceptions about the exhibitions and displays, including questions aimed at testing the level of comprehension after the visit. Questionnaires were pre-tested and modified accordingly in order to ensure the validity of the process.

c). Responses to the use of exhibition space and the museum interior.

3. Structured interview. The researcher conducted 6-part, structured, in-depth interviews with NSM officers, curators, architects and designers, covering the following topics:

a) General personal data

b) NSM policy.

c) Themes or sources of museum concepts.

d) Exhibitions and displays.

e) Interpretations for visitors.

f) Technopolis and urban factors.

Data collection

The processes of data collection were as follows:

1). Data was gathered during visits to the NSM. The museum's allocation of space and relevant theories of interpretation were studied. Data were collected

from documents and pictures. The basic data helped map out a guide and framework for the research.

2). The physical environment and the behaviors of visitors, museum officials and staff of the NSM were observed in field studies in order to analyze the use of space and the characteristics of exhibition forms, displays, and interpretations.

3). Data were collected in the field by direct observation and by participation observation, using digital camera and projective mapping. The observations covered:

- Spatial forms, architecture, interior space, exhibitions, displays, and interpretation in the National Science Museum.

- Visitors' behavior at certain times of the morning and afternoon.

4). Data were also obtained by the use of questionnaires, with interviews of visitors, both children and adults. The questions were both open–ended and closed. The museum's officers, curators, architects and designers were interviewed.

Analysis

In this process, the researcher gathered data, reviewed interviews and questionnaires, and ranked the variables in the study before interpreting the data.

In the conclusion and final presentation, the researcher makes a final interpretation. The results of the research are presented in two parts, as follows:

-The first is a descriptive presentation within the framework of interpretation of both the NSM and the other science museums considered in case studies.

-The second is a symbolic presentation by means of pictures, tabulations, projective mapping, and guidelines for National Science Museum interpretations.

All six priorities in this dissertation's processes helped bring the researcher to the study's final conclusions. The research methodology helped the researcher approach and identify the Science Museum's interpretation guidelines. These guidelines can be useful to other science museums, and to public museums generally, both in Thailand and elsewhere.

Chapter 4

The National Science Museum's Contexts

The word *'context'* refers to the statement at that moment, or the situation, events, information, environment, the conditions in which we are operating or living. It implies, for present purposes, conditions such as laws, the environment, the social structure, culture, religion etc. Cities such as the Bangkok Metropolis, Pattaya, or Chiengmai all comprise different contexts, each with a distinctive environment, and with different social conditions, culture, people and language. When designers cannot change the city to suit their design preferences, the design approach must, perforce, be modified and adapted to the city.

In this chapter, the researcher discusses three main contexts of the National Science Museum which are relevant and which have a direct effect on exhibitions, interpretations and visitors passing through the museum galleries. The three main contexts are as follows;

Background and Policy

National Identity

Urban Context

Background and Policy

This section discusses the historical background of the NSM, its policies, and the objectives which affect exhibition themes, contents and interpretations.

The National Science Museum was inaugurated on the occasion of the Queen's 60th Birthday on August 12th, 1992 through the Ministry of Science, Technology and Environment. A Royal Decree established the Science Museum Project in recognition of Her Majesty's interest in enhancing the public's knowledge of science and technology and in reviving and preserving traditional Thai handicrafts. These initiatives have led to the creation of job opportunities and improved standards of living of the poor in rural areas. The project has progressed satisfactorily.

Although these two objectives may seem to be contradictory, science, technology, and craft are, at base, related. Crafts are nothing more than local technology, and technology functions by respecting and making use of scientific

principles. The researcher discusses this further in the next section (National Identity Context).

The National Science Museum (NSM), as a state enterprise under the supervision of the Ministry of Science, Technology and Environment, is charged with encouraging the public to learn more about science and technology. The Royal Decree establishing the museum was announced on January 30th, 1995 in the Royal Government Gazette, no.112 Section 5A. The headquarters of the National Science Museum is located on 72 acres in the Technopolis, Rangsit - Nakorn Nayok Highway Khlong 5, Khlong Luang, Pathumthani 12120, Thailand.

There are plans to establish Science Museums in provincial areas for the benefit of Thai youth and the general public. These provincial museums will be science and technology centers, contributing to the continuing development of local tradition, moral standards and on-going education. There will be science and culture museums in three provinces, namely Chiang Mai, Nakornrachasima and Songkha.

Figure 29 *Science museums in the future.*

Source : *www.nsm.or.th*

In addition to the above-mentioned science and culture museums, there are already a number of existing science museums around, including the Science Center for Education at Ekamai in Bangkok. Having many such museums is, of course, beneficial to Thai people. However, it needs to be suggested that there should be a coordinating organization to enhance what is unique in each institution and to turn their differences and similarities into strong points which serve them all,

both individually and collectively. The science museum in each different location might be identified by specific features, different from the others, and reflecting the local context. A coordinating body is also needed to manage the marketing of all the nation's science museums.

As mentioned above, the "Science Museum Project" was initiated by the Ministry of Science, Technology and Environment in 1991, and was officially approved in 1992 in honor of the Queen's 5th cycle birthday.

Primary concerns of the NSM have included the preparation of commemorative exhibitions on folk craft and technology related to royal projects. Exhibitions have addressed science and technology in everyday life, the development of agricultural technology and modern industry, ecological systems and the natural environment, and aeronautical technology. The NSM also features an OMNIMAX theater and Biodome Exhibitions.

NSM facilities and services are arranged to appeal to people of varied status and background. In cooperation with other organizations, both in Thailand and abroad, the NSM helps disseminate knowledge for the benefit of education, research and technological advancement. The administrative system of the National Science Museum is that of a state enterprise under the guidance of the National Science Museum Committee, as appointed by the Cabinet.

Developing a science museum became one of the country's major projects. A private company was commissioned to design and build on a turn-key basis. The "Science Museum Project" was completed in the year 2000 and the museum was opened to the public.

According to the Terms of Reference, exhibitions in the Science Museum had to be designed to achieve the following communication goals and objectives (Jarujin Nabhittabhata, 2002: p.127 - 128) :

1). Science and technology must be presented as exciting and vital principles and processes. The way in which this is done must capture and hold the visitor's attention and must always entertain, stimulate and educate.

2). The museum must be a 'centre of influence'. It must be original in the way in which the themes are presented to the visitor but its popularity must be based on sound scholarship. Novelty for its own sake must be avoided.

3). The museum must always encourage visitors to think of the human, social and environmental consequences of new developments in science and

technology. Science museums world-wide see this as being one of their main responsibilities.

4). Because science is today ever more complex, compartmentalized and specialized, it is difficult for the ordinary person to understand. There is a tendency to feel small and ignorant in the face of so much complex information. The Museum must therefore encourage and build confidence in visitors. Exhibitions must explain clearly without being patronizing.

5). The discoveries, new understanding and genius of past generations of scientists, inventors and engineers have played a big role in making the world what it is today. The roles of these influential men of science must be explained to the visitor in a way which instills a sense of wonder about things that we too often take for granted. The historical framework will allow the visitor to relate the present to the past and to understand that science and technology are in a state of constant evolution.

6). Although many scientific discoveries and technological development in the past originated in the Western world, messages within the exhibition must, whenever possible, be related to examples drawn from the history and culture of Thailand.

7). The exhibition must be related to the teaching of science and technology in Thailand's educational system. The contents of the relevant parts of school curricula must be taken into account and be reflected in the exhibition.

8). The spaces within the Museum building are large and impressive. They offer great opportunities. The exhibitions must be of a scale which is equally impressive.

9). The Museum should employ all appropriate forms of communication technology and interactivity in ways carefully balanced with the messages to be conveyed to the visitor. The media must not dominate the messages. The Museum must appeal to visitors of both sexes and of all ages. Disabled people should be able to comfortably visit just as able-bodied people.

10). The museum must offer value for money and must encourage long visits so that maximum financial return is assured. The visitor's enjoyment should also lead to repeat visits and encourage recommendations.

11). The success of exhibitions will depend on the efforts of all parties concerned. Participation and collaboration will be incorporated in the design process, which can be outlined as follows:

Inception. The structure of the design team and the responsibilities of its members will be clearly defined, as will lines of communication between design team and teams of other organizations responsible for the delivery of the project. A preliminary program for the overall design process will be prepared.

Development of the Design Brief. Working with members of the other teams responsible for delivering the project, the design team will develop a design brief for approval by the NSM.

Outline Design. The design team will prepare drawings, a written report and a preliminary cost plan illustrating, in outline form, their interpretation of the Design Brief. These will be submitted for approval by the NSM via the channels agreed upon.

Schematic Design. The design team will develop the outline design, taking into account any alterations or adjustments in the formal scheme requested by the NSM. All parts of the exhibitions will be illustrated in sufficient detail to show their size and appearance, including materials used in construction and communication media employed. The NSM will have power of approval through the agreed upon channels. The preliminary cost plan will be developed in considerable detail. The design program will indicate the priorities which will apply in the design and production phases.

Detail Design. Working from the design scheme, the design team will develop the more detailed design production information. The detailed design will fully illustrate every part of the exhibitions, describing all features, for example, in multi-media elements. It will include outlines of film treatments and descriptions of such items as interactive video programs and proposals for graphic treatments. As the detailed designs for specific areas are completed, they will be submitted for approval to NSM through the agreed channels. Cost checks will take place during the detailed design phase to ensure that cost requirements are being met. During this phase, the information will be prepared for submission for approval by Statutory Authorities in Thailand.

Production Information. The design team will prepare production information, including drawings, specifications of materials, and standards of workmanship for all three-dimensional elements of exhibitions. They will provide information regarding the quantities of materials, etc. needed in sufficient detail to allow contractors to tender bids. This information will prioritize the elements of exhibitions. The design team will prepare specifications for all multi-media

presentations, films, interactive video programs and graphic treatments in sufficient detail to allow contractors to tender bids. The design team's responsibilities during the implementation of the project will be defined in documents prepared after they are appointed. At all times, coordination with the construction management team will be maintained.

The success of exhibitions within the Science Museum will depend not only upon the development of the highest standard of visionary design, based upon a first class design brief, but also upon the use of the highest quality of materials, technology and systems by which the designs will be realized.

1). The structure of the exhibitions must be elegant yet durable. They should be designed for safety and easy maintenance.

2). Replication must be researched and completed in authentic and realistic detail as befits the interpretative and informative role of science museums.

3). Three-dimensional interactive exhibits must be able to convey the intended messages.

4). Systems should be designed and detailed to ensure that they are properly engineered, both mechanically and electrically, meeting the highest standards for smooth and trouble-free operation.

5). Audio-visual and multi-media systems are to be designed and detailed to ensure that they can provide a well-coordinated response to program requirements. They should incorporate hardware which transmits images and sound with the highest possible quality.

6). The lighting systems should be designed to create the required effects and atmosphere, incorporating the latest reliable technology while consuming the least possible energy.

7). Graphics should certainly incorporate Thai and English texts in clear, well designed formats with illustrations and diagrams of the highest quality. They should communicate the required information concisely.

8). Signage should be distinctively designed to enable visitors to easily locate attractions and facilities within the museum.

Generally, the NSM achieves the above eight points. The NSM policy and objectives transform the space as required, in accordance with the purposes of the architectural design, interiors and exhibitions. Policy provides tools for monitoring how well NSM exhibitions meet their objectives.

National Identity

National Identity is one significant context which has been much discussed and debated and which also affects the contents of the museum's exhibitions. The question of national identity has a determining influence on exhibitions, particularly in the area of social and cultural studies as McLean has mentioned: "Museums lie at the centre of these [social and culture] discussions. Their exhibitions and the presentation and interpretation of these exhibition objects are linked to national identity." (McLean, 1986: p.244) This section reviews some of the discussions or debates on national identity and links them to the content, presentation and interpretation of NSM exhibitions in order to better understand the concept and its impact within the museum.

McLean has said that "In societies where challenges to the social, economic and cultural jurisdiction of the nation state are common, and where 'self' has become fragmented and traditional structures destabilized, the concept of national identity has become problematic and contentious. Opinion is deeply divided about issues of national identity, which are inherently complex and little understood in contemporary social science. National cultures construct identities by producing meanings about the nation with which we can identify, meanings which connect its present with its past, and images which connect the past to the present through recounting stories about the artifacts of past cultures which are clearly significant in representing the culture of the nation". (McLean, 1986: p.244)

The approach of the new millennium brought about various changes linked to globalization especially with the effect of the Internet on human communication. Changing modes of thinking have altered social procedures, economic and business patterns, and especially learning and knowledge development.

Museums are one kind of learning environment where knowledge is passed on. Science museums especially, in various parts of the world, display the same subject matter, with similar contents, exhibitions and interpretation. These reflect the effects of globalization and, to some extent, supersede *national identity*.

McLean (1986: 244) mentions national identity in regard to museums established generally as showcases for regional wares, manufactured goods, arts, and other "cultural products". They are microcosms of a sense of identity manifested in nationality. While economic and trade links, accelerated by technological development, become increasingly globalized, and while culture through the media

becomes increasingly homogenized, there is a parallel resurgence of national consciousness. In many countries, nations and regions are clamoring for autonomy. In Europe, the collapse of the Communist East has witnessed the creation of new and re-created nations, while in the pan-European West, there are a number of national and regional identity movements. Museums, as repositories of national history, are expected in some dimension to preserve and celebrate the nation's identity.

As to the significance of national identity in museums, Kaplan reviews McLean's (1986: p.245) museological literature which puts a different focus on national identity . She considers museums in specific historical contexts, and relates them to processes of change. Kaplan demonstrates the many significant ways in which museums have supported images of national identity and promoted national agendas. Kaplan also considers the symbolic significance of particular objects which stand for and embody the nation in the eyes of the populace.

Kaplan emphasizes the role of the museum as a social institution. It is both the product and the agent of political and social change. Thus, periods of significant growth in museums can be related to upsurges of nationalism and to a sense of national identity. In the UK, for example, the founding of the Victoria and Albert Museum, which was created from the 1851 Great Exhibition, represented the pride of the nation in its industries and in its colonization of other nations. The second significant growth of museums took place in the late 20th century. However, the growth of Scottish museums has far outpaced the growth of museums throughout the rest of the UK, reflecting Scotland's reassertion of its national identity. This revived nationalism came to a head with the devolution referendum and re-creation of Scotland's own parliament.

Foster(1991:p.235-260) considered national identity from an archeological point of view. Delaney (1992: p.136) analyzed a permanent exhibition in the recently created Canadian Museum of Civilization, 'as a means to understanding this new role of the national museum, specifically as a site of consumption of a prescribed national identity'. Other commentators make reference to national identity in museums, most of which are included in Kaplan's review (1986: p.245) of the literature, although it should be noted that a number of less well documented contributions have been made.

National identity, then, is not something which is inherited at birth, but is a cultural construct. This raises a number of issues about how this identity is created. 'A nation is not only a political entity but something which produces meanings - a

system of cultural representation'. (Hall, 1992: p.292)In order to understand the disparate meanings of national identity, this diversity of distinct processes needs to be articulated. That is, the disparate elements are connected together to form a temporary unity.

In the National Science Week 2005 Exhibition, at Impact Arena Exhibition and Convention Centre, Muang Thong Thani, Bangkok, Thailand on August 23 - 28, 2005, one of the pavilions in the exhibition was the Royal Pavilion. In it were exhibits relevant to the Thai royal family, with contents about the Kings of Siam and their families from the past to the present, including their actions and activities relevant to science.

Figure 30 *The royal pavilion entry*

Sources : *Science week exhibition 2005 at Muang Thong Thani, Bangkok, Thailand*

In this pavilion, communications to Thai people about science are clearly linked to promptings about the *Thai National Identity*. The representation of this pavilion posits a link between the monarchy and science. For example, the color yellow and a certain flower are meant to refer to King Rama IX. The Observatory Dome represents the activities of King Rama IV concerning planetary science. As visitors from the Thai public learn about science, the same information is mobilized to bolster the prestige of the ruling monarchy as a pillar of Thai nationalism. As a result,

curators, architects and exhibitors all find science exhibits being subtly (or not so subtly) manipulated in order to boost pride in the national identity.

Figure 31 *The representation the Kings in the royal pavilion*
Source : *Science week exhibition 2005 at Muang Thong Thani, Bangkok, Thailand*

Figure 32 *King Rama IV, the father of Thai science.*
Source : *Science week exhibition 2005 at Muang Thong Thani, Bangkok, Thailand*

The National Identity attribute is seen quite clearly in the exhibition in honor of the sixtieth anniversary celebrations of His Majesty's Accession to the Throne at the Challenger Hall and Impact Arena Exhibition, Muang Thong Thani, Bangkok, Thailand, on May 26 - June 11, 2006. The color yellow is a conventional reference to King Rama IX. In Thai culture, yellow is the traditional color for people

who are born on a Monday, His Majesty being the most prominent. In addition, many curved lines, elements of style, forms, gold color and grand space combine to create a celebratory atmosphere in honor of the King, the royal family and the National Identity in this remarkable exhibition.

Figure 33 *The use of the color yellow to represent King Rama IX*
Source: *The exhibition of the sixtieth anniversary celebrations of his Majesty's accession to the Throne at Muang Thong Thani, Bangkok, Thailand.*

Representation is the process by which members of a culture produce meaning. Meaning is not derived directly from objects, but from the way in which the object is represented. Thus, an object takes on a range of cultural meanings, partly as a result of how it has been represented in visual and verbal forms. Different meanings are produced by different symbolic systems. The meanings are contested and changing.

Figure 34 *The use of curved lines and elements of style and form is a way of referring the King and his Royal family.*

Source: *The exhibition of the sixtieth anniversary celebrations of His Majesty's accession to the throne at Muang Thong Thani, Bangkok, Thailand.*

Figure 35 *Gold color and grand space are used in this exhibit.*

Source: *the exhibition of the sixtieth anniversary celebrations of his Majesty's accession to the throne at Muang Thong Thani, Bangkok, Thailand.*

Focusing on the context of museums, Lidchi (1997: p.100) suggests that to understand representation in museums it is necessary to examine how meaning is created through classification and display. She emphasizes that museums are not solely concerned with objects, but also with ideas and notions of what the world is, or should be. There is thus a distinction between the physical presence of objects and their meanings. As Lidchi points out, museums generate representations and attribute value and meaning in line with certain perspectives or classificatory schemas which are historically specific. Thus, museums classify and constitute cultural difference systematically and coherently, in accordance with a particular view of the world that emerges in a specific place, at a distant historical moment and within a specific body of knowledge. The value of the object resides in the way in which it is decoded and encoded. Decoding unravels the meaning of that which is unfamiliar into that which is comprehensible. The meaning of the object, then, is culturally constructed and changes from one historical context to another depending on what classification system is used. The objects will accumulate a palimpsest of meanings, which participate in a continuous history (Ames, 1992). However, a degree of selection takes place, which foregrounds certain meanings, to the exclusion of others, meanings which are considered by the curator to be important to the visitor.

In the museum context, the elements of the exhibitions - objects, texts, contexts of display, and visual representations - combine to articulate meanings, and represent culture. The politics of museums refers to the role of museums in the production of social knowledge. According to Foucault (1989) museum collections are historical, social, and political events. Ideological discourses are articulated through their displays. Museums, then, are created to celebrate the nation, whether at a local, national, or international level. Museums participate in the institutionalizing of power, and in legitimizing selected representations of national identity.

There is a circuit of culture and processes involved in producing the artifacts represented. This circuit refers to the culture of production, that is, the cultured self. Production involves cultural intermediaries or designers who produce meanings through encoding artifacts with symbolic form. In the museum context, this will include the designers of the museum building, the exhibition designers, and those responsible for marketing the museum. Developing this further, O'Neill (1995: p.26) lucidly argues that museum objects, as human creations, 'are given or acquire through use and association many of the attributes of people, and in effect become containers of feeling and sensations'. Thus, instead of curators preserving, displaying,

interpreting and communicating objects, they may be able to reflect people's selves back to them, through objects, enabling them to cope with selves which are different from their own. In this way, museums can nurture and renegotiate identities by embodying and discussing social relations.

An analysis of production needs to take into account the local-global nexus (Robin, 1991), the relationship between local and global. Lofgren (1989: p.5-24) identifies three levels of national-cultural formation, namely international, national, and dialect levels. This model represents national cultures as continually imagined, invented, contested, and transformed by the agencies of individual persons, the state, and global flows of commodities. In order to give meaning to an object, museums often relate it through display and interpretations, juxtaposed to personal, national and international contexts.

Hall (1996) suggests the elements which combine to tell the story of a national culture. The first element is the narrative of the nation as it is told and retold in national histories, in literature, the media and popular culture. Tracing and retelling the story of the nation in museums can be particularly illuminating. Secondly, there are elements of origin, continuity, tradition and the timelessness of the national character. Museums have a significant role to play in reinventing these identities and in developing an imagined community, that is, the idea that we have of a national identity.

By privileging some identities and suppressing others, museums reveal an articulation of national identity which has been contested and negotiated. When considered alongside other factors in the circuit of culture model, the production, consumption, regulation and representation of identity, and the meanings of national identity construction in museums begin to be unraveled.

To sum up, national identity is elusive. Its meanings are constantly changing. Consequently, although it is wide understood that national identity is integral to the meanings of a museum, there has been little real investigation into the ways in which it is contested and negotiated. By locating current thinking on national identity in museums within the cultural and social theories, and in particular within the circuit of culture model, the notion of national identity has not only developed our understanding of this thinking, but has identified a means of articulating the meanings of national identity in museums. As McCrone (D.McCrone et al.: p.7) has argued, it is through museums that we can come to a deeper understanding of identities and, notably, of the national identity.

Urban Context

The urban context or physical surroundings affect the NSM in terms of access and travel time. This section discusses the surrounding environment of the National Science Museum, the Technopolis. The surroundings of the NSM include the general area of Patumthani province, contexts which might not directly affect NSM exhibitions or interpretation. The environment does, however, directly affect how convenient or inconvenient is the journey for visitors to the museum.

Bounded on the north by the provinces of Ayutthaya and Saraburi, on the east by Nakornnayok and Chachengsao, and on the west by Nonthaburi, Patumthani, a low-lying area averaging about 2.30 meters above sea level, is around 28 km north of Bangkok in Thailand's central plain.

North : Ayutthaya and Saraburi
East : Nakornnayok and Chachengsao
South : Bangkok and Nonthaburi
West : Nonthaburi

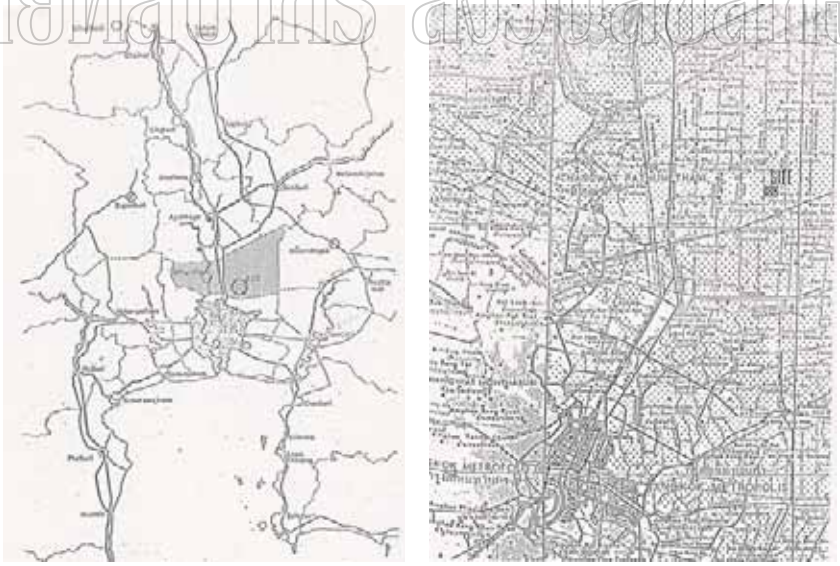


Figure 36 *Map of Patumthani, its surrounding provinces and site*
Source: *Thailand map guide*

The topography or physical features of the landscape generally are lowlands on both sides of the Chaopraya river as it flows through Muang and Samklok districts. These lowlands cover areas on both sides of the river separating Patumthani in two parts, east and west. These districts include Muang, Thanyaburi,

Klong Luang, Nongsue, Lamlukka and some parts of Samklok district. Many canals flow from the river to serve the province. Most of the residents are farmers. This topography is subject to flooding in some parts of western Patumthani. On the eastern side, there is less flooding with many irrigation canals to control the quantity of the water.

In accordance with the physical features of the landscape, architectural works relevant to the surroundings are relatively unproblematic. The location is suburban, far from downtown areas. There has been little urban growth and population density is generally low. There are many government offices surrounding and other points of interest, for example, the Asian Institute of Technology, Thammasat University, Bangkok University, Rangsit University, Rajamangala University, Srinakharinwiroj University, Dream World theme park, Future Park plaza, a Lotus superstore, and the Thammakaya temple. The growth of the city has encouraged the growth of real estate. There are many residential areas and commercial buildings on the Rangsit - Nakorn Nayok Road.

We can access the NSM site along the Rangsit-Nakorn Nayok road which is a by-pass from the Vipavadee - Rangsit road for about 11 kilometers. At Klong 5, a left turn reaches the Klong 5 local road, for a distance of around 4.5 kilometers.

In addition, we can come to the NSM by private car, by the NSM bus or by a pubic bus. At present, there are Rangsit-Thanyaburi buses, or buses which run through the Klong Luang district administrator office.

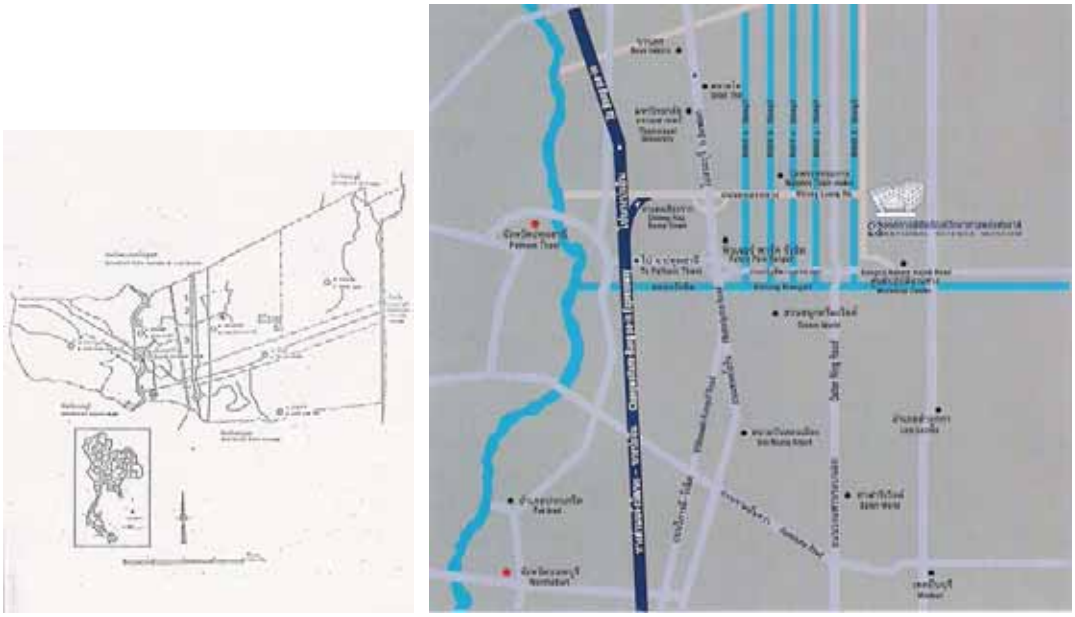


Figure 37 *National Science Museum approach*

Source: *Science museum 2000*

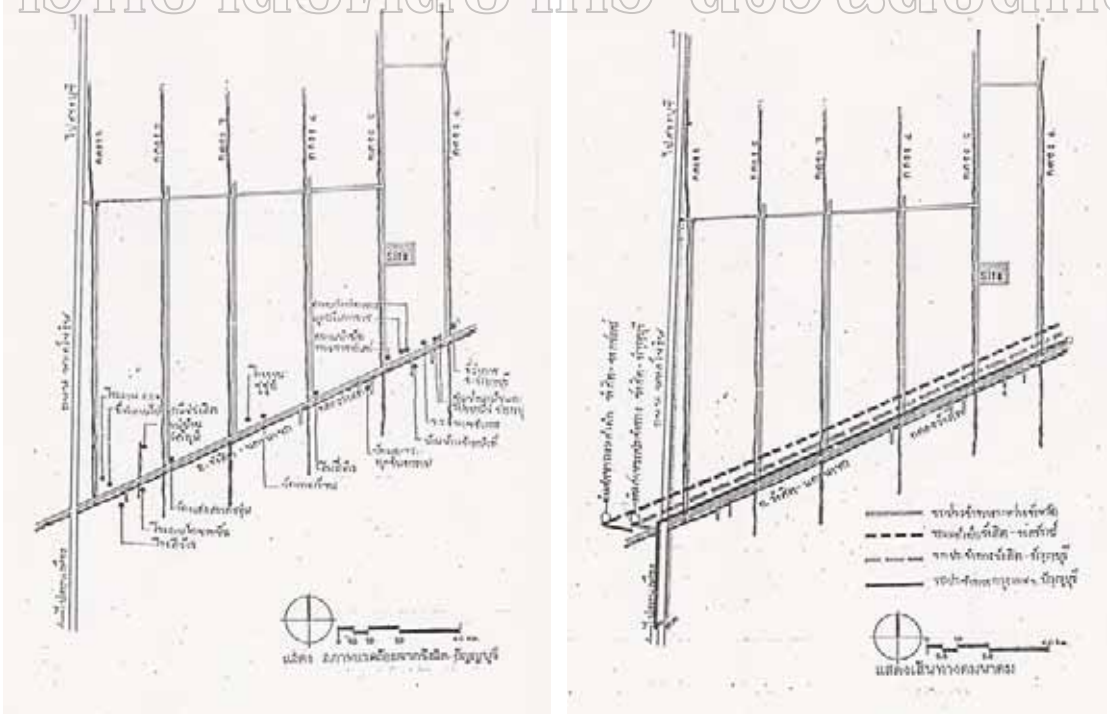


Figure 38 *Site surroundings and transportation*

Source: *Patumthani map guide*

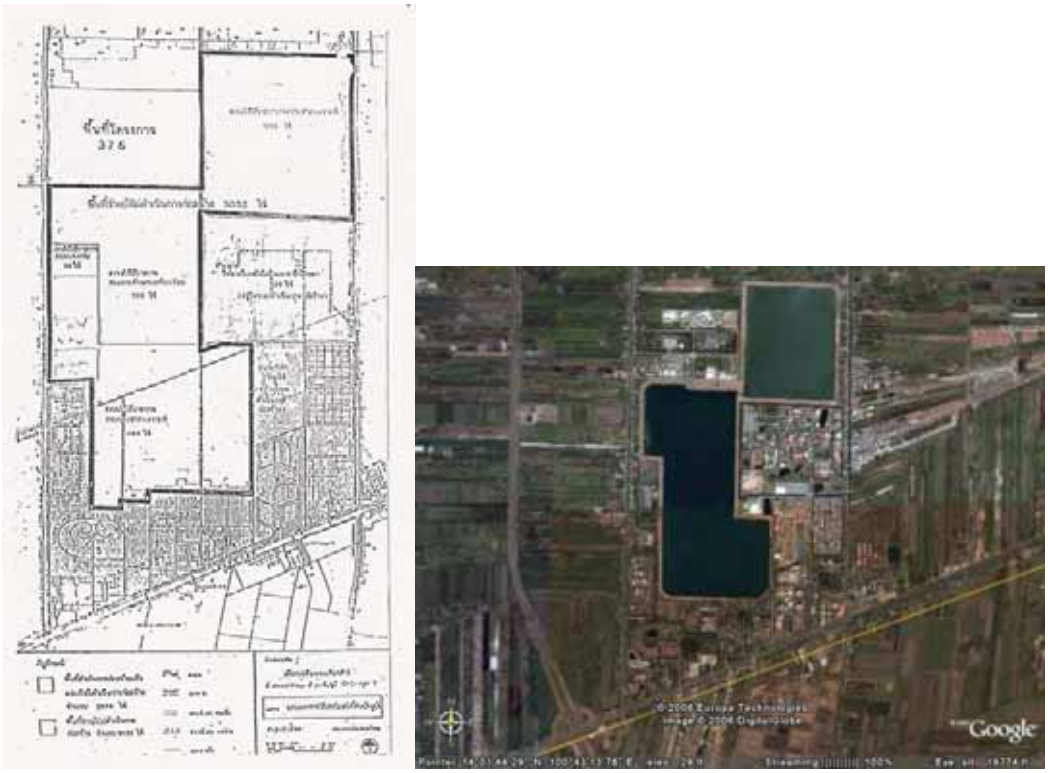


Figure 39 *Land use in the attached areas*

Sources: *Patumthani Map guide and www.google-earth.com*

The National Science Museum is part of the Technopolis envisioned in government policy which gathers together many organizations relevant to science. These are areas which belong to the Ministry of Science and Technology and comprise many buildings relevant to science and research, including the NSM and the other museums in the area.

The NSM site is linked to the northern road of the Technopolis. It covers around 36 rai (rai means a unit of area equivalent to 1,600 square meters). The land takes a rectangular shape, 230 meters wide and 250 meters long. The surrounding land uses are as follows:

North : Plots of farmland
East : Empty land and park
South : Office buildings, Ministry of Science
West : Klong 5 road

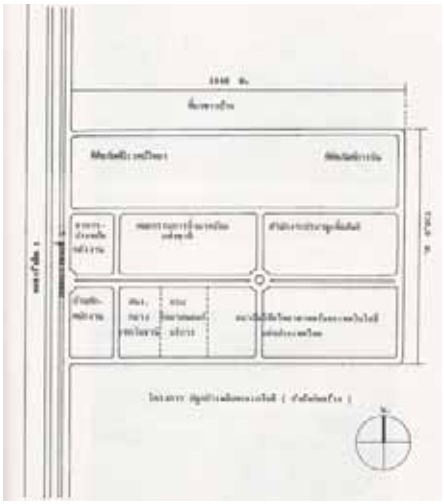


Figure 40 *Technopolis zoning*

Sources: *Patumthani map guide & www.google-earth.com*

Figure 41 *Technopolis entrance*

Source: *The researcher*

Figure 42 *Road in Technopolis*

Source: *The researcher*

Figure 43 *Technopolis zoning and lay - out signage*

Source: *The researcher*

Figure 44 *Buildings in Technopolis*

Source: *The researcher*

Figure 45 *NSM approach view*

Source: *The researcher*

Figure 46 *NSM entrance*

Source: *The researcher*

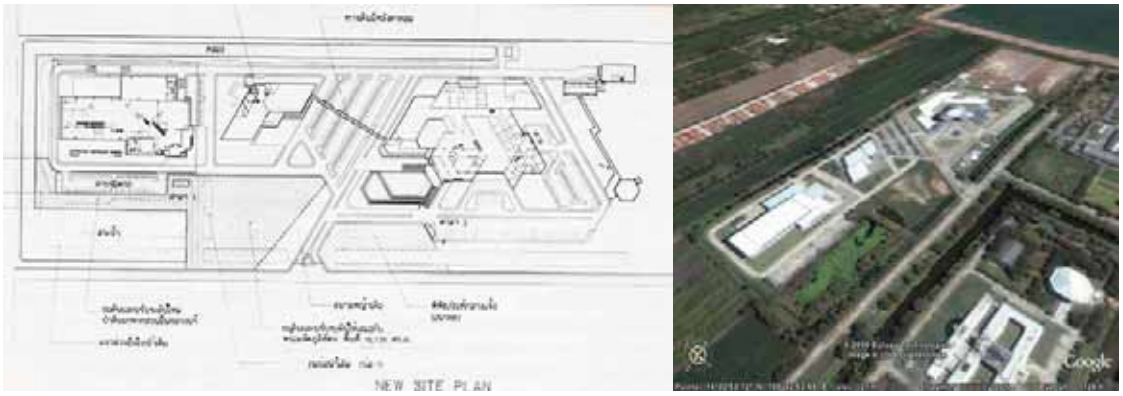


Figure 47 *NSM and the other museums on site*

Sources: *Science Museum 2000 and www.google-earth.com*

The NSM, comprises four museums and two centers nearby, as listed below:

Science Museum, the Queen's project

Natural History Museum, a project focused on gathering information and materials from nature. The building is small and was formerly a research facility.

Information Technology and Telecommunications Museum, intended as an aircraft museum, it is reminiscent, inside, of an airplane hangar. The exterior is shaped like the wing of a bird. However, it now serves as a museum for Information Technology and Telecommunications because this field is rapidly growing in importance.

Ecology and Environment Museum, devoted to the study of ecology and to learning more about ecological systems, the environment and relevant factors. The museum will include living and non-living materials. The building is a Bio Dome after a Canadian model.

Science and Technology Edutainment Center. This includes an IMAX theater with 300 seats.

Thai Artificial and Industry Products Exhibition Center. There are also a moving museum and temporary exhibitions on the boundaries.

This group of four museums and two centers is part of the science activities centre of the Ministry of Science and Technology in the *Technopolis*.

These three main contexts affect the museum's interior spaces, as well as NSM exhibitions and how they are interpreted. In addition, the suburban context or site location affects visitors' travel time and convenience, which, in turn, affects NSM marketing strategies.

Chapter 5

NSM' s Exhibition and Interpretation

This chapter discusses the National Science Museum from the point of both building and exhibition design. The chapter is also relevant to the background, policy, mission and objective of the NSM. In other words, the chapter studies the NSM's design solution relevant to its design aims and objectives. The two main points are discussed under the following headings;

- Architectural Design and Construction
- Museum Interior and Exhibition Design

Architectural Design and Construction

The intriguing design of the Science Museum introduces a new form of museum building. The leading architect, Mr. Chalermchai Honark, the former Deputy Governor of the Thailand Institute of Scientific and Technological Research, has integrated geometric shapes in his design by joining three cubes together, each of the cubes standing on one of its corners. Each corner can bear a load as great as 4200 tonnes.

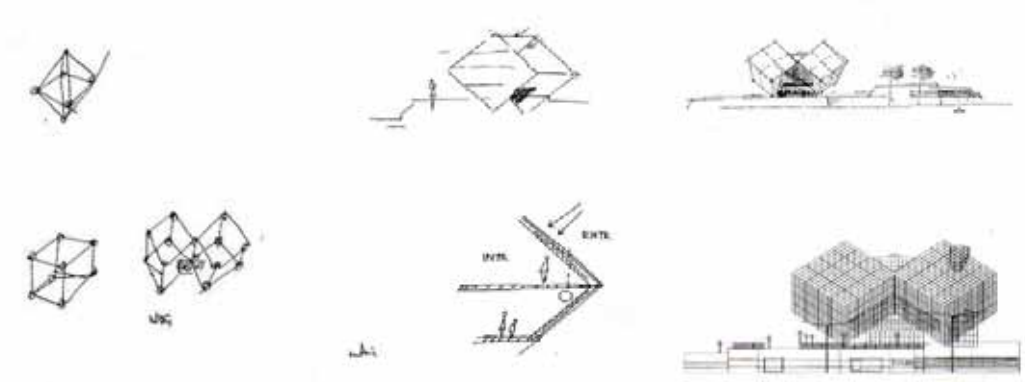


Figure 48 *The sketch idea of NSM. Architecture*
Source: *Jarujin Nabhittabhata (editor). 2002.*

The building structure is made of rust free steel girders with epoxy coating. All the floors in the building are reinforced concrete that can bear up to 500 kilograms per square meter and can withstand wind force of a heavy storm, or 120 kilograms per square meter. The external faces of the cubes are covered with ceramic steel, a durable material that will never require painting during its lifetime. It also has insulation properties, which enhance energy saving for temperature control in the building.

Figure 49 *The construction of NSM.*

Source: *Photo picture at National Science Museum, Patumthani*

Figure 50 *The NSM.'s architectural perspective and mass model.*

Source: *Jarujin Nabhittabhata (editor). 2002.*

The part of the building designed for exhibition areas is in the cube section. The height of this section is approximately 45 meters. It is divided into 6 floors with a total exhibition area of 10,000 square meters. The other part of the building is designed for offices and workshops. This part covers another 8,000 square meters. The external appearance of the cube building also allows a unique interior configuration of every single floor, enabling flexible interiors and exhibition designs on each floor.

On Friday, the 25th November 1994, Her Royal Highness, Princess Chulabhorn, granted royal permission to Mr.Tanin Kraivixien, the Vice President of Chulabhorn Research Institute, to preside over the foundation stone laying ceremony of the new science museum at the Technopolis Park. The construction of the building was completed in 1996.

Her Majesty, Queen Sirikit, graciously conferred her name to this building, “Her Majesty Queen Sirikit the Great Science Museum”.

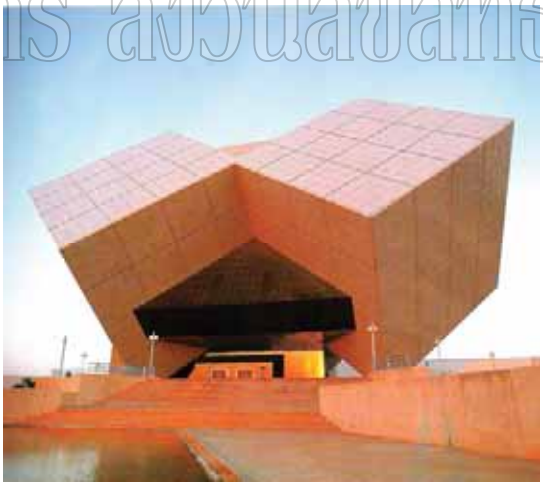


Figure 51 *Architecture*

Source: *Photo picture at National Science Museum, Patumthani*

Museum Interior and Exhibition Design

The main concept of the exhibition design developed from the following objectives and requirements:

1. To create excitement and a new experience that enables visitors to be

aware of the importance of science and technology in the progress and development of Thai society.

2. Hands-on exhibits to encourage visitors to touch, play with and make their own discoveries.

3. To support and benefit the study of science in the context of bothformal and informal education.

4. To display the products of research related to science and technology.

5. The quality of the exhibitions must meet international standards.

6. The exhibitions must be grouped and presented in an interesting and easy to understand manner.

7. To be able to link modern and traditional technology.

8. To offer life-long learning opportunities for all visitors.

The exhibition designs focus on communication between the exhibit and the visitor. (Jarujin 2002) Visitors are allowed to interact with exhibits by touching, playing and trying things for themselves in the various types of presentations such as interactive hands-on exhibits, video presentations, graphic panels, and artifacts of different forms. The exhibits are designed to be easy to understand and to blend well with the whole exhibition design concept in order to function as a credible and attractive center of knowledge in science and technology for the public.

The exhibitions in the NSM are categorized on six floors of the building, as follows;

Reception and Introductory Area ,1st floor

History of Science and Technology, 2nd floor

Basic Science and Energy, 3rd floor

Science and Technology in Thailand, 4th floor

Science and Technology in Everyday Life, 5th floor

Traditional Technology, 6th floor

Figure 52 *Image concept of NSM.' s interior and exhibition.*

Source: *Jarujin Nabhittabhata (editor). 2002.*

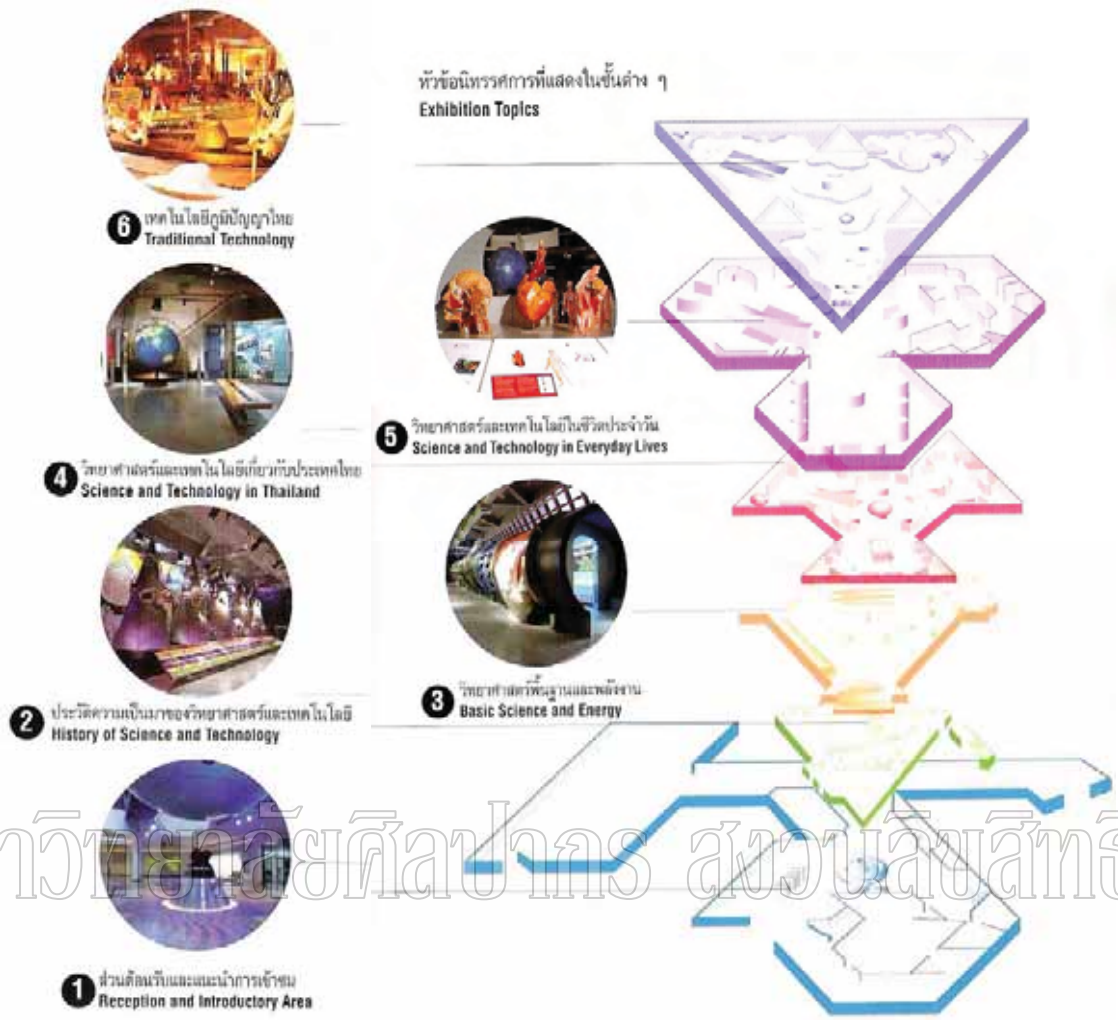


Figure 53 *Exhibition topics in each floor of NSM.*

Source: *Jarujin Nabhittabhata (editor). 2002.*

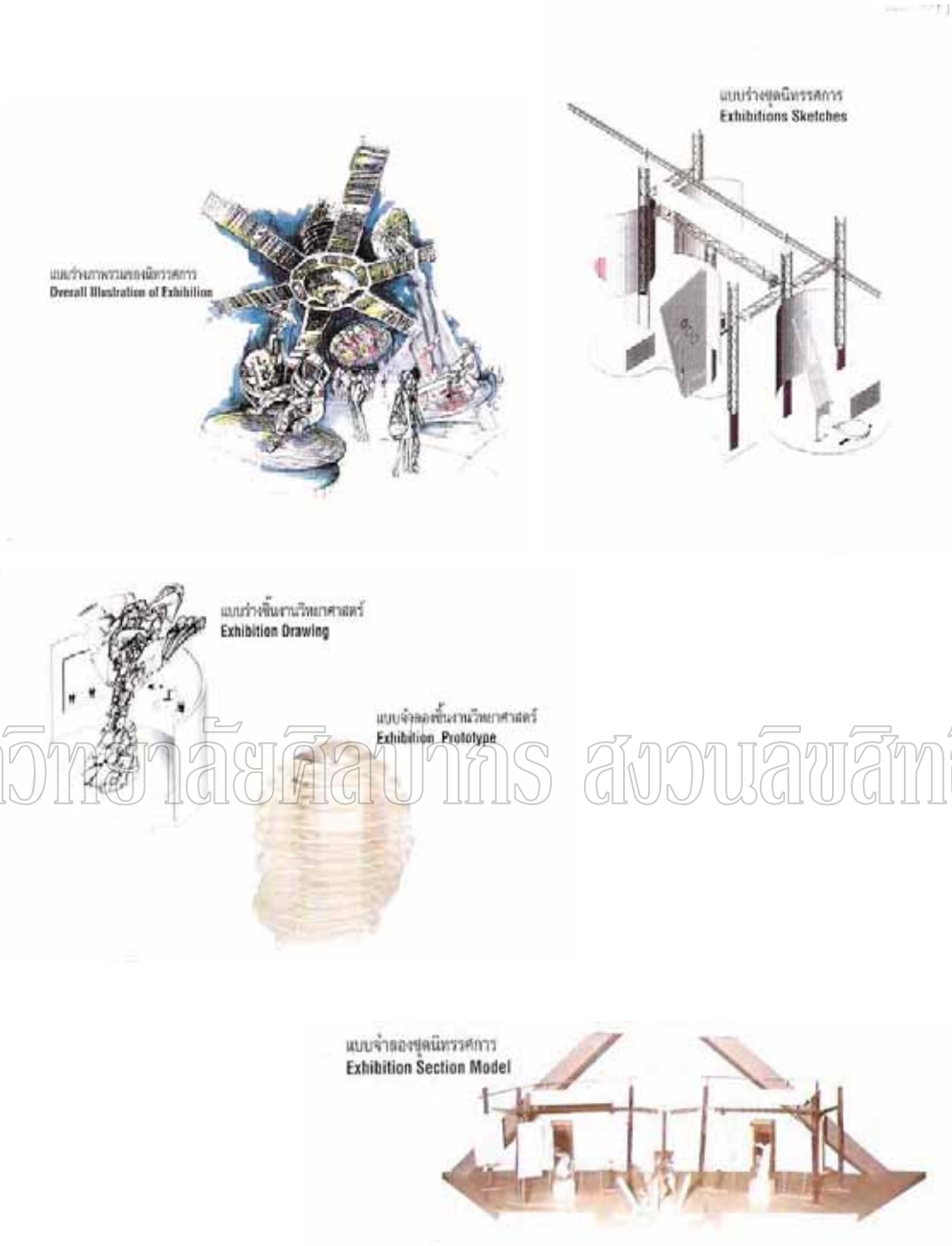


Figure 54 *Preliminary sketch design of NSM' s Exhibition.*

Source: *Jarujin Nabhittabhata (editor). 2002.*

Reception and Introductory Area, 1st floor

The reception and orientation area has a decor that creates a modern, warm and welcoming atmosphere with light and sound systems and introductory displays, supported by a nine-screen video displaying topics presented by the exhibits on each floor. Centrally located is an illuminated scale model of the museum, surrounded by seating on an elevated circular base. The model and its surrounding seating is a popular meeting place for visitors. Cloak rooms, cafeteria, shop, and the cyber station are also accessible on this floor. Over one thousand square meters of space are also available on this floor for temporary exhibition.

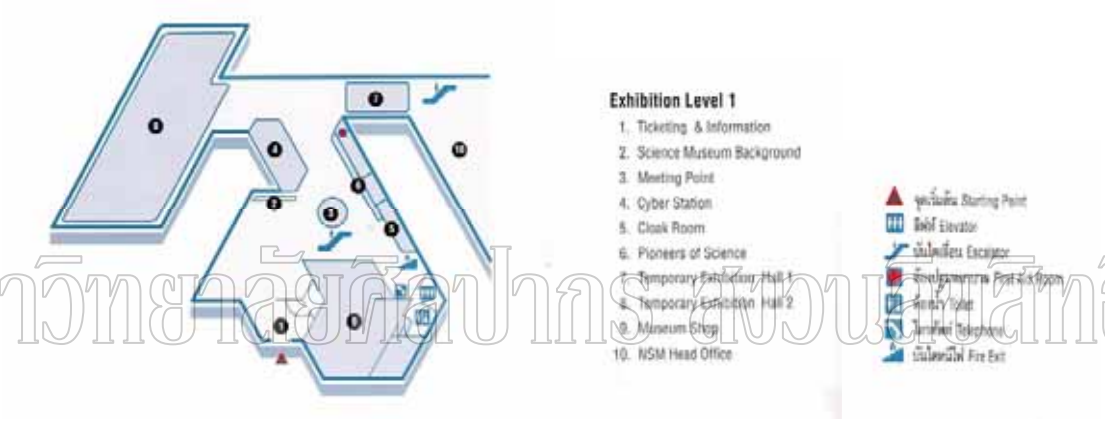


Figure 55 *Exhibition Level 1st Lay-out*
Source: *Jarujin Nabhittabhata (editor). 2002.*

The first floor addresses general science. The exhibition's topic areas are Pioneers of Science, Background of the Science Museum, Meeting Point, Cyber Station, and two halls for temporary exhibitions.

Pioneers of Science. This exhibition aims to provide visitors with examples of individuals who have made major contributions to science over the past 200 years. Their achievements greatly influenced the development of science and technology, effectively enriching the living quality of all mankind. The following scientists are listed as illustrations of the pioneers of science.

Figure 56 *Pioneers of Science*

Sources: *Jarujin Nabhittabhata (editor). 2002.*

1). Christian Barnard (born in 1922), a pioneer in heart transplant survey.

2). Marie Curie (1867 - 1934), discovered the elements polonium and radium and investigated the applications of radioactivity to medicine.

3). Yury Gagarin (1934 - 1968), the first man to orbit the earth in space and accredited as “Hero of the Soviet Union”.

4). Jane Goodall (born in 1934), an anthropologist who consistently observed and studied the behavior of chimpanzees and was awarded a Ph.D. by Cambridge University in 1965.

5). Grace Hopper (1906 - 1992), developed the programming language for the Univac 1 computer and made many innovations that shaped later programming techniques.

6). Dorothy Hodgkin (1910 - 1994), investigated the structure of biological molecules using X-ray analysis. She was awarded the Nobel prize for Chemistry for working out the structure of vitamin B 12.

7). Stephen Jay Gould (born in 1941), developed the theory of punctuated equilibria and revised the evolutionary theories of Charles Darwin.

8). Edwin Hubble (1889 - 1953), discovered evidence for galaxies of stars outside the Milky Way, which indicated that the universe is constantly expanding.

9). Lise Meitner (1878 - 1968), discovered Uranium fission.

10). Linus Pauling (1901 - 1968), won the Nobel Prize for Chemistry for his work on chemical bonding and the 1962 Nobel Peace Prize.

11). Karl Popper (1902 - 1994), wrote extensively on the philosophy of science, and developed a theory of logic based on his belief in the importance of freedom, both in politics and in science.

12). Shin' ichiro Tomonaga (1906 - 1979), won the 1965 Nobel Prize for Physics for his investigation of problems and apparent inconsistencies in quantum theory.

13). Jonas Salk (1914 - 1995), discovered the polio virus, enabling later development of the polio vaccine.

14). James Watson (born in 1916), worked with Francis Crick on the structure of Deoxyribonucleic Acid, DNA, the chemical which is responsible for carrying the genetic information of living organisms.

15). Chien - Shiung Wu (born in 1912), received the Nobel Prize in 1957 for theory about nuclear decay.

16). Alan Turing (1912 - 1954), wrote a paper describing a theoretical computing device which solved problems through a sequence of discrete steps. These ideas were applied afterward as the fundamental theory of the digital computer.

The NSM opens further after the reception and information area in this section. The exhibits mentioned focus on various great and famous scientists in the past. In the researcher's view, such contents make a good beginning for the museum. When beginning to study something new, one begins with a literature review or historical background. This exhibit offers background knowledge about the experience of the great scientists of the past. Many of the discoveries, inventions or innovations of these scientists help us see what "science" actually is. In addition, this knowledge may be a spark which leads visitors to better appreciate the exhibits which follow. In other words, the knowledge and learning about science illuminated by the pioneers of science provide a prototype or inspiration for visitors, especially children, about the importance of scientific learning or research. This appreciation is relevant to science activities, discoveries, inventions, innovations etc. The exhibits in this section are composed of many illustrations which are good interpretations with text describing the relevant content.

Background of Science Museum. These exhibition panels introduce the Science Museum, its background, mission, building design concept, and construction process. Also displayed is information about the concept of exhibition design and about developments which integrate modern technology to make displays more interesting and effective.

- *Meeting point* presents a model of the Science Museum building, the so-called “Cube Building”, and serves as a convenient meeting point for visitors.
- *Cyber station* offers an information center where visitors can search for information on the web through the internet service. Staff are always there to introduce the service and to help visitors to use these Net services effectively.
- *Temporary exhibition halls 1 and 2* present various kinds of locally produced or imported exhibits on varied topics in a display area of about 1,000 square meters.

Generally, the 1st floor is an open area. *Meeting point* is adjacent to reception and information in the horizontal space. In additional, it is visible through open space from the 2nd floor above. A suspended model of the globe also catches the interest of most visitors.

The *Cyber station* information area is large but, unfortunately, it is not used to full capacity at present. Actually, the function of this area is similar to a library. It is geared toward visitors who plan to spend more time doing research and using other facilities in this area. Since most visitors are children arriving with school-class groups, they must keep up with guides and their group and are not free to spend more time in this zone.

In the *Temporary exhibition* areas, circulation of the 1st hall allows visitors to walk in and out freely. This means that they can easily revisit some of the exhibits. The areas here which are in a blind zone should therefore be relocated along the main pathways which people walk along when they are touring this part of the museum.

Figur 57 *Meeting point of NSM.*

Sources: *The author and Jarujin Nabhittabhata (editor). 2002.*

History of Science and Technology, 2nd floor

This gallery reviews the history and emphasizes the impact of science and technology on life on the earth on which we live. Visitors are brought into the world of science and technology on earth and in space as they view chronologically displayed historical events.

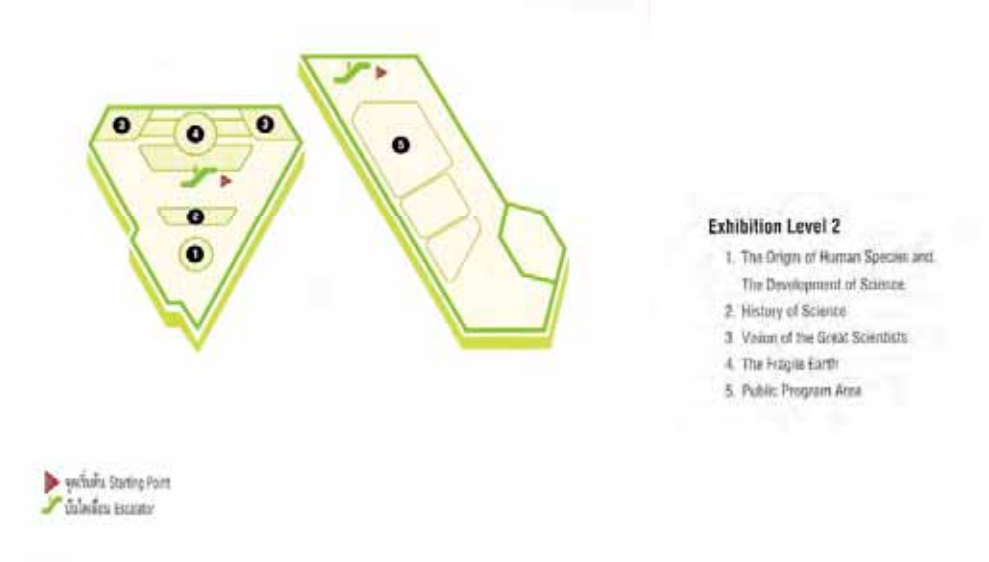


Figure 58 *Exhibition Level 2nd Lay-out*

Source: *Jarujin Nabhittabhata (editor). 2002.*

- *The origin of the human species and the development of science*. This exhibit commences with a life size figure of “Lucy,” cast from the fossil found in Ethiopia in 1974. Lucy has been classified as the oldest hominid genus, Australopithecus, which represents the appearance of human life on earth. Above this figure is Leonardo Da Vinci’s famous design for a flying machine, and higher still, the form of an astronaut on a space walk repairing a satellite in space. This exhibit group shows the never-ending advance of science and technology.

In this section (Figure 59), the push of a button provides an audio description for visitors. The object exhibited overhead is not visible, however, to the person actually standing in front of the exhibit. Few look up to seek out this exhibited object. Moreover, the presentation does not give clear information about the gliders which were the origins of the airplane.

- *History of Science.* Adjacent is the time line illustrating key events in the history of the development of science and technology and showing the rapid acceptance by Thailand of science and technology, commencing as early as 1,000 AD, as evidenced by very high quality bronze casting. The time line illustrates:

1). Communication, the development of writing, the invention of paper and printing, the abacus, the telegraph, telephone, and advanced technology of satellites.

2). Energy, the discovery of various methods of conversion and transfer of energy, and the development of natural energy resources.

3). Earth and space, setting out key events in cosmology and astronomy.

4). Matter, presenting key events in the history of chemistry which led to the understanding of the atomic and molecular structure of matter and compounds.

5). Living things, setting out the steps of phenomenal discoveries in the biological sciences such as the structure of DNA and the chemistry of living systems.

Behind the time line are five imposing cones depicting advances in science and technology.

This area is designed to appeal especially to children not less than 12 years old and to adult visitors. The exhibit content in this area is hard to understand, and the lettering of the titles and subtitles is too small. Most visitors probably do not understand what NSM wants to tell them in this section. The exhibition for history of science should communicate and interpret more clearly than this.

Figure 59 *The figure of "Lucy"*
Source: *Jarujin Nabhittabhata (editor). 2002.*

Figure 60 *Leonardo Da Vinci's famous design*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 61 *History of science*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Vision of the great scientists*. These displays enable visitors to listen to voices representing six great scientists and philosophers who explain their own conflicting and yet strangely similar views of the world.

1).Charles Darwin (1809 - 1882), who suggested that types of animals and plant species have changed over time.

2). Dmitri Mendeleyev (1834 -1907), who suggested a classification system for chemical elements, based on their atomic weights.

3). Aristotle, who developed a hierarchical structure of nature, saying that earth, water, fire and air are the primary bodies from which everything else is derived.

4). Isaac Newton (1642 - 1727), who presented a theory of universal gravity explaining the orbits of the planets, the flattening of planets at their poles and the phenomena of tides.

5). Rene Descartes (1596 - 1650), who suggested that the physical world could be understood as a mathematical system deduced from a series of principles.

6). Albert Einstein (1879 - 1955), who overturned classical physics with his general theory of relatively. He related energy to mass in his famous equation $E=mc^2$.

This exhibit uses LCD media. It works well and succeeds in helping visitors gain new learning. Pushing a button to listen to each speaker makes the exhibit more interactive.

- *Fragile earth*. This exhibit aims to build understanding about the appearance of human beings on earth, the growth and development of science and technology, the impact of human beings on nature, and the delicate balance of the ecosystems that characterize the planet.

- *Facilities for public programs*. The second floor also houses components of facilities for public programs, which are :

1). *Science show theatre*. This theatre has a specially designed stage and can be multipurpose for different kinds of science education activities. Science shows cover various topics in both basic and applied science. The shows are performed by NSM staff and volunteers.

2). *Conference room*. Available to outside organizations upon request, this medium-sized room is designed to host meetings, seminars and other activities. It is well-equipped with IT facilities.

To sum up, most visitors appear not to understand the aim of this exhibit in the section of *Fragile earth,* which is entered through the sphere of the globe. The shapes, forms and atmosphere of the visions of great scientists, as presented, are quite attractive to the children. In the dark space, there are wide-screen monitors which display the imaginative visions of great scientists. Nonetheless, the content here is too abstract and difficult for the general public to appreciate. The Science Museum should provide more exciting, interactive presentations.

Figure 62 *Vision of the great scientists*

Source: *The researcher*

Figure 63 *Fragile earth*

Source: *The researcher*

Figure 64 *Science show theatre and conference room*

Sources: *The researcher and Jarujin Nabhittabhata (editor). 2002*

Basic Science and Energy, 3rd floor

The exhibition on this level is aimed at introducing basic principles about science and energy, mainly through interactive exhibits which allow first-hand experimentation and learning, and which encourage accurate understanding by visitors. Exhibits are grouped by subject, such as mathematics, light, and force and motion. Scientific concepts are illustrated behind the displayed artifacts, and applications are illustrated in both Thai and English on colorful panels. Touch screens serve as alternative devices for information searches. A mini-theatre with a multi-vision projector system shows a film about energy in action to emphasize the significance of such power as a resource for humans.

Figure 65 *Exhibition level 3rd Lay-out*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Sound*. This exhibition explains and illustrates the behavior of sound and the application of such knowledge. Visitors learn about how sound travels through various media such as air, ice and water, about the cause of echoes, the transmission of sound through tubes of different sizes, and the production of musical notes from combinations of sounds of different pitches and tones. Musical instruments, string, percussion and wind, displayed in this exhibition reflect the high degree of understanding of sound by inventors of the past. The exhibition comprises the following exhibits.

1). *Speaking Dishes*. Two parabolic dishes are placed at a distance from each other, far enough so that a person at one dish cannot hear a word directly from a person at the other dish. When the person at one dish speak softly at the dish in front of him, however, the sound waves of his voice travel to the focal point of the dish and then reflect back to the focal point of the other dish on the opposite side of the area. The person at the second dish is able to hear clearly and distinctly the voice of the person at the other dish. This method is similar to the means used for the transmission of sound and radio waves over long distances on land and into outer space.

Speakers at both dishes can see each other, with the escalator between them. The exhibition is well positioned.

2). *Sound Tubes*. This exhibit demonstrates the behavior of sound when transmitted through tubes of different sizes. Speaking into a tube, one hears a strange voice coming out. If the diameter and the length of the tube varies, the sound produced varies as well. The exhibit provides intriguing demonstrations and answers about how the music of sound can be varied systematically.

This presentation is interesting with its simulation models, but the positioning of the tubes is quite low, more convenient to younger children than to older ones.

3). *Sound Wave and Musical Notes*. This exhibit shows how different pitches and tones are made by musical instruments. When a string is plucked, hit, or otherwise stimulated, it causes the air molecules around it to move and vibrate as well. The vibration is passing from one molecule to another, moving the sound across the room to our ears. High and low pitches are caused by vibration at different frequencies. A shorter string makes a vibration at a higher frequency, thus giving higher pitch. Playing on strings of different sizes can produce combinations of high and low pitches or musical notes. String and percussion instruments operate on this concept. The objects in this exhibition are not focused and highlighted, which makes the exhibit a bit dull in appearance.

4). *Sound Waves*. This exhibit consists of circular plates and tubes made from different metals. A graph pictures the different tones produced when the plates and tubes are struck. This knowledge has various applications, a few of which are shown here. This is another of the exhibits which does not receive much interest from children due to its nondescript appearance.

5). *Echoes*. Sound reflects from hard surfaces such as glass or brick walls. The reflection of sound from a distant surface, allowing us to hear it again, is called an echo. Visitors can experience an echo from the “Echo Chamber” in this exhibit. Ships use echoes to chart the depths of the sea. Echoes in a concert hall can be reduced by using carpets and soft materials to absorb the sound. This interactive presentation is a favorite with children.

Figure 66 *Speaking Dishes*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 67 *Sound Tubes*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 68 *Sound Waves and Musical Notes*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 69 *Sound Waves*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 70 *Echoes*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Mathematics*. This exhibit presents mathematics in a way intended to dramatize that math is much closer to our lives than most people realize. Examples ranging from counting to measurement of distance and volume, with calculation as well as mathematical theories, can be explored in this area. Visitors can learn about and sample different kinds of measuring devices and calculators, both simple and advanced, from a touch screen at the exhibition. Exhibits in this area cover the following subjects:

1). *Counting*. This exhibit allows visitors to compare the efficiency of counting by hand compared to using a counting device.

2). *Addition*. This exhibit introduces the abacus, an ancient device used for addition and subtraction. Visitors can compare doing calculations with an abacus with using an electronic calculator.

3). *Multiplication*. The relationship between multiplication and addition is demonstrated in this exhibit.

4). *Pythagoras.* Visitors are invited to prove a theorem by Pythagoras, the ancient Greek 'Father of Mathematics', which states that "the square of the hypotenuse of a right triangle is equal to the sum of the square of the other two sides."

5). *Measuring Angles*. The theodolyte displayed here is a device used for measuring angles. Visitors can use this device to measure angles between different objects around the gallery.

6). *Measuring Distances.* From this exhibit, visitors can learn about the different ways by which distances can be measured, and the various measuring units that have been used from the past to the present. Modern measuring devices are displayed, including one which is based on the understanding of the behavior of light. Modern scientists use this method to measure the distance to the moon.

7). *Volume.* Three kinds of differently shaped containers, i.e. triangular, rectangular and circular, are presented here and the visitor invited to judge the volume when the same amounts of liquid are poured into the containers. It is obvious that the shapes of some containers make it more difficult to judge their volume.

Figure 71 *Counting, Addition and Multiplication*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 72 *Pythagoras*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 73 *Measuring Angles*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 74 *Measuring Distance*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 75 *Volume*

Source: *Jarujin Nabhittabhata (editor). 2002*

The Science Museum succeeds by piquing and responding to visitors' curiosity. The *Pythagoras* presentation is a successful, interactive exhibition. By contrast, the large, colorful *Counting, Addition and Multiplication* presentation boards, though striking, are not interesting, and fail to keep the attention of visitors. Furthermore, many more stimulating topics could be used by the NSM in the *Addition* exhibit section. The *Measuring Angles, Measuring Distances* and *Volume* presentation offers only the most common teaching examples and is not innovative. There are also too many objects in the exhibit, which lacks an interesting focal point.

- *Light***.** This exhibition is displayed in a darkened space, specially designed to prevent the entry of light. The objective of the exhibition is to demonstrate the nature and behavior of light, including its reflection, refraction, and combination of colors and shadowing. Various behaviors of light are shown, including the technology of optical fibers which has revolutionized the telecommunications industry. The exhibits in this dark room include the following:

1). *Lens and Prism*. Both concave and convex lenses refract light rays. While light rays converge in a concave lens, they diverge in a convex lens. The particular shape of a prism refracts white light into the different colors which we call the *spectrum*. Visitors will discover the amazing behavior of light in this exhibit, which presents more clearly some objects which we could not see clearly in nature. This part is colorful but, unfortunately, it is very difficult for visitors to understand.

2). *Light and Color*. The white light we see is actually a combination of several colors. Most colors are the result of mixing two or three of the primary colors, red, green and blue. This exhibit allows visitors to have fun creating different colored

lights. The researcher, however, suggests that there are more effective and meaningful ways to help the visitors understand the character of light.

3). *Shadow.* When an object obstructs the light path in this exhibit, some light falls on the screen while some does not, thus creating a shadow. The visitors can create their shadow on a screen coated with a light-activated chemical which helps reveal the relationship between light and shadow. This exhibit section is interactive and allows visitors to become more directly involved in the learning process.

4). *Optical Illusion.* Optical illusions are often mistaken for supernatural phenomena. This exhibit shows how an illusion can be produced on a pane of glass placed at 45 degrees to an object with a light beneath. This is a familiar museum technique. The researcher suggests that some more imaginative method of exhibition be conceived in this case.

5). *Optical Fibers.* The display presents optical fiber, a wonderful material that makes information transfer much more efficient. As light reflects along the internal surface of the glass fiber, it is transmitted from one end of the cable to the other with minimal loss, compared to other means of transfer. Cables made with bundles of optical fibers are now laid along the ocean floor to provide efficient connections. These cables enable the transfer of light along the optic fibers. Visitors are dramatically impressed when they see the intensity of light emitted from the end of the cable in the exhibit.

6). *Camera Obscura.* The ‘”camera obscura” was developed 200 years ago. It consisted, basically, of a dark room with a pinhole lens on one of its walls and a screen on the other end of the room. Since light travels in straight lines, it enters the pinhole lens and falls on the screen in the darkened room. An inverted image of the view outside would appear on the wall. An image of the gallery outside can be seen in this exhibit. It is a very typical presentation which most children have seen in their science classes.

Figure 76 *Lens and Prism*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 77 *Light and Color*

Source: *Jarujin Nabhittabhata (editor). 2002*

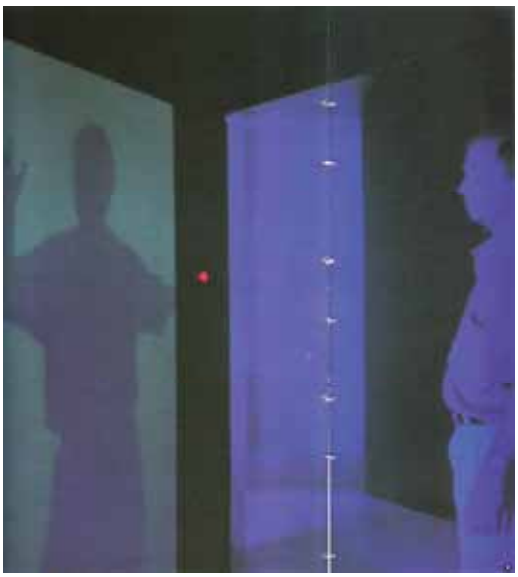


Figure 78 *Shadow*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 79 *Optical Illusion*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 80 *Optical Fibers*

Source: *Jarujin Nabhittabhata (editor). 2002*

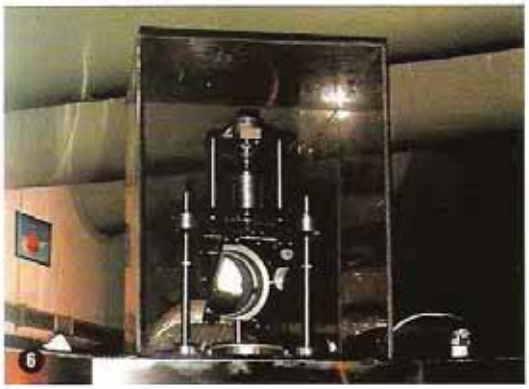


Figure 81 *Camera Obscura*

Source: *Jarujin Nabhittabhata (editor). 2002*

○ *Electricity*. One of the necessities in our lives today is “electricity.” Since electricity cannot be seen, this exhibition aims at creating a better understanding with presentations on electrical charges and the production and conversion of electricity into other forms of energy. The exhibits in this section are as follows:

1). *Electricity from the sun.* As people consume more and more electricity, it is necessary to find ways of making electricity without polluting the air or consuming the earth’s natural resources. Solar cells made of silicon or other semiconductor materials convert solar energy directly into electricity. Visitors can manipulate a solar cell panel and examine the electricity generated by the cells. This exhibit is another very typical and unimaginative one.

2). *Electrical Circuit*. When charged particles called electrons move through a media such as a metal or solution, we call it electricity. In an electrical circuit, a cell causes the electrons to flow along a wire to the other end and back to the cell, thus completing a circuit. By connecting with electricity, an appliance receives the energy it needs to do its work. Visitors can learn from this exhibit how electrical circuits are connected and how electrical current flows. However, most of them seem not to understand the explanations presented in the exhibit.

3). *Battery.* A number of cells linked together are called a battery. Alessando Volta, an Italian scientist, invented the first battery from leather soaked in salt solution interleaved between zinc and silver discs. The unit of energy, the “Volt”, is named after Volta. Visitors are introduced to various kinds of batteries and their different properties. Since there are many exhibit stations like this, it is not of much interest to visitors.

4). *Static Electricity.* When rubbing certain kinds of objects over each other on a day with low humidity, the objects become electrically charged, and can be used to lift small pieces of yarn or flour. This exhibit allows visitors to create static electricity and to investigate its properties. As with the presentation on Electrical Circuits, most visitors cannot understand this exhibition.

Figure 82 *Electricity from the Sun*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 83 *Electrical Circuit*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 84 *Battery*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 85 *Static Electricity*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Magnetism*. This exhibition deals with magnets, their properties, magnetic force, and its application and uses in various common devices such as a compass, a microphone or a stereo system. The display includes the following:

1). *Magnetic Forces – Attraction and Repulsion.* A magnet exerts a most interesting and invisible force. It is attracted to other magnetic materials and can be used to lift magnetic materials such as iron or steel. A few magnets are made from iron, but most are made of alloys of nickel and cobalt or special ceramics, materials which we refer to as magnetic. A magnet has two poles, north seeking and south seeking. The north seeking pole of one magnet will attract the south seeking pole of another, but like poles repel one another. The presentation board and the exhibit object communicate the content well.

2). *Electromagnets*. When an electric current flows through a wire wound into a coil, the coil becomes a magnet. This temporary magnet is called an electromagnet. The magnetic force becomes stronger when a larger electric current flows, or when the number of turns in the coil increases. This exhibit offers an opportunity to try to make an electromagnet and to examine its attraction force. There are several more interesting exhibit objects, and this one does not stand out from the others.

3). *Spin the Coil - Generate Electricity.* Besides its attraction and repulsion properties, a magnet or a magnetic field is also used for production of electricity, as shown in this exhibit. As a metal coil moves through a magnetic field, electrical current is generated. Visitors will enjoy seeing how their energy can be transformed to produce electricity. This interactive exhibit object is outstanding because of its size and the opportunity for visitors to participate.

4). *The Application of Electromagnets*. Metal detectors are one of the applications of magnets used for security. When a piece of metal passes through the electromagnetic field of a detector, the device will sound an alarm. A Maglev train applies electromagnetic technology on rails to make a smoother ride. Electromagnetic cranes are used to lift heavy loads in factories. These are a few examples of applications of electromagnets. This exhibit is similar to others which have only narratives on the presentation board.

Figure 86 *Magnetic Forces*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 87 *Electromagnets*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 88 *Spin the Coil - Generate Electricity*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 89 *The Application of Electromagnets*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Forces and Motion*. This exhibition introduces visitors to some of the different kinds of forces around us. These forces such as gravity, air pressure, and friction have tremendous effects on our lives. Visitors will understand the connection between force and motion and view a number of inventions built to aid our daily activities by using our knowledge of force. The exhibits in this area are as follows:

1). *Lifting an object with a pulley*. A pulley is the power-assisted device for lifting an object in the opposite direction to gravity. Combinations of pulleys can help lift heavy objects with much less effort. This exhibit allows visitors to see how this is done with the various pulleys provided.

2). *Gravity and Plants.* All living things on earth, plants as well as animals, are subject to the influence of gravity. The shoots of young plants grow upwards, away from gravity, reaching for sunlight. Roots grow downwards towards the pull of gravity, seeking water and anchoring the plant to the ground. This exhibit demonstrates that when a stronger force affects the plant in another direction, horizontally, for example, the result will be a change in the direction of its growth.

3). *Newton and Force of Gravity.* Watching an apple falling from an apple tree, Sir Isaac Newton realized that there must be a force causing the apple to fall down. This force became known as gravity. Newton was the first person to explain the vast effects of gravity and to propose that the orbits of the moon around the earth and of all the planets around the sun were the result of gravity. Visitors can observe the speed of different sized objects moving under the effect of gravity.

4). *Newton's apple.* Sir Isaac Newton realized that there must be a force that caused the apple to fall to the ground. He performed many experiments with different weighted objects and found that it took the same amount of time for these objects to fall to the ground. This constant force later became known as gravitational force. This exhibit allows visitors to demonstrate the truth of Sir Isaac Newton's theory.

5). *The Bernoulli Blower.* Bernoulli's theory states that moving air has less pressure than the surrounding air. This exhibit shows a ball in a stream of blowing air. The exhibit dramatizes the danger of the power of air caused, for example, by a rapidly moving train. Bernoulli's finding is also applied in the building of the wing of an airplane to create lift, where the upper part of the wing has a greater curve than the under part.

6). *Gear and How it Works.* A gear is a mechanical device for power assistance. A few gear wheels of different sizes demonstrate this helpful power. If we turn a large gear wheel, it can turn a smaller gear wheel, but using the small gear to turn the large gear would be more power efficient.

7). *Gravitation Force and the Solar System.* The seasons occur as planets, responding to gravitational force, rotate round the sun. This exhibit, called a 'gravity well' , will show that the object (planet) that is closer to the center of gravity of the sun is subject to greater force and therefore must move around it at much faster speed.

8). *Centrifugal Force.* Newton's First Law states that a moving object will travel in a straight line if there is no other force applied to it. The moon rotates around the earth because of the gravitational pull of the earth. An ice skater will spin around faster or slower, depending on whether his arms are stretched out or held close to his body.

From the picture (Figure 90), *the Bernoulli Blower* exhibition resembles that overseas science museums (in the next chapter). In the researcher's opinion, there are differences in color, shape and other elements which bring out the interesting points in the display. *Gear and How it Works* (Figure 91) is an interesting display. It would be even better, however, if connected to the function of the engine to show how they work together.

Force and Motion (Figure 92), like many other exhibits, is not a novel presentation. It presents only a narrative which describes Newton's laws on the presentation board. The other exhibit objects are also quite typical (Figure 92). Some are window displays, others stand parallel with the corridor, quite ordinary and unexciting.

Figure 90 *The Bernoulli Blower*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 91 *Gear and How it Works*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 92 *Force and Motion.*
Source: *Jarujin Nabhittabhata (editor). 2002*

○ *Friction*. This force occurs when an object moves on a surface. Friction can cause problems, but most of the time it is very useful in our lives. Friction is reduced when the surfaces of two contacting objects are smooth. Visitors will discover some of the incredible uses of friction as well as ways to avoid problems caused by this force. The exhibition has the following exhibits on display.

1). *Down the Slippery Slope.* When an object moves on surfaces of different materials, the friction that occurs in each case is different. Friction varies with the smoothness and composition of the surface. This exhibit offers simple experiments which examine friction arising on surfaces comprised of different materials.

2). *Send the Train on its Way.* This exhibit shows a miniature train moving uphill. The energy from electricity turns the wheels, pushing the train forward. Friction between the wheels and the tracks keeps the train going on the track. Visitors can see that as the train climbs up higher, gravity becomes greater than friction. The wheels no longer grip the track, and the train slides down due to gravity.

3). *Lubricant.* A lubricated surface causes less friction in mechanical processes. Machines are made with materials with smooth, shiny surfaces or by separating the surfaces. This exhibit shows a sample mechanical process and allows visitors to examine friction when there is lubricant in the system and when there is not.

4). *Wheels and Brakes.* Though friction damages surfaces and causes problems to machines and equipment, we cannot live without it. This exhibit allows visitors to observe how a brake works to stop a wheel from moving, and lets them feel the friction needed to stop it. Our safety relies very much on friction, for example between car tires and road surfaces, and between our feet and the floor.

For *Down the Slippery Slope* and *Send the Train on its Way*, the exhibit objects (Figure 93) make an abstract presentation which does not communicate well with children. The exhibit should be realistic and interpret more clearly than this.

For the *Lubricant* exhibit, (Figure 94), the background is particularly distinctive. However, it should not overwhelm the object exhibited in front. For the section on *Wheels and Brakes* (Figure 95), the visitors will see the wheel in the clear glass cabinet and the narrative on the presentation board behind. The problem in this exhibit is not to show the function of the Wheels and Brakes, but to illustrate only the friction of wheels on the road. These exhibits, clearly, do not meet their objectives as well as they should.

Figure 93 *Down the Slippery Slope and Send the Train on its Way*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 94 *Lubricant*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 95 *Wheels and Brakes*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Matter and Molecules*. The objective of this exhibit is to create a better understanding of matter and molecules, illustrating facts about water and its composition, crystals, and the molecular structures of some substances. Visitors are invited to consider the four states of matter, liquid, solid, gas and plasma from the exhibits in this area which include:

1). *Plasma*. The fourth state of matter is plasma in which the number of positive and negative ions is relatively equal. This state brings about changes in the electrical properties of matter. Hydrogen gas, for example, usually does not conduct electrical current, but when it is in the plasma state, it will. Matter can assume a plasma state when subjected to heat, radio waves, or an electromagnetic field. Familiar examples of plasma in nature are lightening and the plasma inside the sun.

2). *Liquid Crystal.* The molecules of liquid crystal move freely as molecules in liquid, but mostly they are nicely arranged, like the molecules in a solid. Therefore, liquid crystals can behave like liquids and solids. This exhibit shows the special characteristics of liquid crystals and the changes in their physical properties when heat or electricity is passed through them. Liquid crystals are used in the display panels on calculators and digital watches.

3). *The Elements in Water*. This exhibit illustrates the chemical process of electrolysis, or decomposition by electricity. A water molecule is composed of two

elements, hydrogen and oxygen. By passing electricity through water, the two elements can be separated. Electrolysis can be done in other kinds of solutions as well. When water molecules gain or lose an electron, they decompose into hydrogen and oxygen ions. The hydrogen ions accumulate at one electrode and oxygen ions accumulate at the other. Visitors will witness this chemical reaction and find that these unstable ions will react and form a new molecule.

4). *Crystal.* As water evaporates from a solution, the concentration increases, resulting in crystallization of the substance in the solution. Decreases in temperature also cause crystallization. When a crystal is gradually formed over a period of time it has a unique arrangement peculiar to that particular substance, resulting in a crystal of a distinct color and shape. From these observations, scientists were able to hypothesize about particles inside each kind of substance. This exhibit displays the remarkable shape and growth of crystals formed in different kinds of solutions.

5). *Fluidized Bed*. This exhibit displays a system called a fluidized bed, in which solid particles behave as a liquid when air is blown in, separating the particles and making it possible to float an object in the solid. Visitors can examine this system with their own hands. Since air blown through solid particles helps to increase the separation between particles in the system, fluidized beds can be used to speed up chemical reactions.

The exhibits on *Matter and Molecules* tend to have excessive narrative descriptions on the presentation boards. Most visitors do not want to be burdened with all this reading. The presence of facilitators to explain and describe the exhibit would be a better solution. In the researcher's opinion, it would be better if the presentation colors were tints rather than fully saturated.

Figure 96 *The Elements in Water*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 97 *Plasma, Liquid Crystal and Crystals*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 98 *Fluidized Bed*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Heat*. This exhibit deals with heat and its characteristics, including the different ways heat can be transferred by conduction, convection and radiation. Visitors will discover the uses of heat transfer, and will explore many types of thermometers. Materials used as insulators are also considered. The exhibits in this area cover the following topics:

1). *Conduction.* Heat conduction is the transfer of heat from molecule to molecule. When they get hotter, molecules vibrate faster. As they bump into each other, their vibration passes along and so does the heat. Heat travels faster in metal than in wood or liquid. Plates made from different kind of materials are displayed which allow visitors to determine the ones with the best heat conductivity.

2). *Convection.* Molecules of gas and liquid are constantly moving. In the process referred to as convection, heated molecules convey heat as they move in different directions. Visitors can trace the direction of movement of heated liquid molecules in this exhibit.

3). *Radiation.* Heat radiation is the transfer of heat with no medium involved, as when heat travels to the earth from the sun. In this exhibit, visitors can feel heat radiating and how it is absorbed by different materials.

4). *How Hot Are You? (Thermometers)*. A thermometer is a device used for measuring the level of heat. A thermometer usually contains a chemical that changes in volume or color when temperature increases or decreases. This exhibit displays various types of thermometers used nowadays. It also features a giant thermometer filled with liquid crystal which changes color in accordance with temperature and helps visitors measure their own body temperature.

5). *Conductors and Insulators.* This exhibit demonstrates the uses of combining materials which are good conductors with materials which are not. A number of devices are shown which are made from combinations of materials which are good conductors and other materials, called insulators, which are not. For instance, a saucepan is made of metal which heats up quickly. The handle of the pan, however, is made of plastic that remains cool and is easy to hold. Visitors will learn about various kinds of conductors and insulators from this exhibit.

The section on *Conductors and Insulators* communicates very well. The researcher agrees with the presentational approach used in this section. However, the rest of these exhibits do not communicate clearly to visitors. In *Conduction and Thermometers*, for example, the exhibit simply presents different materials such as aluminum, bronze and copper without actually illustrating heat conduction.

The presentation on *Convection* consists of narrative descriptions with illustrations on the presentation boards like other exhibits in this section, but having visitors touch and feel different textures and materials does not actually provide a convincing explanation of the concept of 'radiation.'

Figure 99 *Conduction and Thermometers*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 100 *Convection*
Source: *Jarujin Nabhittabhata (editor). 2002*

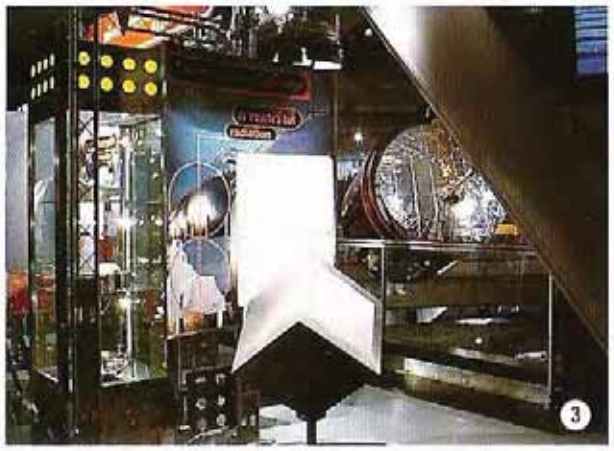


Figure 101 *Radiation*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 102 *Conductors and Insulators*

Source: *Jarujin Nabhittabhata (editor). 2002*

○ *Energy tunnel*. This exhibition is displayed in a long tunnel located in an area apart from other exhibits. It illustrates various forms of power existing on earth. Energy from food, for example, becomes muscular energy which we use in our daily activities. Energy from natural resources such as wind, water, and fossil fuels as well as energy produced by nuclear reaction are considered in this area. Visitors will be shaken up by an earthquake platform, an artificial earthquake representing the power of the earth. New technology, the solar cell, which converts solar energy into electricity, provides an environmentally friendly source of energy. The exhibits in this area cover the following topics:

1). *Muscular Energy.* Energy that we used in our daily activities is sent through blood vessels after the digestion of food. Fat, proteins, and food rich in carbohydrates such as starch and sugar can potentially supply more energy. Our body needs this energy to repair and nourish our cells and to drive all activities. Many examples of rich, nourishing food are on display. The exhibit invites visitors to try converting their muscular energy into electricity, which is then transformed to kinetic energy in a small moving vehicle.

2). *Water Power.* Power from moving water can be used to produce electricity. This is hydroelectric power. Water passing through a high dam contains enough energy to turn turbines in a generator; the higher the dam, the greater the energy. In some countries, tidal energy is also being harnessed to generate electricity. The model of a hydroelectric system displayed in this exhibit shows how the energy is transformed.

3).*Wind Power.* Wind power has been a useful source of energy for thousands of years. Nowadays, wind power is used to turn windmills designed to turn generators, thus producing electricity, as displayed in this exhibit.

4). *Energy from Fossil Fuels.* Energy from coal, crude oil, and natural gas has been used by humans for ages. However, in the past 200 years, this carbon based energy has resulted in the rise of carbon dioxide levels in the air, which has led to a 'green house' effect and global warming. This exhibit studies these fossil fuels and explains the importance of using them more carefully as we seek other, substitute sources of energy.

5). *Nuclear Power.* Nuclear power is becoming a major power source in some countries. This exhibit shows how electricity is generated in a nuclear power plant. This exhibit suggests that if the nuclear power is used carefully, the benefits may be greater than the dangers involved.

6). *Solar Energy.* As fossil fuels used for energy production are depleting, solar energy offers an alternative source. Transformed into electricity by solar cells, the energy of the sun is clean and virtually unlimited. Visitors will see how solar cells are used in this exhibit.

7). *Power of the Earth.* Earthquakes are caused by the movement of the huge plates of rock that form the surface of the earth. The result is the release of an enormous wave of force through the earth. Thailand is not located in an earthquake zone like Japan or the Philippines, but visitors can glimpse something of the awesome experience of an earthquake from this exhibit.

The huge *Energy Tunnel* is an interactive exhibition which attracts many curious visitors. Musc*ular Energy* is in the first part of the tunnel (Figure 103).

The section on *Water Power* fails to show how waves are actually transformed into energy.

The next exhibit, *Wind Power,* compares old-fashioned and modern windmills with crucial audio effects dramatizing the energy of the wind. Effective description is an important element in communicating with museum visitors.

After that, the *Energy from Fossil Fuels* exhibit offers a simulation model showing the use of energy from coal, oil and natural gas. In this researcher's opinion, the model communicates less than the motion pictures. Visitors will better understand the VTR presentation.

Next is the *Nuclear Power* presentation (figure 108). Most visitors do not gain much new insight or understanding from this rather technical presentation about a complex and controversial process.

The next exhibit, *The Solar System*, does not do a good job of communicating with the audience. The model simulates solar cells and residential areas (Figure 109).

The final exhibit in the tunnel is the *Power of the Earth*. This is the interactive highlight, as visitors experience a shaking floor simulating what might be felt during a real earthquake. This display is supposed to treat the idea of harnessing the energy of an earthquake for useful purposes, but does not achieve this objective.

Most exhibit objects in the Energy tunnel are using narrative sounds in their audio presentations. The questionnaires and observations from this dissertation show that, in the absence of such narrative sound, visitors do not understand the presentations.

Figure 103 *Energy Tunnel*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 104 *Muscular Energy*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 105 *Water Power*

Source: *Jarujin Nabhittabhata (editor). 2002*

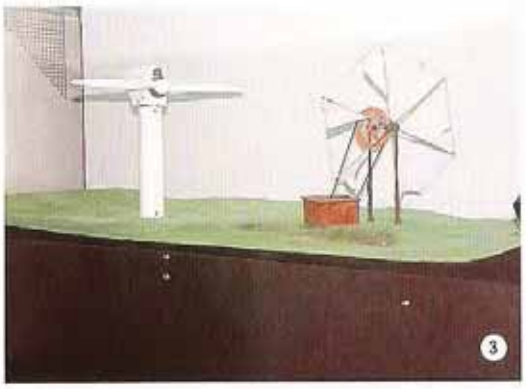


Figure 106 *Wind Power*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 107 *Energy from Fossil Fuels*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 108 *Nuclear Power*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 109 *Solar Energy*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 110 *Power of the Earth*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Cinema*. A cinema located on this floor shows a film on using energy in our daily lives and about the many other forms of energy around us. The aim is to raise audience awareness about energy conservation. Unfortunately, audiences tend to drift in and out of the theater, or simply use it as a rest area, without seriously attending to the film.
- *Chemistry.* This exhibition presents information on matter, molecules, molecular bonds and chemical reactions displayed on touch screen computers. More interested visitors can search for more detailed information. This is a pure science exhibit using typical methods such as question and answer formats on computers.

Figure 111 *Cinema*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 112 *Chemistry*

Source: *Jarujin Nabhittabhata (editor). 2002*

Science and Technology in Thailand , 4th floor

The overall theme of the exhibition in this gallery is understanding Thailand. After viewing all the exhibits, a visitor will have a better understanding of the natural history of Thailand, the country's global setting, its geology, ecology, economic and physical geography, engineering principles associated with structures, agriculture and industrialization, and the power of nature. Various types of presentation are used in this gallery. There are graphic panels illustrated and scripted in both Thai and English, video presentations, artifacts, and interactive exhibits that visitors can touch or experiment with. Touch screens are also available for those who want to search for more information.

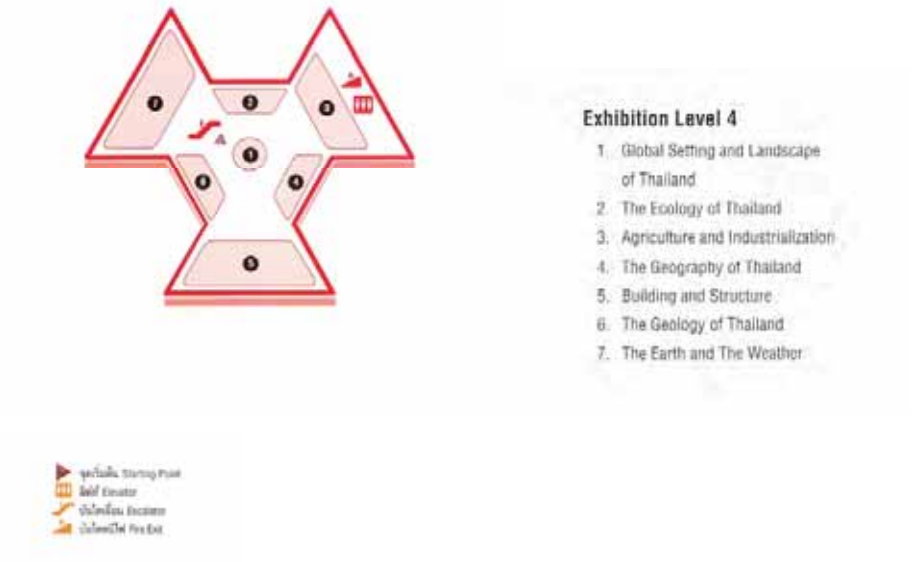


Figure 113 *Exhibition level 4th Lay-out*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Global Setting and Landscape of Thailand***.** The visitor is presented with the global setting of Thailand by means of a globe, 2.2 meters diameter, rotating in real time with simulated day and night. A series of four models arranged beneath this globe show pictures of city and suburban landscapes, industrial scenes, and the rural landscapes of the countryside. In this display, visitors see the diversity of the environment in each region as it affects the settlement and everyday lives of the community.

1). *City and Suburban.* This model shows the pattern of a city landscape in comparison with a suburban landscape, as in Bangkok, for example. As the community grows, much of the nation's commercial, political and social life focuses on the city. Increased population brings dense traffic, more construction, and the need for more housing. Many people prefer to live in less densely populated suburban areas. Therefore, efficient transport systems linking cities to suburban areas are essential.

2). *The Industrial Landscape.* This model pictures an industrial estate in which factories and warehouses are the main components. Such communities are usually located near seaports so that goods can be transported for delivery to distant population centers.

3). *A Shoreline Town.* This exhibit shows how people live and follow their occupations in coastal areas. Fishing is the main activity, but tourism offers better job opportunities and higher earnings in this area.

4). *Rural Landscape.* This image of the Chao Phraya basin is an example of a rural landscape in Thailand. It shows the life style of people in provincial areas.

The picture (Figure 114) shows a simulation of different parts of Thailand. The model communicates well and helps visitors understand. However, the large globe, rotating in real time with representations of day and night is unnecessary in interpreting the physical character of Thailand. Visitors hardly perceive its meaning.

Figure 114 *Landscape models of Thailand*.
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 115 *The 2.2 meters diameter globe model shows the global setting of Thailand*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Geography of Thailand.* This exhibit demonstrates how the continent on which Thailand is located was formed. Two hundred and fifty million years ago the world consisted of one land mass in one ocean. Fifty million years later, this huge land mass began to break up, forming two major land masses, Gondwanaland in the south, and Laurasia in the north. Thailand used to be part of the Laurasia continent. Gondwanaland split into pieces, and India began floating towards Asia. Eventually, India collided with Tibet, which was then an underwater shelf. This tremendous collision pushed Tibet up out of the sea. The impact also caused the mainland of Southeast Asia, where Thailand is situated, to buckle and fold along three nearly parallel lines, forming the main mountain ranges of the region. At the same time the central plain sank, forming a basin.

Through this exhibit, visitors can see different types of landscapes across Southeast Asia, of which Thailand is one part. The character of the land differs from one geographic location to another. Most of the areas in the north, west, and south comprise mountain ranges lying in a north-south direction. The area in between is a fertile flatland with several rivers. Two huge central plains are separated by a mountain range. In the north eastern region, there is a highland area with the Mekong River as its main resource of water.

Due to the diverse character of Thailand's geography, types of soil in each region vary. Farming is also different, and occurs even in woodland areas. The visitor will learn about different types of farming and crops, and see different views of Thailand's geography.

The formation of Thailand with geographic map (Figure 116) is easy for most visitors to understand. But many visitors do not grasp that *the geographic map* (Figure 117), is a view from high above the earth. The *Information touch - screen* (Figure 118), computer presentation communicates well with visitors, but access is limited to only one monitor.

Figure 116 *The formation of Thailand with geographic map*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 117 *The geographic map over looking from space*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 118 *The Information touch- screen.*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Geology of Thailand.* Information about the main geological regions of Thailand is illustrated in the form of graphic panels and objects. Several types of rock are displayed, along with colorful panels describing the formation of rock such as granite, sandstone, and limestone. Thailand is rich in a number of minerals found within these main rock types, for example, tin, tungsten, zinc and coal, as well as precious stones such as rubies and sapphires. The presentation also covers a story about fossils along with a model, situated in the centre of the exhibition. The famous

Thai geologist, Mr. Varawuth Sutheethorn, is depicted working on a dinosaur fossil that he first found at Kalasin, a province in the northeast of Thailand.

The panel board exhibit on *quarrying and mining in Thailand* (Figure 119) is quite ordinary and does not attract much interest from visitors. The *model representing dinosaur fossils found in Kalasin* is much more successful.

Figure 119 *Panel shows quarrying and mining in Thailand.*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 120 *Model represents dinosaur fossil found in Kalasin.*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Ecology of Thailand.* Thailand used to be a rich habitat for flora and fauna from woodlands and plains to coral reef areas. Until the 1930s, 70% of Thailand was covered with forest. The trend toward industrial development has changed land utilization during the past 30 years. Today, only 15% of the national area is undisturbed woodland. Laws and regulations were passed in attempts to preserve these natural resources, and several national parks were established. Various types of ecological systems in Thailand are presented in this exhibit to illustrate some relations among plants, animals and humans in each system.

Figure 121 shows a model of the deep sea eco-system. In the researcher's opinion, this should be on a 1:1 scale. The exhibit could much more effectively dramatize for visitors the feeling of the deep sea. *Graphic panels illustrate the bio-diversity of Thailand* (Figure 122) is a typical computer and panel board which is generally in use in the exhibition. Beyond the *Human activities impacts on the natural ecosystems* is presented using *duratan* technique. Visitors must see the whole thing in order to understand the comprehensive exhibition.

Figure 121 *An under-sea water ecosystem model*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 122 *Graphic panels illustrate the biodiversity of Thailand.*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 123 *Human activities impacts on the natural ecosystems.*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *The Earth and the Weather.* This exhibition explains the physical structure of the earth, how it works, and weather conditions in the lowest layer of the atmosphere known as the *troposphere*, which affects life on earth. The roles of the sun and the moon in determining weather patterns, and the role of science and technology in weather recording and forecasting are also presented in this area. Visitors will see that during the past 200 years, there has been considerable alteration in the environment and in weather conditions due to many human activities.

In this area, visitors are presented with a multimedia interpretation of the Big Bang theory, showing the beginning of the universe along with other exhibits covering the following topics: the Sun, the Earth and the Moon, the water cycle on Earth, the weather, satellites, weather forecasting, geography of Thailand, the effect of weather and geography on living, and the effect of science and technology on the environment.

The interactive exhibit in this area is *Earth Structure and how it works*, which is a simulation model showing the core of the earth. The other exhibits in this area are typical panel boards.

Figure 124 *Big Bang*.

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 125 *Earth Structure and how it works.*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 126 *Weather and Forecasting & Weather Condition.*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Agriculture and Industrialization.* Weather conditions and the fortunate location of the country are the most important factors that enable Thailand to serve as an important source of food for the world. The growth of the economy and industrialization in the past 20 years brought about the modernization of production processes, not only in agriculture but also in industry. More and more science and technology has been introduced into production, generally, from the field through to the manufacturing process. This has meant increased yields and improved production with higher quality for local consumption and export.

The exhibition on these themes shows a model of a manufacturing line revealing the transformation of raw material moving through different processes. Each production phase offers a handle which the visitor can turn in order to get a better idea of the whole process and the importance of the machinery. Models compare old styles of farming and modern farm techniques to give a clear message about how science

and technology benefit agriculture and industry. A rice production line is modeled, starting from planting and going through harvesting, processing in a modern mill, and exporting.

The application of science and technology in other fields of agriculture is also illustrated, showing biotechnology in plant breeding, prawn farming and chicken farming. These activities contribute to higher yields and enable farmers to make use of improved yields to earn more money while producing more food for export. Nowadays, 70% of Thai export products are from agriculture.

In the researcher's opinion, the *models comparing old style farming and modern farming* display should show a process of evolution. The rice processing exhibit and the process of conveying seem rather exotic. If the exhibit showed the real process more convincingly, more visitors would be attracted.

Figure 127 *The models comparing old style farming and modern farming.*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 128 *The model of rice processing and panels of biotechnology*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 129 *Handling machines showing the process of conveying*.
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Buildings and Structures*. This section shows how modern building technologies have been incorporated in the development of structures and buildings, and in the construction of houses in different regions. Some famous sites are modeled and displayed in this area, for example, the Bhumibol Dam, the National Science Museum, the Rama IX Bridge, the Bank of China, and a Thai temple. These models illustrate some principles of engineering and highlight architectural aspects in the design of some famous buildings. Today, the computer plays a major role in architecture design. It enables us to simulate a building and its structure with all details, and to rapidly and precisely analyze the effect of forces and loads on the building before starting construction.

This section should exhibit more bridges, both in Thailand and abroad, and should clarify interesting points about their construction and technology. The *Structures and Foundation* exhibit communicates well. It is interactive. There are more interactive activities for children in the sections *“Build a house” and “Build a bridge”*. *Do it yourself activity* introduces children to basic knowledge in construction. Overall, the fourth floor is very interesting in interpretation and exhibition.

Figure 130 *Bridges*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 131 *Structures and Foundation*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 132 *"Build a house" and "build a bridge" do it yourself model*

Source: *Jarujin Nabhittabhata (editor). 2002*

Science and Technology in Everyday Lives, 5th floor

The exhibits on this floor display the use of science and technology in everyday activities. The presentation is arranged in five groups, comprising body and health, communication and transportation, quality of life, including water and air quality, garbage management and recycling, home and office, and visions of the future. The exhibitions are presented in the form of graphic panels illustrated and scripted in both Thai and English, with examples, interactive exhibits, video presentations and multimedia on touch screen computers.

Figure 133 *Exhibition Level 5th Lay-out*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *The Body and Health.* The sequence of exhibits shows the structure of the body and the part played by medical science and technology in correcting health problems and preventing disease. The presentations give information about the body and how to take good care of it. This display explains the function of the smallest units of the body, the building blocks which we know as cells. It helps visitors understand the position and function of the various organs of the body. Many organs and body parts are modeled larger than life size, i.e. brain, hand, heart, muscle, lungs and digestive system. The panels give considerable detail about the skeleton and nervous and reproductive systems, supported by touch screen displays. Information about a healthy life style emphasizes the necessity of helping the body help itself as we eat healthful food and take regular exercise. Health checks are also provided in this

exhibition, along with a series of panels and displays showing the development of modern medicine and surgery.

The display models of human organ systems are familiar to secondary school students, most of whom have seen these in their classrooms before. This exhibit should be more interactive, showing more functions and processes. However, this model is well interpreted and more communicative than the genetics and inheritance exhibit. The researcher observes that the *Heart operation model* section is not directly relevant to the objective of the exhibit as a whole.

Figure 134 *Models of human organ systems*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 135 *Genetics and inheritance*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 136 *Heart operation model*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Transportation.* This exhibit shows the evolution of vehicles from past to present, not only for land but also water and air transportation. Stories about the bicycle, motorcycle, automobile, ship, airplane, and spacecraft are the main contents. The development of the engine and automobile toward more economical use of clean energy, as well as the development of water transport, historic voyages from past to present, and the development of air transportation are presented in various forms. An informative interactive simulation of an airplane landing showing how the pilot controls the plane provides some sense of the thrill of flight. The presentation interprets both land and water transport in order to give a picture of the history of technology which preceded the development of the vehicles we use nowadays.

Figure 137 *Land and Water Transportation*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 138 *Air Transportation*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Quality of Life.* This exhibition explains how science and technology affect every facet of our daily lives. All forms of life depend on the earth's resources. Human demands can and do affect the environment in many ways, sometimes adversely. Advanced societies use vast amounts of energy and resources, both for industrial production and daily living.

Production and consumption produce waste that must be disposed of. In recent years, we have become more aware of the consequences of our wasteful ways on future generations. Now, more than ever, it is important to educate people about how to use the cleanest and most energy efficient technologies. The exhibits are grouped in the following categories: quality of life, air quality, water quality, environmental pollution, and production and recycling.

The *Water cycling* exhibit (Figure 139) consists only of panel boards and does not communicate much about water cycles. Production and Recycling (Figure 140) should communicate better how materials are transformed for new uses.

Figure 139 *Water cycling*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 140 *Production and Recycling*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Home and Workplace*. This exhibit shows the visitor an example of contemporary homes and offices fitted with modern, energy saving appliances. The appliances are cross-sectioned so that the working parts and operations can be observed. A multimedia presentation gives a view of how modern telecommunication technology will be involved in almost every activity in the very near future. This will eventually affect the life styles of many people. For example, it is already possible to work at home, shop on the internet, and be entertained and informed by satellite. The contents of this section clarify and highlight the science and technology used in daily life, but neither the subject nor the exhibit contents are relevant to their objective.

Figure 141 *A modern living room*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 142 *A modern kitchen*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *A Vision for the Future*. The visitor is challenged by a multi-media presentation showing possible future life styles and ways of working, as described through images and provocative captions. A conversation takes place between the older and the younger generation about their vision of the future in terms of communication, transportation, pollution and genetic inheritance issues. Visitors are encouraged to record their own views and are made aware of continuing dangers to the environment and the implications for their life style under the impact of new technology. Unfortunately, these exhibits (Figure 143) do not communicate well. Most of the visitors sampled did not understand the meaning of these abstract displays. A video clip featuring an imaginative view of the future would be more effective.

Figure 143 *A Vision for the Future*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 144 *Demonstration area*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *Demonstration.* This area is provided for specialists introducing various fields of science and technology for the better understanding of visitors. Because the small demonstration corner is free-standing and surrounded by visitors, some viewers stand at the demonstrator's back. Furthermore, a long presentation might become tedious to those who tire of standing.

Traditional Technology, 6th floor

This exhibit illustrates the determination, implementation and outcome of Her Majesty, Queen Sirikit's initiative in creating supplementary work to provide additional income for people in rural areas. An important aspect of the project is the revival and preservation of local arts and handicrafts, reflecting local wisdom passed down for generations. Visitors will see some of the inside stories of craft production, including the selection and preparation of raw materials, equipment, skills and processes. Each step is the outcome of accumulated knowledge and experience. The displays consist of eight areas in the Queen's gallery, with handicraft products from the Support Foundation, Carving Technology, Metallurgy, Wickerwork, Weaving Technology, Thai Lifestyle, and a study and demonstration area.

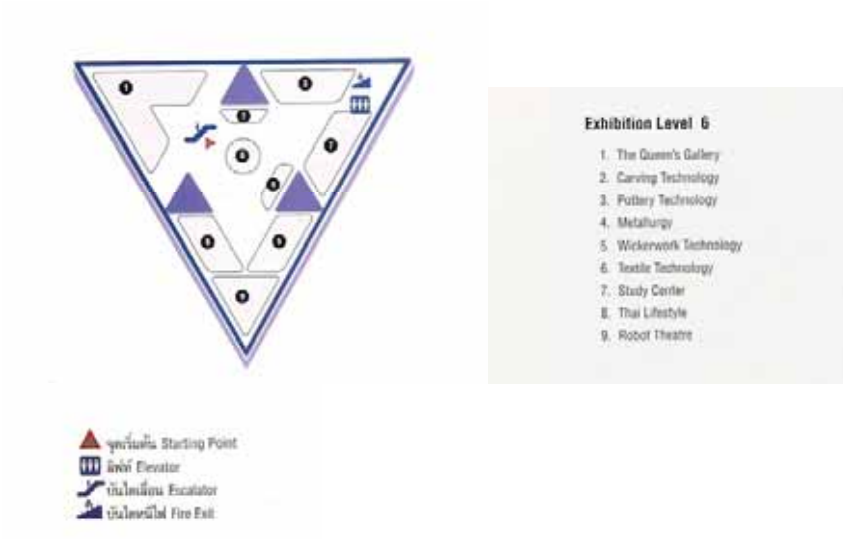


Figure 145 *Exhibition Level 6th Lay-out*
Source: *Jarujin Nabhittabhata (editor). 2002*

- *The Queen's Gallery.* This exhibition illustrates a handicraft promotion project developed by Her Majesty. Handicraft skills are deeply rooted in the spirit of Thais. Appreciating the artistic skills of her people and the abundant raw materials in the fertile land, Her Majesty stated In one of her royal addresses that, "*Having an opportunity to get close to the people allows me to discover certain talents hidden within them. The descendents of poor and uneducated farmers are actually the saviors of our country's traditional art. After proper training, a glimpse of great artistry shines from their work. Rough hands that always work in the field to supply grains and food to our country can also create a wide range of refined pieces of art*".

Formed to receive and preserve the distinctive traditional craft skills of Thai people, the Support Foundation, established under Royal Patronage, is aimed at creating supplementary work for poor farmers and to continue traditional arts and handicrafts for the next generations.

These parts (Figure 146 and 147) are good exhibits which interpret the Queen's role and support for the foundation in developing local technology and industry.

The aesthetic expertise of local artisans, the availability of natural raw materials, and respected traditions have contributed to a better living for the poor, providing them with sustainable income through creative work. Thai cultural heritage is presented in their outstanding products, which are now appreciated worldwide. Such acclamations and praises for her efforts are heard wherever Her Majesty, the Queen, goes to promote the products of Thai handicraft.

Some handicrafts displayed in this area include embroidered fabrics from mountain peoples (Karen, Yao, Mong, Akha), hand-woven fabrics from different regions, Krajudmat, bamboo wickerwork, products from Yan Lipao, silverware, artificial flowers, and ceramics. All are displayed with the gracious consent of Her Majesty the Queen.

This exhibit (Figure 148) includes some actual products. However, the demonstration should go further, with more simulations than are now present in the exhibit.

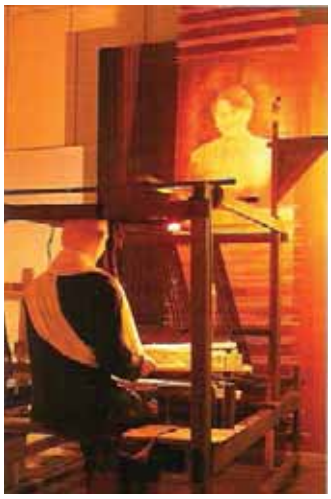


Figure 146 *The Queen's Gallery*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 147 *The Support Foundation*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 148 *Thai Handicrafts*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Carving Technology*. Thai carving is a highly specialized handicraft that requires proficient and artistic artisans. Well-trained people who understand traditional Thai patterns and have reasonable experience are best suited for this activity.

The exhibition presents the carving processes and technology for three types of materials, i.e. stone, wood and leather. All the materials require similar techniques and processes of drafting, carving, and decorating.

Most Thai carving designs are inspired by Thai tradition and culture that reflect the natural living style of Thai people. Three major types of Thai carving are three-dimensional, bas relief, and flat carving. Chisels and mallets, chopping blocks and whetstones can be seen in the exhibit.

This floor has much that is interesting to see. However, if there were real carvers on hand, the exhibit would be much more exciting.

Figure 149 *Stone Carving*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 150 *Wood Carving*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 151 *Animal Hide Carving*
Source: *Jarujin Nabhittabhata (editor). 2002*

○ *Pottery Technology.* Pottery is a kind of traditional handicraft that has been developed by the creativity of Thai people over centuries. First developed to fulfill needs in everyday life, pots, bowls, ceramic covers and the like soon become beautiful and artistic. These objects not only reflect the creativity of our ancestors but also reveal the living styles of Thai people in different regions. The exhibition shows the whole production process as follows:

Preparation of raw materials - clays from different sources have different physical and chemical characteristics but need similar methods in preparation to purify the clay. These include, for example, mixing with water, stirring, setting, drying, and kneading.

Shaping - various methods are used, depending on the type of clay, the desired product, and the firing methods. Pots can be made by free-style shaping, coiling, clay sheet, potter's wheel, shaping by wheel and blade, or molding and casting.

Glazing - a form of decorating that not only makes the object look good, but also makes it more durable. When heated, glaze hardens into a smooth, water-tight surface on the object. There are other methods for decorating ceramic objects. Colored glazes are used in many ways. Bencharong is a kind of ceramic in which the decoration is painted over the glaze. Proficiency and patience as well as artistry are needed to produce this particular kind of colorful and resplendent ceramic.

Firing - a process of baking the product after it is shaped to make it strong and durable. Several types of chimney have been used in different regions and each of them has its specific characteristics and procedures.

These exhibits are similar to the ones in Carving Technology. While the exhibited objects are very interesting, an artisan should actually be on hand to demonstrate. In other word, seeing the process of glazing and firing in a kiln taking place would communicate to visitors much more memorably.

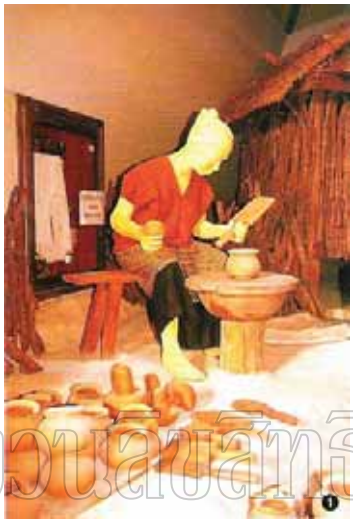


Figure 152 *Shaping*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 153 *Glazing*

Source: *Jarujin Nabhittabhata (editor). 2002*

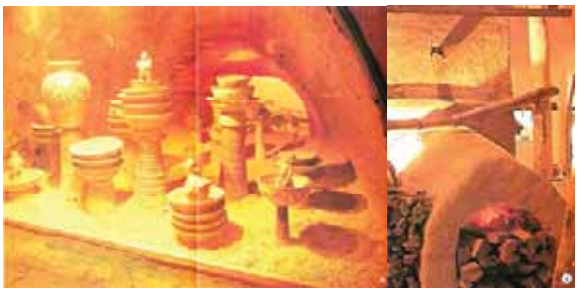


Figure 154 *Firing and Kiln*

Source: *Jarujin Nabhittabhata (editor). 2002*

Metallurgy. This exhibit reveals the ingenuity of Thai people in understanding the different characteristics of metals and shows their ability to invent and apply appropriate techniques to create products from metals such as Buddha images, knives and monks' alms bowls.

Molding - This display presents the process of molding a Buddha image by using the Lost Wax Process. The whole process is illustrated, showing the sketching of the Buddha image, sculpting the image from clay, wax or plaster, making a mould of plaster or silicone rubber around the sculpture, putting wax onto the mould, fixing the wax on the mould, creating a plaster cast inside the wax image by filling the center with plaster, firing the entire shell, draining out the wax, smelting the metal, pouring the melted metal into the mould, taking off the shell and then polishing the image.

Beating - In this craft, metal is beaten into different shapes to produce different products such as knives, swords, and even monks' alms bowls.

This exhibit part is the same as the one before it. An actual artisan is needed, although some portion of the process is presented for visitors' understanding.

Figure 155 *Molding*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 156 *Beating*

Source: *Jarujin Nabhittabhata (editor). 2002*

○ *Wickerwork Technology.* This exhibit presents equipment, tools, and raw materials, and the methods of manufacture of several types of wickerwork in different regions of Thailand. Bamboo, reeds, rattan, khla, sisal, coconut leaves, and palmyra leaves are the most popular raw materials that have been used in this work. Some materials can only be found in a specific region such as yan lipao (Lygodium flexuosum). Water hyacinth and corn shells, which are waste materials, are also widely used.

Five types of wicker work are presented in this exhibition :

1). Wickerwork in daily life and in agricultural activity

2). Wickerwork used in construction

3). Wickerwork in clothing

4). Wickerwork for house decoration

5). Wickerwork for sport

This section exhibits materials, processes and final products. Every display is neat and well communicated. However, the presence of working artisans would be the best exhibit.

Figure 157 *Processing of Wickerworks*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 158 *Wickerworks from Yan Lipao*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 159 *Wickerworks from bamboo*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Textile Technology*. Technology used in weaving Thai fabrics differs according to the raw materials available in each region. In this exhibition, two types of fiber, namely cotton and silk, are displayed. Every step from growing and spinning to actually weaving the fabric is shown, together with the process of silk production, from raising silkworms, unraveling the silk cocoons, and dyeing and weaving to produce shimmering fabrics. Colors and patterns of woven textiles are handed on from generation to generation, and are distinctive to each region.

Techniques of weaving can be differentiated as follows:

1). Pha Phuen, or using one color for both warp and weft, resulting in a plain fabric.

2). Pha Lai, or using two colored yarns in the weft, resulting in chequered motifs or strips.

3). Pha Yok Dok, meaning “lifted” designs, referring to various types of twill weave.

In addition, there are other special techniques which create different effects using supplementary weft such as Pha Khit (continuous supplementary weft). Patterns depend on the imagination of the weavers in each region.

This exhibit about the origin and processing of materials used and the handicrafts which reflect local technology would be more interesting if there were real artisans at work and a facilitator on hand to engage visitors more interactively.

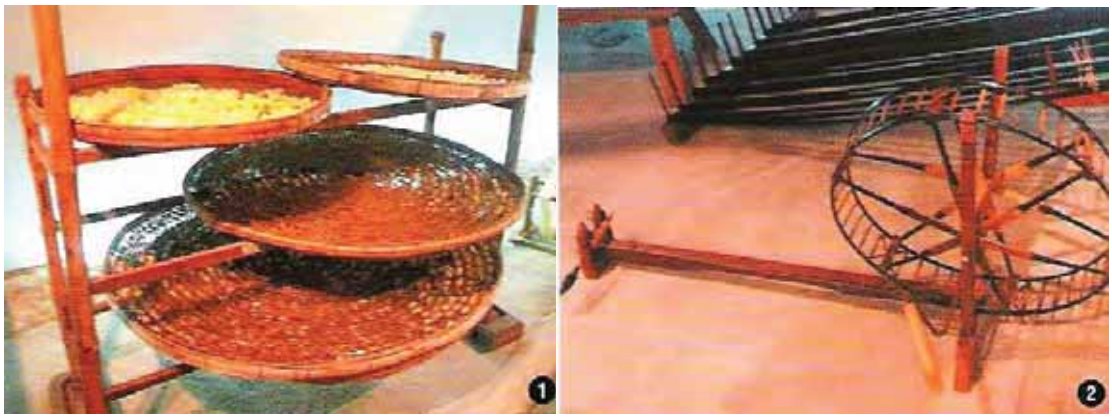


Figure 160 *Silk raising and Hand weaving*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 161 *Raw materials for making dye*

Source: *Jarujin Nabhittabhata (editor). 2002*

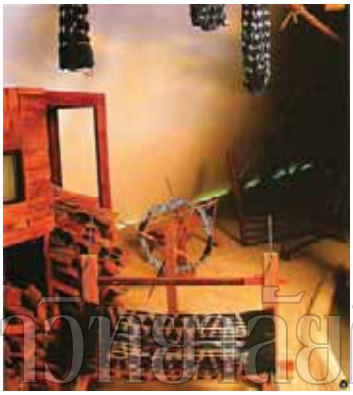


Figure 162 *Tie dyeing*

Source: *Jarujin Nabhittabhata (editor). 2002*

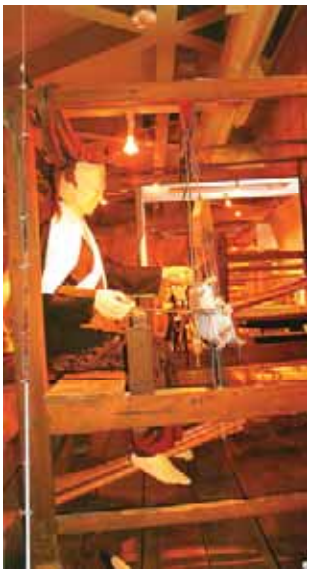


Figure 163 *Threading machine*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Thai Lifestyle.* This exhibit shows the lifestyles of Thai people, some aspects of which have been handed down for generations. The close link between people and nature in their jobs, culture, and civilization is highlighted.

Occupations - Rice farming has traditionally been the primary vocation for the majority of Thai people. During the rainy season, tidal flow added fertility in the form of loam to the paddy fields. Cattle served not only as beasts of burden but also as a source of food, fertilizer and other products such as leather.

Culture and Civilization - All year round, there are many cultural festivities that are related to natural phenomena. The Loi Krathong festival and boat racing are two cultural activities organized during the flooding season. During the maturing stage of the rice seed, its so-called “milking stage”, a specific kind of rice cooking is possible. This is known as *Matupayas rice*, and cooking it is a popular activity in Thai society.

Normal Lifestyle - During the lull after harvesting, several activities are undertaken in order to produce tools and materials for fishing, wickerwork, and weaving.

This exhibit shows tools created as local technology. These tools reflect local dimensions of science and technology relevant to the life style of many Thai people. The exhibit objects on this, the 6th floor, identify the Thai nationality and Identity better than the other floors.

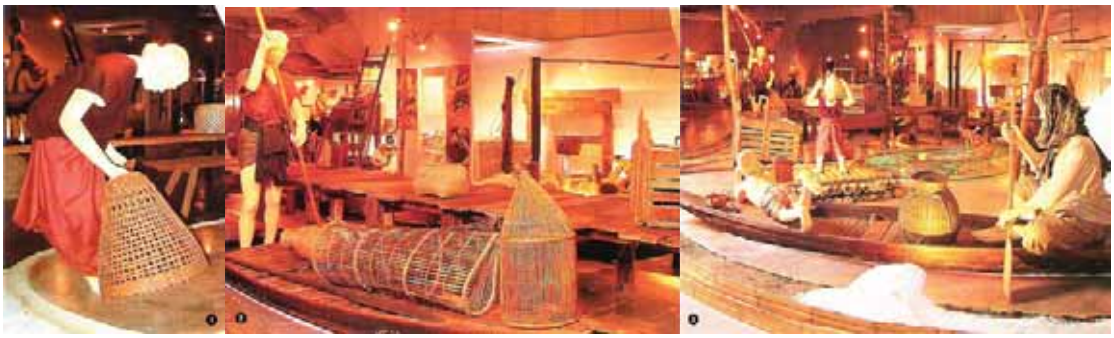


Figure 164 *Thai Lifestyle in the Rainy Season*
Source: *Jarujin Nabhittabhata (editor). 2002*

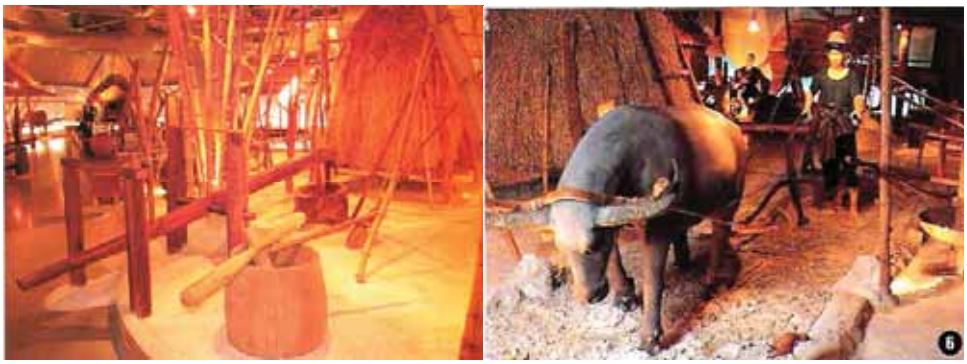


Figure 165 *Thai Lifestyle in the Dry Season*

Source: *Jarujin Nabhittabhata (editor). 2002*

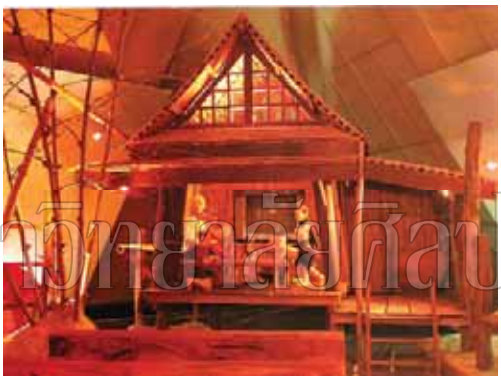


Figure 166 *Robot Theatre*

Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 167 *Study Area*

Source: *Jarujin Nabhittabhata (editor). 2002*

- *Robot Theatre.* Robot Theatre is an exhibit with video supplements of a grand father telling stories to his grand children. The stories are of His Majesty, the King and Her Majesty, the Queen, who spend time and effort in Royal projects to help people in rural areas so that they will have supplementary incomes from traditional handicrafts. This project later became the Support Foundation. It not only raises people's income, but also helps preserve the heritage of the Thai people.
- *Study Area*. This area is reserved for specialists in various fields of Thai traditional technology such as carving, pottery and metallurgy. They take turns in organizing demonstration classes in the rural environment. The area is decorated with traditional toys made from bamboo, clay, seeds, etc.

These exhibits are the final displays of this floor. The presentations help Thai people to identify their own native science and technology.

The issue of Thai nationality and identity has been discussed in Chapter 4. Concerning the national identity presented in the National Science Museum, the researcher compares similar presentations in the Paris and Tokyo National Science Museum in the next chapter (Chapter 6).

The results of the evaluation of their exhibits, displays, and interpretations will be discussed and compared in order to obtain guidelines and criteria by which Thailand's own Science Museum can be managed.

Within the exhibition in this NSM, the final presented exhibition shows the original objectives and policy. As to how well they meet their aims, these issues will be discussed alongside the research questions in the final chapter (chapter 7).

Chapter 6

Science Museums from Overseas

This chapter compares science museums from Eastern and Western countries in search of varied ideas about exhibition, presentation, space communication and interpretation which could be adapted or applied in Thailand's National Science Museum. The chapter could be called notions from overseas museums. Studying these selected museums also helps the researcher define criteria for interpretation and exhibition in the National Science Museum.

The selection of cities for review was based on their international status, high standard of living and good business climate. To ensure that the lessons learned from these overseas museums are suitable as models for study, the specific science museums chosen were selected on the basis of the following qualifications:

a).The museum is located in a great city serving a wide variety of people with high standards of living and a good business climate.

b).The museum is large with international features which could provide interpretation guidelines for the National Science Museum, Thailand. The exhibitions, both temporary and permanent, offer interesting interpretations which can serve as criteria as part of the solution of this research.

c).The selected institutions should be regionally representative in terms of exhibition, presentation, space communication and interpretation, and in their objectives and the expression of national identity.

Data and information obtained from these overseas museums are also obtained from websites, guidebooks, and other secondary sources. This information is limited and constrained. For those museums that the researcher had an opportunity to visit in person, the data and information are broader and deeper. From the above criteria, the selected science museums are:

a) National Science Museum, Tokyo

b) National Museum of Science and Industry, Parc de la Villette, Paris

Apart from these, the researcher will mention other relevant museums as well. The researcher will compare the Tokyo and Paris museums on the basis of the

relevant information, similarities and differences pertinent to the interpretation in the following items;

- Site location and urban condition
- Buildings, surrounding, and architectural interpretation
- Museum interiors, activities and exhibitions

Site location and urban condition

Site location is significant in museum marketing. An appropriate site elicits the elegance of museum architecture. Moreover, a fine location in the flow of urban planning contributes to traveling convenience, which affects marketing. Site location, historical background and urban conditions are all a matter of consideration here. The researcher will analyze these issues and compare them with the NSM in Patumthani province in the search for the most appropriate location for a science museum.

a) Tokyo National Science Museum, Ueno Park

Tokyo is an unimaginably stimulating city. Tokyo's many enriching museums give visitors a straightforward, detailed introduction to the city. Tokyo, with a generally mild climate, is located in the approximate center of the Japanese archipelago. It is bordered to the east by the Edogawa River and Chiba Prefecture, to the west by mountains and Yamanashi Prefecture, to the south by the Tamagawa River and Kanagawa Prefecture, and to the north by Saitama Prefecture. The Tokyo Megalopolis Region, or Greater Tokyo Area, is made up of Tokyo and the three neighboring prefectures of Saitama, Kanagawa and Chiba. This area is home to around 26% of Japan's total population. The National Capital Region is made up of Tokyo and the seven surrounding prefectures of Saitama, Kanagawa, Chiba, Gunma, Tochigi, Ibaraki and Yamanashi. Tokyo is a metropolitan prefecture comprising smaller administrative bodies, special wards and municipalities. The "central" area is divided into 23 special wards (ku in Japanese). The western Tama area is made up of 26 cities (shi), 3 towns (cho) and 1 village (son). The 23 special-ward area and the Tama area together form a long, narrow stretch of land, running about 90 kilometers east to west and 25 kilometers north and south. The Izu Islands and the Ogasawara Islands, two island groups in the Pacific Ocean, are also administratively part of Tokyo, despite being geographically separated from the metropolis. The islands have between them 2 cho and 7 son. The overall population of Tokyo is about 12.54 million (as of September 1, 2005). The area is about 2,187 square kilometers.

Asakusa (East)
Yushima - Nezu (West)
Kanda - Ochanomizu (South-West)
Akihabara (South)
Ryogoku - Morishita (South-East)

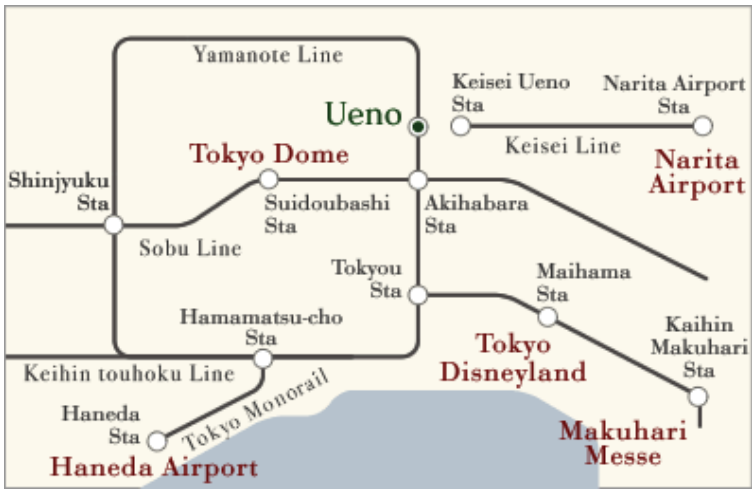


Figure 168 *Attached areas and MRT station of Ueno*

Source: *http://www.kahaku.go.jp*

Ueno Park is a large public park in Tokyo adjacent to the Ueno Station. The park, which was opened to the public in 1873, offers visitors a large variety of attractions. At the park's south entrance stands a statue of Saigo Takamori, an important personality of the late Edo and early Meiji Period. He played a central role in realizing the Meiji Restoration of 1868. The park was established through an imperial land grant to the city by Emperor Taisho. The official name of the park is Ueno Onshi Ken, which can be translated as "Ueno Imperial Gift Park". Ueno is the eastern-most hub of central Tokyo and is famous for its park, museums and markets.

Apart from being the oldest and largest park in the city, Ueno is regarded as one of Tokyo's most beautiful, with temples, shrines, pagodas, a pond, a zoo and some of Japan's finest museums.

Visitors to Ueno Park can go to the Tokyo National Museum, the Orient Museum, the National Science Museum, the Shitamachi Museum, the National Museum for Western Art and the Tokyo Metropolitan Fine Art Gallery. Since 1882, Ueno Park has also been home to Japan's first zoological garden.

Figure 169 *Map of the Ueno Park area and surrounding areas*
Source: *http://www.kahaku.go.jp*

The Shinobazu is a large pond, famous for its lotuses, in Ueno Park. The Bentendo Temple, dedicated to the goddess of prosperity and the arts, stands on a man-made island in the middle of this pond. This particular building dates back to 1958. The 17th-century original was destroyed in the air raids of 1945. The tall, thin building with floors branching off at every angle presents a striking image against the backdrop of the sky.

Moving round the park close to the Keisei Ueno Station Exit, visitors will find the Kiyomizu Kannondo Temple, modeled after the famous Kiyomizu Temple in the historic city of Kyoto. Couples who want to have children traditionally pray here. Also next to the exit is a large statue of Saigo Takamori (1827 - 1877), an important samurai warrior who lived during the period of the Meiji Restoration.

Cherry blossoms bloom in the spring; lotuses flower in summer (late April to early May). The tree-lined promenade that runs southward through the park is a very popular place for "Hanami" parties (cherry blossom watching parties). With

karaoke machines under every tree and thousands of drunken "salary-men" in a festive mood, the atmosphere can be quite incredible.

Figure 170 *Temple of Benten*
Source: *http://www.japan-guide.com*

Figure 171 *Toshogu Shrine*
Source: *http://www.japan-guide.com*

Figure 172 *The Tokyo Metropolitan Art Museum*
Source: *http://www.parkside.co.jp*

Figure 173 *The Ueno Royal Museum*
Source: *http://www.parkside.co.jp*

Figure 174 *Kane-ei Temple*
Source: *http://www.parkside.co.jp*

Figure 175 *Yushima Tenmangu*
Source: *http://www.parkside.co.jp*

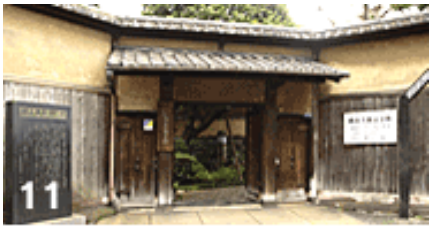


Figure 176 *Taiken Yokoyama Memorial Hall*

Source: *http://www.parkside.co.jp*

Figure 177 *Ameya Yokocho (candy store alley)*

Source: *http://www.parkside.co.jp*

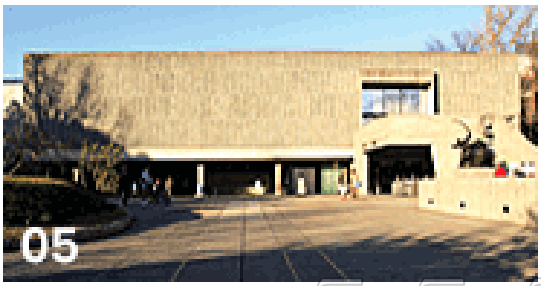


Figure 178 *The National Museum of Western Art*

Source: *Ueno Park, Tokyo and http://www.parkside.co.jp*

Figure 179 *The Tokyo National Museum*

Source: *http://www.japan-guide.com*

Figure 180 *Ueno Park Hanami.*
Source: *http://www.kahaku.go.jp*

. Ueno Park is home not only to art galleries, museums, temples, and a zoo, but also to hundreds of thousands of crows. The area surrounding the Ueno is as famous for its downtown atmosphere and population of homeless people as it is for its storehouses of culture. The park itself has a sizeable but inconspicuous homeless population. These indigent people generally keep to one area of the park (facing the Science Museum). One sees small groups of three or four old men soaking up the sun as they chat quietly on the kerb. On Sundays, people sit in crowds and rows, cross-legged, in the groves listening to Christians preaching with microphones as an organist drones away in the background. Regarding the Ueno site, the notable characteristics of the location can be summarized as follows:

1.) The park and its museums are located in Tokyo's 'shitamachi' (working and merchant class) Ueno district, in Taito Ward.
2.) It is a large area full of natural and cultural beauty.
3.) The park has the most museums of any single area in Japan.
4.) It is an area rich in historical, cultural and religious significance, with the most temples in Tokyo.
5.) The area is in the middle of the city, conveniently located across the road from JR Ueno station (the Shinkansen, i.e. bullet train, terminal).
6.) Ueno is in the central zone of Tokyo.
7.) It is a community space which is able to handle many different functions and activities.
8.) In addition to the Ueno Zoo, there are many distinctive public spaces on the site such as the Tokyo Culture Hall, the Tokyo National

Museum, the National Science Museum and the National Museum of Western Art.

9.) A favored tourist venue, the area is popular with both Japanese and foreigners, besides providing an unofficial refuge for many homeless people.

b) National Museum of Science and Industry, Parc de la Villette, Paris.

Paris is celebrated round the world for its beauty and charm, and for its long history as a center of learning and culture. Parisians call it the 'City of Light.' People flock to the city from all over the world to study its impressive monuments and museums, savor its cuisine, and to enjoy the famous nightclubs and sidewalk cafes. Paris is the political, cultural, and economic center of France as well as one of the most vibrant metropolises in the world. About 15 percent of France's inhabitants live in the Paris metropolitan area. Roughly circular in shape, Paris proper has an area of 105 sq km (41 sq mi). It is bounded by a 35 km (22 mi) long ring road called the Boulevard Périphérique. Paris proper constitutes one of eight départements of the Île-de-France region. The Paris metropolitan area stretches over the three adjacent départements, which are known as the inner suburbs (la petite couronne). The metropolis extends further, to the fringes of the four larger, surrounding départements, known as the outer suburbs (la grande couronne). The city is divided into 20 political units called arrondissements. The numbering of the arrondissements spirals outward, starting from the western part of the Île de la Cité, then moving clockwise all the way to the 20th arrondissement in eastern Paris. The Seine passes through Paris from the southeast, loops north, and then curves to the southwest on its outbound journey. Many of the city's greatest monuments lie on the banks of this historic river and have been designated a World Heritage Site in 1992 by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The Seine provides the simplest division of the city: The north side of the river is known as the Right Bank (Rive Droite), while the south side is called as the Left Bank (Rive Gauche). The Right Bank contains 14 arrondissements; the Left Bank contains 6. In addition to arrondissements, Paris is made up of neighborhoods, or quarters (quartiers), usually of historical or cultural origin. These neighborhoods do not always have clearly defined boundaries.

Public transportation within Paris consists of a network of bus lines and an extensive subway system known as the Métro. A high-speed commuter train network

known as RER (*Réseau Exprèss Régional*) also links inner and outer Paris. The hub of the Parisian subway system is at the Châtelet-les Halles station, where several Métro lines and the east-west and north-south RER lines meet. Millions of people use the Métro or RER every day. Visitors can visit Parc de la Villette and Cite' des Sciences et de l' Industrie by taking the Metro (Subway train line 7) to the Porte de la Villette station.

In an effort to ease the flow of automobile traffic within Paris, the city built several underpasses in congested areas, expressways on either side of the river, many underground parking lots, and the long Boulevard Périphérique ring road along the city's boundary. The Seine was the primary regional commercial route in the area until the construction of the railway in the 19th-century. The river is still used for freight by barges, however, and the Paris port is one of the nation's largest. The river also carries a dense traffic of pleasure boats. A network of 33 bridges (*ponts*) connects the two banks of the river in inner Paris. The oldest bridge is the Pont Neuf (ca.1607) at the western tip of Île de la Cité. The Pont au Double and the Pont d'Arcole on either side of the island stand on the sites of the city's earliest bridges.

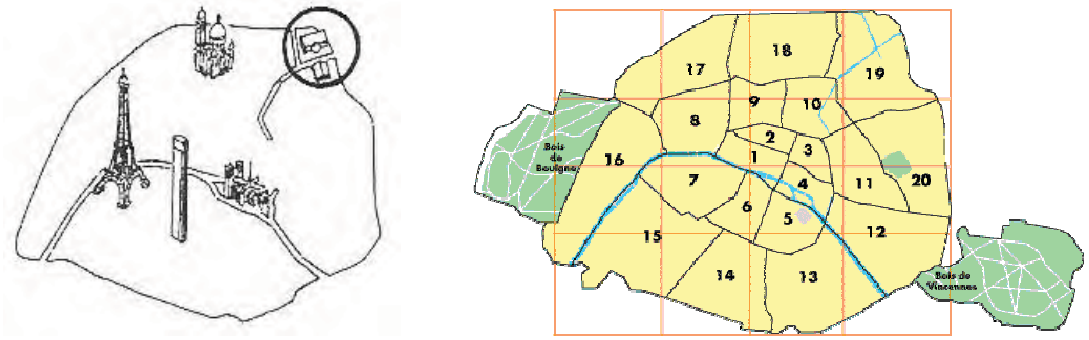


Figure 181 *Map of Paris and the Cite' position (in the circle)*

Sources: *www.cite-science.fr*

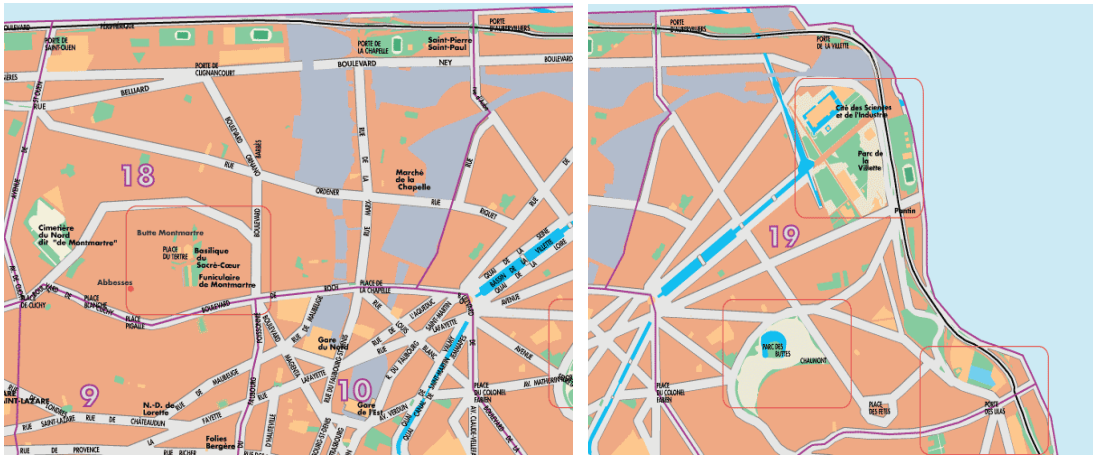


Figure 182 *Enlarged map of Paris and Parc de la Villette*

Source: *www.cite-science.fr*

Figure 183 *Site location of Parc de la Villette and Cite des Sciences et de l'Industrie*

Source: *www.cite-science.fr*

The Parc de la Villette is one of the city's more modern public gardens, built in 1987. It is located on the 19th-arrondissement, in north-eastern Paris. The site, an old industrial area of 86 acres, formerly served as a national meat market and slaughterhouse. The park was developed as the result of a campaign for urban renewal.

In the 18th-century, La Villette was still a village, a small farming community just outside Paris and an ancient point of passage towards the North, the East and Germany. Parisians came to the l'Octroi rotunda built by Ledoux to stroll and to taste the famous "guinget" (a local white wine) in cafés. In 1812, Napoleon had a canal dug from the Ourcq to supply Paris with water. The Bassin de la Villette waterway was also open to boats.

From 1867, the Paris abattoirs were united in a single complex in La Villette. It was a vast ‘city of blood, meat and trade’ stretching over 40,000 square metres. The Grande Halle held up to 4,600 cattle. A bell at the head of the square in the Tour de l'Horloge (Clock Tower) implacably governed the business of the abattoirs and their three thousand workers. The last ox was slaughtered there in 1974. In 1979, development of the 136 acres of waste land and buildings was begun. One of the projects then drawn up by the State was the construction of a National Museum of Science and Technology.

Designed as a 21st-century garden the park links the Cite des Sciences to the north and the Cite de la Musique and the Parisian National Conservatory of Music and Dance to the south. In addition, there is the Grande Halle and the Zénith. (Tschumi, 2000) The largest green space in Paris hosts a number of cultural facilities and events, including cinema, theater, dance, music, puppetry, circus, cabaret and street theater. The garden consist of a series of theme gardens: mirrors, dunes, play, shadows, bamboo, mists, trellised vines, movements, balance, islands, children’s fears and dragons.

Parc de la Villette, the city’s largest park, was the first major landscape design to draw upon deconstructionist philosophy. It was the result of a competition won by Bernard Tschumi in 1982. Tschumi wished to design the largest discontinuous building in the world. Jacques Derrida, the philosopher, encouraged him to consider form before function. This anti-modernist approach deconstructed the traditional procedure. Related to his theoretical work on event space, Tschumi’s proposal for a distinctly urban park called for the deployment of a number of abstract, un-programmed structures, dubbed 'follies'. It was intended that the bright red structures would then house various events and groups related to the activities of the park. Many, but not all, do just that, but not always the activities envisaged. The park was designed like a city with its streets, gates, buildings, folies and squares. The Canal de l'Ourcq runs through it, and the park hosts shows, restaurants, and fun and cultural activities.

In Tschumi's mind, the Parc de la Villette was not a park at all, but was a new type of city. Despite the fact that he started with an old industrial site, he decided that his design would not be *contextual* nor would it recreate or refer to things from the old site. Instead, he was starting from a *pure concept*, and for inspiration he looked at general concepts of large organizations and how they fit into the city of Paris. After testing the superimposition, he decided the point-grid system worked best and that the concept of the discontinuous city would be the starting point for his design of the new park. (Tschumi, 32,44) Tschumi's design for the Parc de la Villette is *anti-contextual*, has no relation to its surroundings, and subverts borders on which "*context*" depends.

Famous for its grid of red, follies, Parc de la Villette is a case study in how not to design a park. Human use seems to have been a very low priority for architect Bernard Tschumi, who envisioned this park as an exercise in deconstructionist technique. The result is a dull landscape that substitutes absurd sculpture and disproportionately scaled structures for playfulness and variety. Once the novelty of the structures wears off, there is little to sustain one's interest or imagination, although the dense programming offsets the inhumanity of the surroundings to a certain extent.

Tschumi laid down three geometries: of points, lines, and curves. Clashes were encouraged. The points took the form of a collection of steel pavilions, inspired by Russian Constructivist art and painted red. The primary lines are not unlike traditional French avenues. The most dramatic curved feature is the Cinematic Promenade. Alongside the Promenade are a number of themed areas. Bamboo Garden is an exotic oasis. There is a Fog Garden, a Dragon Garden, a Mirror Garden, a Wind and Dune Garden. Those are the elements of the park. But the main element of the Parc is the National Museum of Science and Industry. All stand together to complete the park's community.

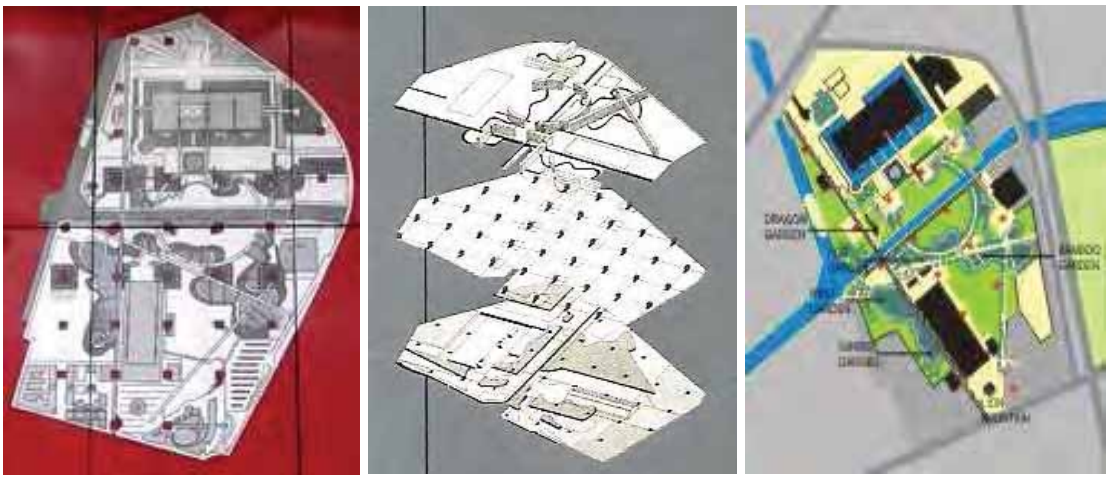


Figure 184 *Geometries of points, lines and curves of Parc de la Villette*

Source: *www.cite-science.fr*

Within the boundary of the Parc de la Villette, visitors find playgrounds for children. Apart from the Cite', there are:

la grande halle: a masterpiece of 19th-century metallic architecture; a giant hall and old cattle market, which provides a setting for exhibitions, shows, festivals and trade fairs.

The Zénith: located in the eastern section of the park is a 6,400-seat hall that hosts rock and pop concerts.

Cité de la Musique: the national conservatory of music and dance. This facility spreads over 23,000 m^2 at the southern entrance to the Parc de la Villette. Its first section, the Conservatoire National Supérieur de Musique et de Danse de Paris was completed in 1990. In 1996, the Cité de la Musique opened fully. It contains the Ensemble Intercontemporain, the Institute de Pédagogie Musicale et Chorégraphique, the museum of music, the concert hall and a branch of the SACEM (Society for the Advancement of Continuing Education for Ministry).

Folies - small red buildings housing mini-exhibits and snack bars.

All of these structures are the elements of Parc de la Villette, next to the National Science Museum and Industry of Paris.

An imposing part of the Parc de la Villette, the Cité des Sciences et de l'Industrie is one of the largest scientific and cultural centres in the world and also one of the most innovative. The researcher could sum up the information relevant to the Parc de la Villette site as follows;

1.) *Place of civilization*. Its task is to assist all its contemporaries in entering the intelligence of today's world to better manage and master the future.

2.) *Place of education*. It provides young people with the opportunity to explore informal ways of acquiring knowledge in partnership with French National Education.

3.) *Place for widening knowledge*. It offers everyone - children and adults, the general public and researchers - the many tools of its resource centers.

4.) *Place of social progress*. It has successfully developed the Cité's vocational guidance centre, built up its interactive software library and presented exhibitions on different career sectors.

5.) *Place of debate*. It directs its efforts toward bringing together researchers and participants who are eager to discuss important questions raised by scientific and technological progress. Each year, it hosts many conferences and congresses of national or international scope. Today, much of its work is devoted to making the skills it develops available to "virtual" users who wish to consult the Cité from their homes.

Tschumi’s design questions the conventional conception of a park as green open space. While there is plenty of grass here, the natural park is clearly designed to express the fact that it is artificial, domesticated. Several thematic gardens are incorporated into the scheme, offering places of discovery, unexpected encounters and juxtapositions between seemingly natural and man-made artifacts. In the researcher’s opinion, the National Museum of Science and Industry presents itself along a convenient visiting route which brings together the value of history and an industrial location. It was very smart indeed to set the Science Museum in the North-East of Paris. This strategy disperses interesting sites to visit around Metropolitan Paris. The museum is a landmark on the boundary of the city’s north - east.

Buildings, surroundings, and architectural interpretation

a) Tokyo National Science Museum Buildings

The Tokyo National Science Museum is composed of three buildings which mix old and new architecture. They are the Main building, the New building and the Midori-kan building.

Completed in 1930*, the Main Building* is an elegant structure with a red brick tile veneer.

The New Building was first opened to the public in 1999.

The Midori-kan Building is opposite the central courtyard of the Main Building.

The three buildings are all connected to facilitate the movement of visitors. Although the Main Building is old and quite different from the Midori-kan and the New Building, the complex is neither jumbled nor discordant. Despite the various materials, ages, and styles, the buildings hold together in their heterogeneity, saved by the spaces between gardens, fences, footpaths and wide streets.

The more the content of exhibits increase, the more exhibition spaces need to expand. All of these buildings are designed with the emphasis on useful function rather than on communicating the visual idea of 'Science Museum'.

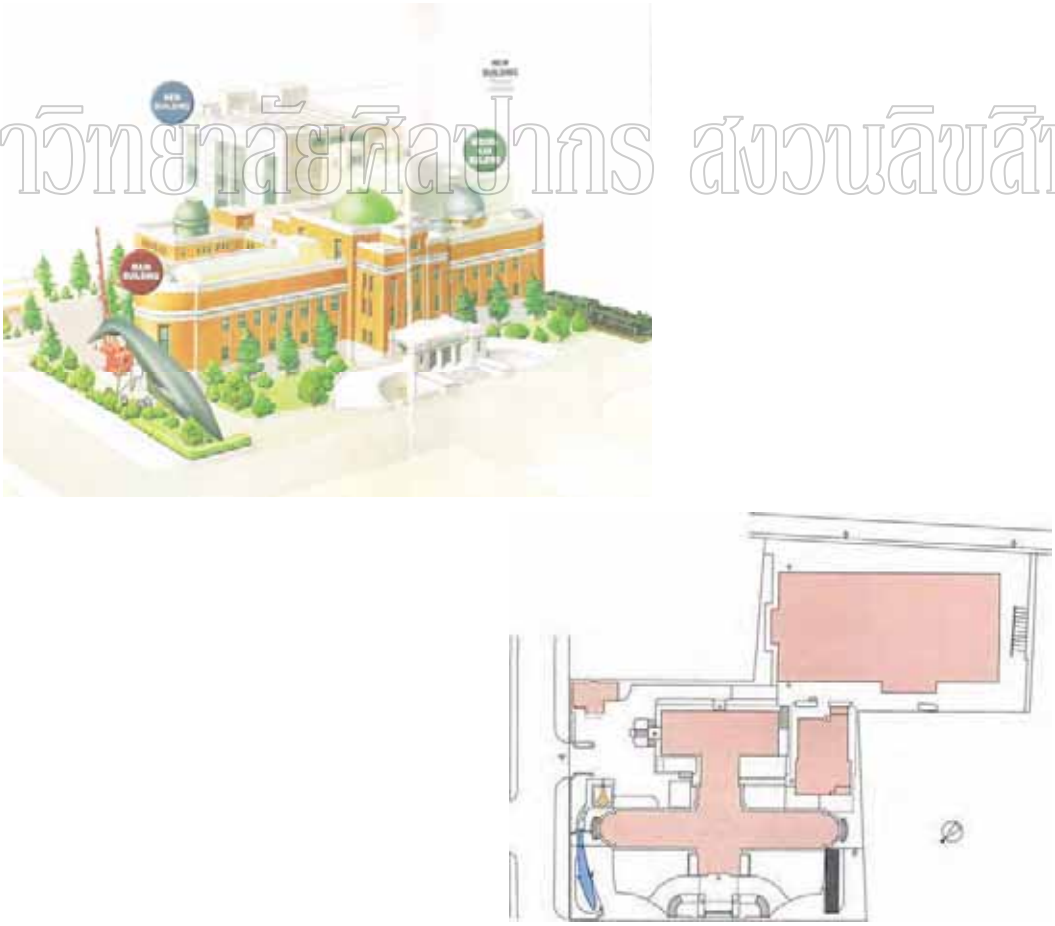


Figure 185 *Three buildings and lay-out of National Science Museum.*

Source: *The National Science Museum Guidebook 2002 and http://www.kahaku.go.jp*

Figure 186 *Main Building*
Source: *The National Science Museum Guidebook 2002*

Figure 187 *New Building*
Source: *The National Science Museum Guidebook 2002*

The out-door exhibitions are as follows:

- *The Lambda rocket launcher* was used to launch Japan's first satellite, "Osumi," on February 11, 1970. The rocket displayed is identical to the one originally launched.
- *The blue whale* is the largest animal in the world. The huge model shows a 30 meter long killer whale about to dive from the surface into the ocean depths.
- *Three engines* were imported into Japan in the latter part of the 19th century with the aim of supporting research into this type of machinery. These were built at a time when steam engines were the primary source of power. Only a few of these antique devices survive today, which makes them very precious indeed.
- *The commemorative stone pillar (Courtyard)* was erected in 1877 when the Museum (called the 'Education Museum) first opened in Ueno park. Displayed in front of the pillar are fossilized eelgrass, petrified wood and stones collected in 1960 from a research base in Antarctica.
- *The D51 steam locomotive* was manufactured in 1939 and continued to run until 1975. Regarded as one of the most useful types of locomotives for hauling freight in Japan, 1115 were built.

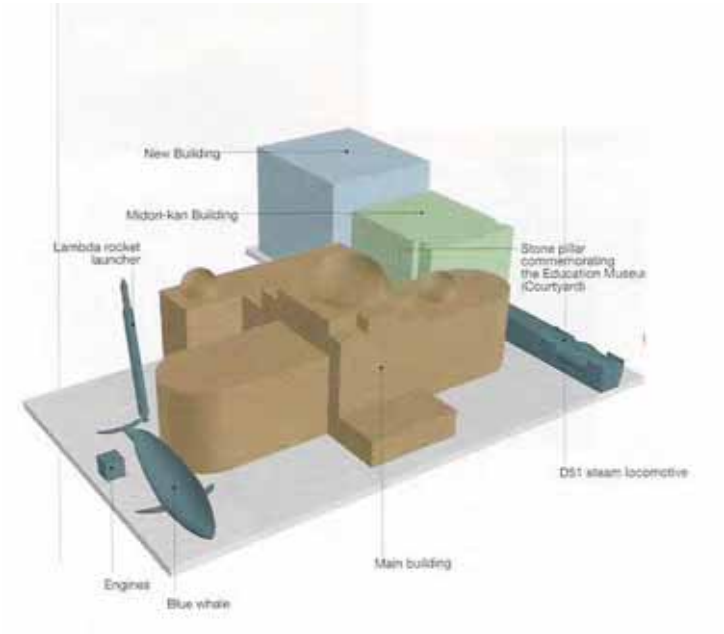


Figure 188 *Massive form of National Science Museum and out-door exhibition.*
Source: *The National Science Museum Guidebook 2002*

Figure 189 *Lamda rocket launcher.*
Source: *The National Science Museum Guidebook 2002*

Figure 190 *Blue whale*
Source: *The National Science Museum Guidebook 2002*

Figure 191 *Three engines*
Source: *The National Science Museum Guidebook 2002.*

Figure 192 *D51 Steam locomotive*
Source: *http://www.kahaku.go.jp*

Figure 193 *Commemorative stone pillar (Courtyard)*
Source: *The National Science Museum Guidebook. 2002.*

The out-door exhibition objects range in size from normal to large scale and are appropriately shown outside the museum. They present information about biology, engineering, and the history of Japanese science and technology. These out-door exhibits reinforce the images and ideas presented inside the Museum buildings. In this regard, the National Museum of Science and Industry in Paris has a differential format of the out-door exhibit. The next section discusses the National Science Museum of Paris, the buildings, their surroundings and the architectural interpretation.

b) National Museum of Science and Industry, Paris

In 1980, twenty-seven architects were consulted with a view to creating a National Museum of Science, Technology and Industry in an unfinished building originally intended for another purpose, i.e. the great abattoir sales hall whose construction had been halted in 1973. The structure planned as an abattoir thus

became the Cité des Sciences et de l'Industrie. The man behind this vast development project was the architect Adrien Fainsilber. The plans submitted by Fainsilber were the result of a study of the scale of the site and its environment. The new science museum established a special relationship between the Cité and the park, taking as much advantage as possible of its specific nature. The building's design was based on three themes. The pivotal theme is water, which links the world and life. This forms the surrounding of the main building. Plant life has a place inside the Cité in three large bioclimatic greenhouses facing the park. Finally, light, "source of energy of the living world", brightens the permanent exhibition areas via two domes, 17 meters in diameter.

Figure 194 *Lay-out of Cite' des Sciences et de l'Industrie and Parc de la Villette*
Sources*: www.cite-science.fr and La cite' des Sciences & de l' industrie*

The National Museum of Science and Industry is one of the world's largest and most visited science museums. The National Museum of Science and Industry, or Cité des Sciences et de l'Industrie, located at the top of the park, is a masterpiece of modern architecture. The huge building houses vast collections, a media center, exposition halls, and other facilities, all oriented toward science and technology. Although *"la Cité,"* as it is sometimes called, may yet be little known to tourists, it is well known to residents.

An icon of the Science Museum is its Geode dome, which has a distinctive spherical shape. The main building is very straightforward, but the Geode dome is distinguished from the buildings around it by its shape and polished stainless steel exterior. Reflected from the sky above, it looks like a globe with changing surface patterns reflecting the light and color of the sky. This dome, with its exotic technological shape, has become a boundary landmark and serves as an expressive symbol of the science museum.

Figure 195 *Position of Geode dome and main building*
Source: *La Cite' des Sciences & de l' Industrie*

Figure 196 *Main building*

Source: *La Cite' des Sciences & de l' Industrie and* *www.cite-science.fr*

Figure 197 *Activities outside the Museum*

Source: *www.cite-science.fr*

Surrounding the Geode and the museum building is a small park and an encircling canal. There is a restaurant with a boat ride downstream along this canal. Visitors can enjoy these entertainments as well. In addition, there are other science activities for visitors outside the Museum buildings such as a sky telescope and some simulators.

The Parc de la Villette includes one of the largest slaughterhouse buildings and these two canals. The human dynamics of these elements were not lost in the final design of the Parc. Its design is quite in contrast to the 19th century 'park in the city' championed by Fredrick Law Olmstead. The inhabitants of a modern 21st-century city are different from their 19th-century counterparts: their parks should also be different. The idea of a city park as a sort of representation of nature in the heart of

the city does not necessarily satisfy the various needs of modern city dwellers. Parisian city parks no longer serve as communal areas. Rather, they are used mostly by children and by the elderly. Parks now function as a place to rendezvous or meet which the town square once provided. Paris is no longer organized around a traditional center. It spreads out in suburbs, causing the central focus to be diffused. The Parc's challenges are twofold. *The first is to respond to the decentralized city and to create a new area of focus and activity. The second is to supply additional cultural stimulus to the citizenry of Paris.*

The park represents a new model for 21st century cities in which program, form and ideology come together. Within the park, three simultaneous operations are going on. The first is a series of events that encourage dreams and fantasies not normally found in traditional city parks. The second is a series of places where these fantasies can be played out. The third is the suggestion of movement in space by the lines and curves built into the landscape.

The designer of Parc de la Villette, Bernard Tschumi, likes to think of the park as work in progress, an architectonic design that will never be finished. It is a living, breathing reflection of the people who use it. Continuous change is therefore fundamental. Parts of it can be taken down, changed and rebuilt. The three systems in the park, as mentioned above, are a system of surfaces, of lines and of points has the functions below.

The *surfaces* of the park host activities that include, for example, game playing, exercising, entertainment and markets, along with the appropriate surfaces used for each activity. Other surfaces are constructed of compacted earth and gravel and are more free and varied in form.

The lines of the park are supplied by a grid of whimsical Folies or "follies," the orthogonal system that guides pedestrian movement, and by the Path of Thematic Gardens, which intersects the coordinate axes and provides unusual and unexpected encounters with nature. The north-south axis joins two subway stations. The east-west axis joins Paris and the suburbs.

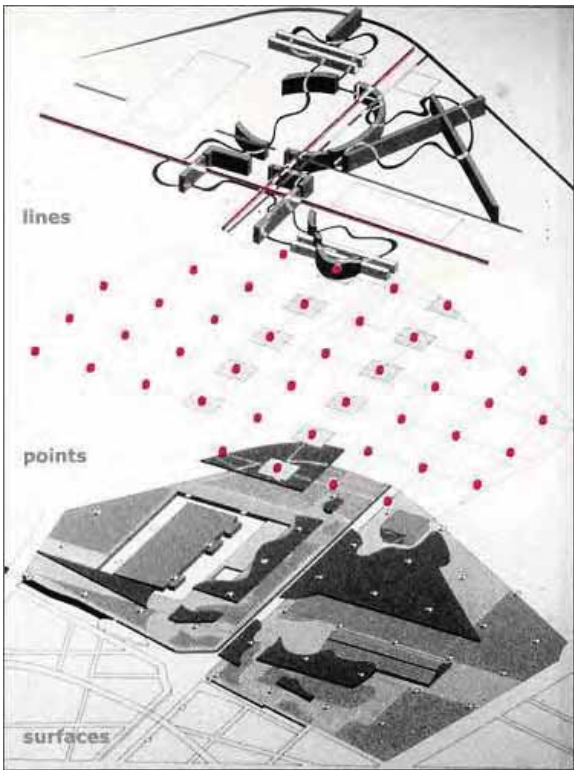


Figure 198 *Exploded axonometric illustrating three overlapping systems*
Source*: Tschumi, Bernard. Cine'gram folie, le Parc de la Villete/ Bernard Tschumi. Princeton, NJ: Princeton Architectural Press,(1987)3.*

The points in the grid system of Folies placed at 120 meter intervals serve as a common denominator to the entire park. They are 10 x 10 x 10 meter cubes that can be changed to accommodate specific needs. The strict repetition of the Folies creates a recognizable symbol for the park. Each Folie replaces static, traditional park monuments and will be future reference points for emerging social and artistic change in an evolving society. The resulting grid presents an infinite field of intensities and extensions in and out of the parc because there is no hierarchic center.

The Parc de la Villette's conceptual framework allows for multiple combinations and substitutions within the constructed space. Something can easily be replaced or revised without damaging the spirit and identity of the Parc. The organizing structure of interchangeability of objects, people and events allows for future artistic expression without the constraining hierarchies of traditional urban parks.

Figure 199 *Folies , red steel pavilion characteristic*
Sources: *www.cite-science.fr and La Cite' des Sciences & de l' Industry*

Figure 200 *Sculpture in Dragon garden*
Source: *www.cite-science.fr*

Figure 201 *Sculpture and activities in the garden*
Source: *www.cite-science.fr*

The city of Paris is composed of objects and spaces, continuity and discontinuity. The Parc de le Villette provides a focal point for all types of expression and activity. It has the regularity of a grid and the flux of French arcades. Casual, directed movement through the park can lead one to unexpected smaller spaces. The park's design is based on the disjunctions and dissociations of life in modern Paris, not on the idealistic notion of bringing the masses to nature.

The character of the Parc de le Villette is like nothing done before. It illustrates the concept that it is not the subjects but, rather, the interaction of thoughts and ideas that make the design and function of a space successful.

Critic Peter Jones has suggested that there are notable precedents for the Parc, and that it is not as radical a break from tradition as the "first major piece of Deconstructivist architecture," that Tschumi presents it to be. For example, in the overall composition of points, lines and surfaces, the design clearly resembles Cubist art (Figure 202). The use of industrial materials references Modernist landscape projects (which were also complex, abstract and asymmetrical). Jones emphasizes the ways in which Tschumi is influenced by modernism in art and architecture. It is also possible to compare his work to earlier developments in landscape architecture.

Figure 202 *Parc de la Villette plan and an example of Cubist artwork*
Source: *www.cite-science.fr*

In the Parc de la Villette, primary axes or lines respond to major civic buildings, and are ‘well defined by their canopies and supporting structures.’ This formal and axial approach to laying out a new urban park is certainly not novel, and in fact reflects traditional European strategies dating back to the Renaissance. These, in turn, have played out through the early 20th- century in designs influenced by the École des Beaux Arts, and continue to affect contemporary design approaches. In turn, the point grid of follies are (as Jones points out) “all too real, too unambiguous, even monumental.” As such, they read as monuments in a traditionally formal park (Figure 203), though they are not presented as such by Tschumi. Even the more organically orchestrated surfaces are themselves not a new invention. Rather, the action of going between and around these “sequential programmes” references other existing frameworks, such as the picturesque (although Tschumi frames this in terms of filmic theory) and the arts and crafts, both of which emphasize dynamic views and movement over a single dominant perspective. Even the overall denial of a singular expressible meaning and the focus on experience are not new notions; they are naturalistic landscape strategies dating back to Transcendentalism, which evidenced similar underlying strategies.

Figure 203 *Two ‘follies’ shown as objects in the landscape*
Source: *www.cite-science.fr*

Though his background is in architecture and urban design, Tschumi may be drawing on formal, experiential and creative aspects perhaps more derived from historical landscape architectural precedents and movements than from other sources. In a way, however, these various “readings” of the project as having origins in various disciplines (and within the discipline of landscape architecture, origins in various sources) are consistent with Tschumi’s theoretical disposition. He could well argue that it is precisely the multiplicity of meanings that can be read into the park that

free it from any single definitive interpretation and achieve its disjunctive capabilities. These comparisons do, however, suggest that he is drawing more strongly on precedents of landscape architecture than he overtly acknowledges in discussions of the Parc de la Villette.

The study of the Science Museum buildings and their surroundings show that the position of a museum is significantly relevant to its community zone, surrounding environment and marketing. The appropriated site brings about the arrival of visitors. A museum should not stand alone, separate from the community area. In other words, the convenience, journey and infrastructure are significant factors when positioning the museum. The next section discusses items relevant to the museums' interiors, exhibitions, activities and presentations.

Museum interiors, activities and exhibitions

a) Tokyo National Science Museum, Ueno Park

This section discusses the objectives of the Paris and Tokyo science museums. The major purpose of this section is to look at government policies, museum objectives and the relevant contexts encountered as visitors pass through the exhibitions and presentations in their Museums. The information and data are analyzed with a view to finding suitable solutions for the needs of Thailand's own national science museum.

After WW II, Japan recovered with dramatic speed and now is second only to the US in the size of its GDP. During the 60s and 70s, Japan kept up a rapid pace of development. In step with this rapid growth, Japan created a vast amount of local infrastructure all over the country. Growth was concentrated in the "Pacific Belt Zone" that includes such major cities as Tokyo, Osaka, Nagoya, and Fukuoka.

In part of its Comprehensive National Development Plan, national goals controlled and balanced justifiable investments in local infrastructure such as roads, rails, water, and sewage. Japan's centralized government organization controlled and balanced investment all over the country.

In the field of Science and Technology, there is also a need for qualitative policy. Japanese development was based mainly on manufacturing industry. The national government invested vast amounts on infrastructure to support growth. These developments were especially welcomed by Japanese manufacturers, who were already good at turning out high quality products, based on a mass production system

that employed many subcontractors with strong technical skills. They captured the innovative technology of leading countries (such as the United States and the European Union) and improved it. With these strengths, the Japanese manufacturing sector enjoyed enviable growth in completely new technologies and products.

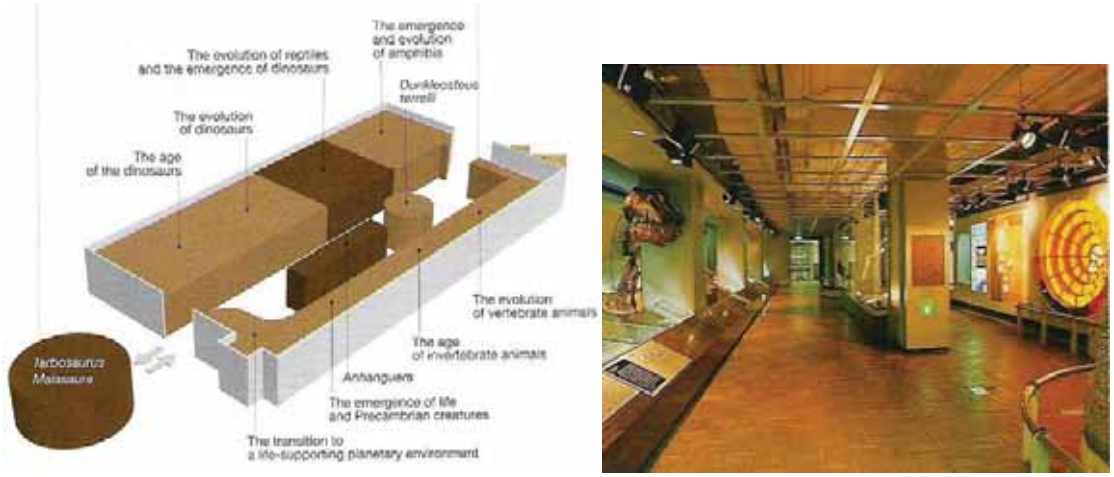
The growing center of the whole industrial sector then shifted from manufacturing to knowledge-based industries. In knowledge-based industries, innovation and new knowledge creations are the sources of competitiveness. Stronger intellectual property rights are making it increasingly difficult to pirate innovations. Developing “new knowledge creation” and industries based on continual innovation became important, not only for Japan’s national government, but also for regional administrators. Science and Technology policy receives the emphasis it needs to activate local industry and to improve the quality of life in the regions.

In Japan, local governments spent 781 billion yen (US. 6.8 billion), roughly 17% of government (national and local) expenditures, in Science and Technology (as of 1999); 46% were funded to public research institutions, and 33% were funded to local government, universities and higher education institutions. This expenditure included all the relevant Science Museums in Japan. *It could be said that the Japanese government linked science to industry. In the Museum, science is an education, as we can see in exhibitions of the Tokyo National Science Museum.* Japanese culture also appears in the Science Museum, as the researcher discusses in the following.

The Tokyo National Science Museum concentrates mainly on the evolution of life on Earth. However, its comprehensive permanent displays and exhibitions address nearly all aspects of scientific endeavor. The Museum focuses more on natural history than technology. Images of dinosaurs and stuffed animals have a high profile. There is also a section on the solar system and interactive galleries where visitors can carry out their own little experiments. The museum has two chief areas to explore in the Main Building and the New Building, as well as the Midori-Kan Building and outdoor exhibits.

The first floor of the Main Building of the Museum traces the phylogeny of living creatures from dinosaurs to Homo Erectus. The theme of the second floor of this building is Natural Selection. A stuffed and portly Stella Sea lion welcomes visitors stepping into the second floor. The third floor exhibits plants and animals of Asia, a small collection of conventional Japanese clocks, different items relating to the

exploration of space such as one of the flags carried to the moon during the Apollo 11 and Apollo 17 space missions, and many other things.



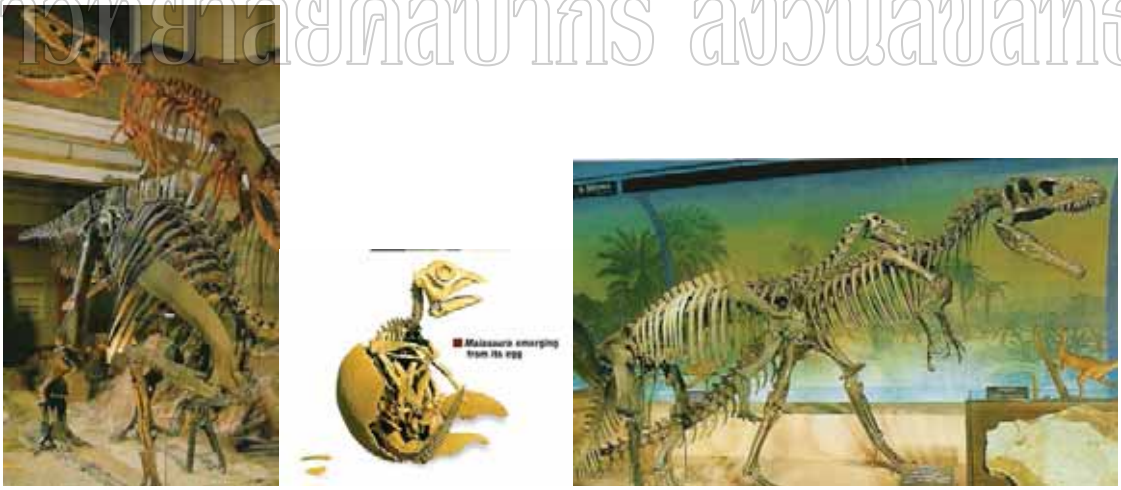


Figure 204 *Lay - out and exhibits of Evolution of Life on the first floor, Main building*
Source: *The National Science Museum Guidebook . 2002.*

The Main building includes an *information* desk, a consultation room, a lounge, a Museum shop and a café. There are also useful *Museum Activities* such as collecting for the museum, especially bringing in new specimens and artifacts which are indispensable for primary research for building up new knowledge. There are three issues which touch the researcher's opinions about the main building:

1. The contents of the exhibits in the main building can be categorized in six sections. The first five sections emphasize Biology. The sixth section, quite different, emphasizes Astronomy. The researcher suggests that the sixth section should hold closer to the themes in the first five.

2. In terms of presentation, most of the displays include exhibition objects which are shown in window displays. All displays and presentation methods present specimens on exhibition. Most are simulations, but some are real specimens. The displays are interesting. They intrigue and enliven like illustrations in a book. Some exhibits have curators who describe the content to visitors. Some are interactive when visitors press buttons and elucidate sounds. These are very simple methods which may not sound exciting, but the use of color and lighting is harmonious. Most of the décor uses colors which are mild tints. Everywhere things are smooth, clear and clean. Lighting in exhibitions generally facilitates circulation and spots on exhibit objects. Lighting brings about dominance. In addition, lighting clarifies emphases and communicates with visitors well, bestowing some interpretation on the contents of the exhibit displays. The exhibits are easy to see and understand. Visitors are encouraged and supported in their concentration.

3. National identity is interpreted via the contents, objects or displays in the Museum exhibits. These include

a). *Meteorites and the Solar System*. The exhibits in this room comprise mainly a systematic display of meteorites that have fallen on Japan and a visual representation of the fall of a meteorite. Also on display are calendars, a celestial globe, telescopes, and artifacts that illustrate the history and nature of astronomy.

- *The fall of the Kokubunji meteorite.* The Kokubunji meteorite fell onto the town of Kokubunji, Kagawa Prefecture, Shinjuku on July 29,1986. This is one of the few meteorites whose fall was observed by a large number of people. The exhibit includes a model of the town and a visualization of the falling meteorite. Also on display are meteorite fragments collected from the site.

- *Kasen meteorite.* The largest meteorite ever found in Japan is the Kasen meteorite, which fell on the Kasen area of Rikuzen-Takada City in Iwate Prefecture in 1850. It weighs more than 100 kilograms.

- *Lunar rocks (Apollo 11).* Fragments of lunar rocks collected by Apollo11 and Apollo17 and subsequently presented by the United States of America to the

people of Japan are on display. The photo shows moon rocks collected by Apollo11 and a Japanese flag that was taken to the moon and brought back.

- *Harumi Shibukawa's celestial globe. (This is classified as an important cultural property.)* Since ancient times, Japan fused calendars imported from China. In the 17th century, Harumi Shibukawa devised the first Japanese calendar and was appointed as the first official astronomer to the Shogunate. The photo shows a paper celestial globe made by Harumi Shibukawa in 1697.

Figure 205 *The fall of the Kokubunji meteorite and Kasen meteorite*
Source: *The National Science Museum Guidebook . 2002.*

Figure 206 *Japanese flag that was taken to the moon and back.*
Source: *The National Science Museum Guidebook . 2002.*

b) *Japanese Clocks* on display here were mainly designed and made by Japanese clockmakers from the 17th-century to the middle of the 19th-century. They

include hanging clocks, standing clocks, pillow clocks and “shaku” clocks. A special characteristic of all of them is the way in which the dials and mechanisms are based on the principles of measuring the length of daylight and darkness in different parts of the country, the time measurement method commonly used in these times.

- *The 100,00 year clock* was made in 1851 by Hisashige Tanaka. In addition to six dials, including a Japanese-style one, the upper part features models of the sun and the moon.

- *A Standing clock* represents one Japanese clock. The mechanism rests on a base of 4 legs.

Figure 207 *100,00 year clock* and *Standing clock*
Source: *The National Science Museum Guidebook . 2002.*

c) *Animals and Plants of Japan*,

- *Natural forest of Yakushima Island.* A cross-section and part of the trunk of a Yaku cedar (Cryptomeria japonica) over 1,600 years old, with a description of the native forest of Yakushima Island and the flora to be found there.

- *Japanese beech grove.* A Japanese beech grove shown as it looks in the spring when the buds are opening. Pure beech woods, rarely found in the world today, still exist in Japan.

- *Animals from the Asian continent.* Featured here are examples of animals that crossed to Japan from the Asian continent, including the brown bear (Ursus arctos), ermine, flying squirrel, and others.

- *Animals characteristic of Japan.* This exhibit shows representative mammals and birds indigenous to Japan, including the Japanese serow (Capricornus

crispus), the Japanese monkey (Macaca fuscata), the Japanese crested ibis (Nipponia nippon), the Japanese stork (Ciconia ciconia), and the Japanese crane (Grus japonensis).

- *Marine fauna characteristic of Japan.* Thanks to the influences of the Kuroshio and the Oyashio currents, Japan's coastal waters form habitats for marine creatures that live in both warm and cold waters.

Figure 208 *Natural forest of Yakushima Island and Japanese beech grove*

Source: *The National Science Museum Guidebook . 2002.*

Figure 209 *Animals characteristic of Japan*

Source: *The National Science Museum Guidebook . 2002.*

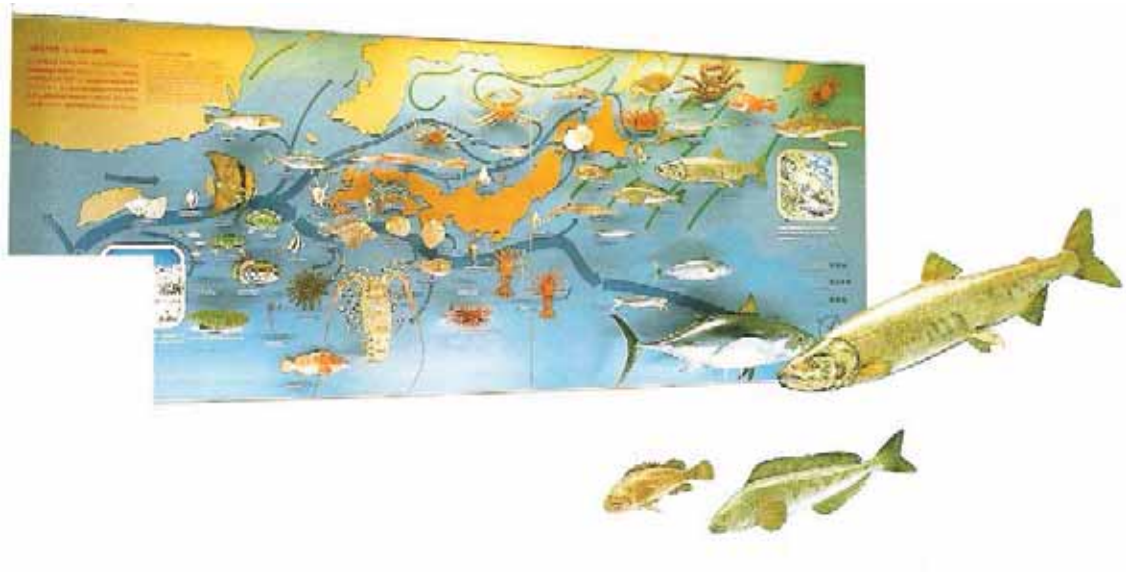


Figure 210 *Marine fauna characteristic of Japan*

Source: *The National Science Museum Guidebook . 2002.*

The New Building has five floors. The basement houses fossils and examples of dinosaurs from the cretaceous period. Moving upstairs, interaction becomes the name of the game in ‘discovery plaza’ and ‘discovery wood. The first floor has a semi-chintzy exhibit of oceanic diversity of life. The second floor consists of all kinds of hands-on science experiments. A room with tilted floors and mirrors exemplifies how our sense of space works. In an audio room, sounds come from different places. A helicopter-bike rises a bit off the floor if you pedal hard. There is a sound parabolic mirror device, and much more. The third floor is set up as a wooded area, with stuffed deer, a wild pig, a raccoon and some birds. The animals are floor-level so children can touch them. The remaining floors are reserved for special exhibitions.

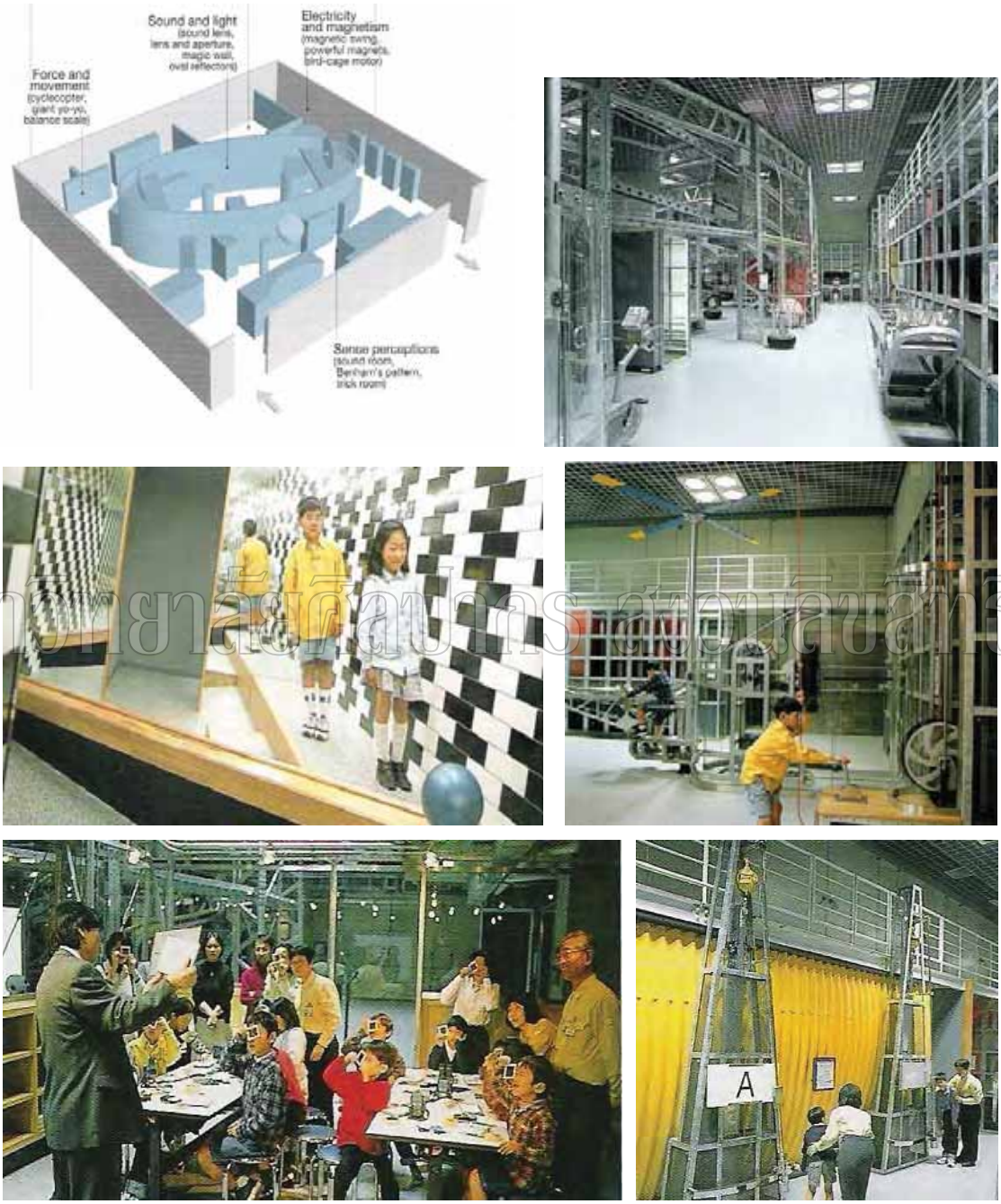


Figure 211 *Lay - out and exhibition in the Discovery Plaza: Science in Everyday Life*

Source: *The National Science Museum Guidebook . 2002.*

In the New building, there are two issues relevant to the researcher's opinion, as follows:

1. The method of categorizing and organizing. There are four various sections in Science, as follows:

B1 floor - Mysteries of Origin and Extinction: Dinosaurs. This section deals with dinosaurs, a subject of interest to many Japanese people. In the researcher's opinion, this item could be joined to *Evolution of Life 1*, another exhibit pertinent to the origins of the dinosaurs.

1st floor - The Diversity of Living Things: Marine Creatures. This section exhibits living creatures under water relevant to *Evolution of Life 4, the Speciation and Diversity of Life, and Animals* and *Plants of Japan* of the Main building. In addition, this section is similar to the *Animal Kingdom* in the Midori - kan building.

2nd Floor - Discovery Plaza: Science in Everyday Life. This part exhibits Physical Science which could be organized to relate to *Meteorite, Solar System and Clocks* in the Main building.

3rd Floor - Discovery Plaza: A Wood Filled with Surprise. This part simulates the atmosphere and the creatures of the forest. Children who visit can experience some empirical learning. In the researcher's opinion, this section can continue relevant to *Evolution of Life* in the Main building or *Animal Kingdom* in the Midori - kan building.

2. All four parts of the New building are presented differently from the Main building and the Midori - kan building. In the New building, visitors are in a simulation of the real environment. The children who visit enjoy themselves with interactive reproductions, unlike the other two buildings in which visitors walk past and see the exhibited objects as in a window display.

The Midori Kan Building is the smallest building here. It contains classified exhibits that show the characteristics of different animal groups, displays of rocks and fossils classified by geological era, and a rich lineup of anthropological specimens. Here we can marvel at the rich variety of the natural world, including the dynamic panorama of natural history in the Science theatre. Taking a break from looking at exhibits, the first floor has a very comfortable restaurant located on the first floor of the Midori - Kan. A varied menu makes this a good place to relax over a meal.

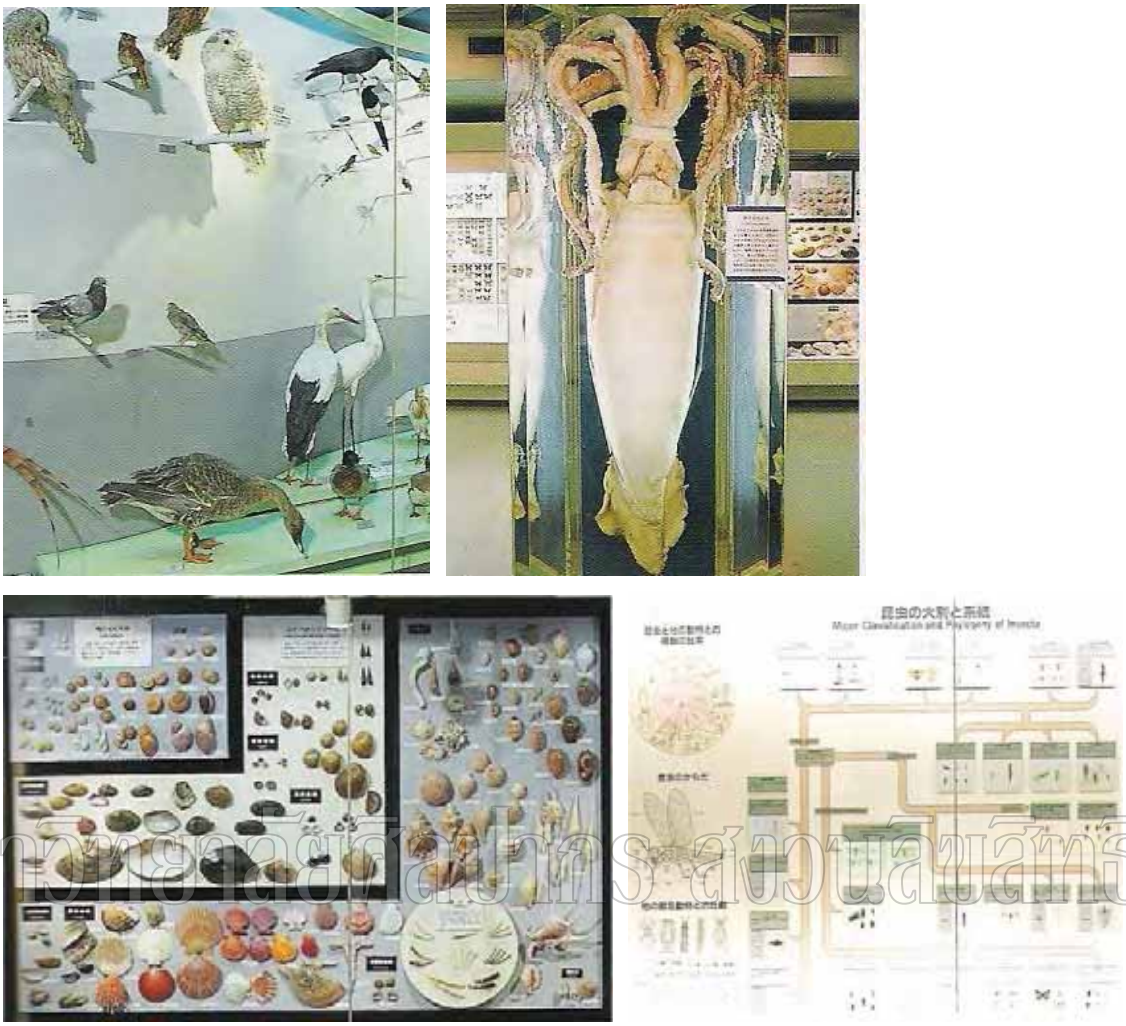


Figure 212 *Birds, Giant squid, Mollusca and Insecta, Midori - kan building*
Source: *The National Science Museum Guidebook . 2002*

All the five sections of the Midori-kan building have both similarities and differences, compared to the Main building, as follows:

1. Regarding the content of the exhibitions, Midori-kan is categorized in five sections, following the floors of the building. *Animal Kingdom* is similar to *Evolution of Life* in the Main Building. This suggests a certain redundancy in exhibit contents which might better be integrated into a continuous space which would better aid visitors in their overall understanding.

2. In the theatre the science presentations, while remaining relevant, should not be fixed but should rather change with events each season. In this theatre, the movies are relevant to Natural History. Entry and exit presentations for the exhibits should be relevant to Natural History as well. Sometimes, the categories of exhibit

contents are not relevant to each other. This might be due to the fact that the National Science Museum has only occupied for the Main building for the first time in 1930. The Midori - kan building offers new exhibit contents, but sometimes without adequate concern for existing exhibitions.

3. Regarding the items *'Geological History of the Japanese Archipelago*' and *'Origins and Microevolution of the Japanese People, Anthropology'* these are Natural History issues which are relevant to each other and to the theatre on the third floor. *Meteorites, Solar System and Clocks* in the Main building could be integrated with *Geological History* and categorized in the same section.

4. Because the item, *'Origins and Microevolution of the Japanese People, Anthropology*' concerns the evolution of the Japanese people, this section could be continuous or relevant to the *Evolution of Life 1-4.* It could be one section, for example, as *Evolution of Life 5.*

5. *Friendship Hall*, *Reading Corner, Teachers' Center, Observation Center* are neutral items which connect this zone with the neutral activities of the three buildings.

6. The presentations in this building are similar to the Main building in that the displays are exhibition objects shown through windows. All the displays and presentations use specimens in their exhibitions. Most are simulations or models, but some are real specimens.

7. Regarding the issue of national identity, the exhibitions in this building include:

- *Animals in danger of extinction.* Many species of animals have already become extinct and many more face the same fate. The Japanese wolf has not been seen since the last sighting in 1905. The Iriomote wild cat barely survives on Iriomite Island in Okinawa. Large members of the Accipitrid family such as the golden eagle have become scarce as a result of deforestation.
- *Giant squid (Architeuthis japonica).* This is the largest of the invertebrates. The specimen on display of the genus *Architeuthis* was caught in the Sea of Japan. It measures about 3.8 m. from the tip of its rear fin to the end of its front tentacles.
- *Hachiko and Jiro.* The Akita dog, Hachiko, is famous for its loyalty, and the Shakhalin dog, Jiro, took part in an Antarctic exploration.

Figure 213 *Hachiko and Jiro*

Source: *The National Science Museum Guidebook . 2002.*

Figure 214 *The story of the Futaba-Suzuki plesiosaur*

Source: *The National Science Museum Guidebook . 2002.*

○ *The story of the Futaba-Suzuki plesiosaur.* The Futaba-Suzuki plesiosaur is a well-known fossil of a marine reptile found in Fukushima Prefecture. Taking the discovery and excavation of the fossil as its theme, the story uses three dimensional images to recreate the world of plesiosaurs and other dinosaurs some 85 million year ago in the late Cretaceous period of the Mesozoic era. The exhibit also explains how the fossils of animals that lived in the sea came to be found on mountainsides. Many shark teeth were also found, some of them embedded in the fossil bones.

The exhibition in the item *" Geological History of Japanese Archipelago"* and "*Origins and Microevolution of the Japanese People, Anthropology*" are directly related to the Japanese identity appropriate to the National Science Museum.

Figure 215 *Japanese twin of quartz crystal*

Source: *The National Science Museum Guidebook . 2002*

Figure 216 *Joint burial of the Jamon period and People of Yayoi period*

Source: *The National Science Museum Guidebook. 2002.*

The aforementioned comprise all the exhibit contents in the three buildings of the Tokyo National Science Museum on exhibition for visitors. Every part of the exhibit contents show that the Tokyo National Science Museum is impressive in clarity of interpretation. Its reputation nationally and internationally is well-deserved. Tokyo National Science Museum does a good job in communicating a sense of national identity to visitors, mostly children. The children enjoy and are entertained as they absorb knowledge from the museum exhibition.

b). Paris National Museum of Science and Industry, Parc de la Villette

For centuries, Paris was the cultural and intellectual center of the Western world, a magnet drawing representatives of international intellectual and artistic communities. The city of Paris has been the birthplace of new ideas. In the 18th

century, the city was an important force to generate the Age of Enlightenment. It welcomed and supported many new artistic movements, such as impressionism, fauvism, cubism, and surrealism; and new art forms, such as photography and film. Parisians place a high value on the arts. Theaters, concert halls, repertoire cinemas (devoted to the so-called 'indy' films), museums, art galleries, and annual festivals enjoy large audiences and substantial funding from both the civic and national governments. The city has been home to many great thinkers and philosophers.

Paris boasts around 150 museums (*musées*), ranging from the Louvre, one of the largest and most famous museums in the world, to the very small Musée, Zadkine, located in the former home and studio of cubist sculptor Ossip Zadkine, by the Jardin du Luxembourg. The Louvre houses an exceptional collection of Greek, Roman, and Egyptian antiquities, and great paintings of French, Italian, Dutch, and Flemish schools. The *Mona Lisa* (1503-1506) of Leonardo da Vinci and the ancient Greek statues *Venus de Milo* (150-100 BC) and *Victory of Samothrace* (about 200 BC) are among its world-renowned treasures. The museum was remodeled and enlarged in the 1980s, and its entrance is now sheltered by Chinese American architect, I.M.Pei's large glass pyramid. The Musée d'Orsay, located in a converted railway station, is devoted to French painting, sculpture, photography, and other works of art created between 1848 and 1914. It is best known for its impressionist collection, the largest in France. The Musée Nationale d'Art Moderne (National Museum of Modern Art) is located in the Pompidou Center, near Les Halles. Devoted to 20th-century and contemporary art, the museum contains significant fauvist, cubist, and surrealist collections, among others.

Medium and small-sized museums are scattered all over the city, with an exceptional concentration located in palatial former townhouses in the Marais neighborhood of east central Paris. Le Musée de l'Histoire de Paris (Museum of the History of Paris) in the Hôtel Carnavalet and the Musée Picasso in the Hôtel Salé are the most popular museums in the Marais. The Musée de l'Histoire du Judaïsme (Jewish History Museum) is located in the Hôtel Saint-Aignan. The Marais is also home to various cultural institutions and libraries. Even the homes of some famous artists and writers have been turned into museums, notably the Musée Rodin near the Invalides, the Musée Victor Hugo in the Marais, the Musée Delacroix in Saint-Germain-des-Prés, the Musée Zadkine and Musée Bourdelle in Montparnasse, and the Musée Balzac near the Trocadéro on the west side. There are several other museums in the Trocadéro area, notably the Musée de l'Homme (Museum of Man),

which features anthropological and ethnographical exhibits, and the Musée Guimet, with its collections of East Asian art. Also nearby is the Musée Marmottan where 80 paintings by Claude Monet are housed, including *Impression, Sunrise* (1872-1873), which gave the impressionist movement its name.

Major temporary exhibitions are held at the Grand Palais by the Champs-Élysées, while artworks donated to the city are housed at the neighboring Petit Palais. Temporary exhibitions of contemporary art are shown at the Musée du Jeu de Paume, on the western edge of the Jardins des Tuileries. The neighboring Musée de l'Orangerie houses French art from 1880 to 1930, including Monet's *Nymphéas* (1916-1926).

In the Latin Quarter, the Musee National du Moyen Age (National Museum of the Middle Ages, also known as the *Cluny Museum*), houses a series of world-renowned tapestries known as *La Dame à la Licorne* (The Lady with the Unicorn, 1484-1500). The museum is located in the Hôtel de Cluny, a 15th-century mansion.

The neighborhood of La Villette, located on the northeastern edge of the city, *is a major cultural hub for the city*. The Parc de la Villette is the site of the Cité des Sciences et de l'Industrie (City of Science and Industry) and the Cité de la Musique (City of Music), which houses both the Musée de Musique (Museum of Music) and the Conservatoire National Supérieur de Musique (National Higher Conservatory of Music). The French people look upon art and culture as the joy of life. They look at everything as culture and their government treats their Science Museum as cultural. They easily link their museums to cultural issues. This is why the Cite' is located on a site rich in cultural history.

Apart from its location, the Science Museum's interiors and exhibits present science in a relevant cultural context. The interior architecture of this Science Museum could be separated in two parts. First, the main building is a huge rectangular form for exhibits and general activities. The other sector is the *Geode*, one of the world's largest geodesic domes. It is a powerful symbol of past and future. This spherical dome is used as a planetarium and for astronomical simulations.

Figure 217 *The axonometric of National Museum of Science and Industry*

Source: *www.cite-science.fr*

Geode has a hemispheric theatre with 354 seats inside its stainless steel structure. The audience is treated to a screen which stretches 180 degrees. “Geode” is also a circular theater which produces and shows multimedia productions. This IMAX Theater is separated from the museum building but connected by a corridor below. It is a modern theatre which shows movies in a three dimensional format. The theatre is located at the front of the main building in the southern area.

Audiences are treated to imaginative images and entertaining sound. Located at the base is a characteristic reflecting pool, its structure built on the level of a public park. Lights reflect off the glass covering the theater, enlivening the whole round image of this unique theater. The texture of the circular form of this hemispheric auditorium is smooth, reflections from the sky above and the pool below showing in the glass. Not far from the dome are trees, a playground, and a real submarine that visitors can tour. Walking inside the heart of the “Geode” symbol of the Cite, one finds a pearl of modern technologies, mixing glass and iron. With its symbolic form, location and reflecting glass, Geode is the iconic sign of this museum.

The main building looks like a gigantic rectangular factory. Architects transformed the slaughterhouse which was built in 1950 and closed in 1970. This slaughterhouse became the main building of the National Competition of the Paris Science Museum in 1980. The main purpose of this design project was to gather the existing structures of the slaughterhouse into a suburban pubic park.

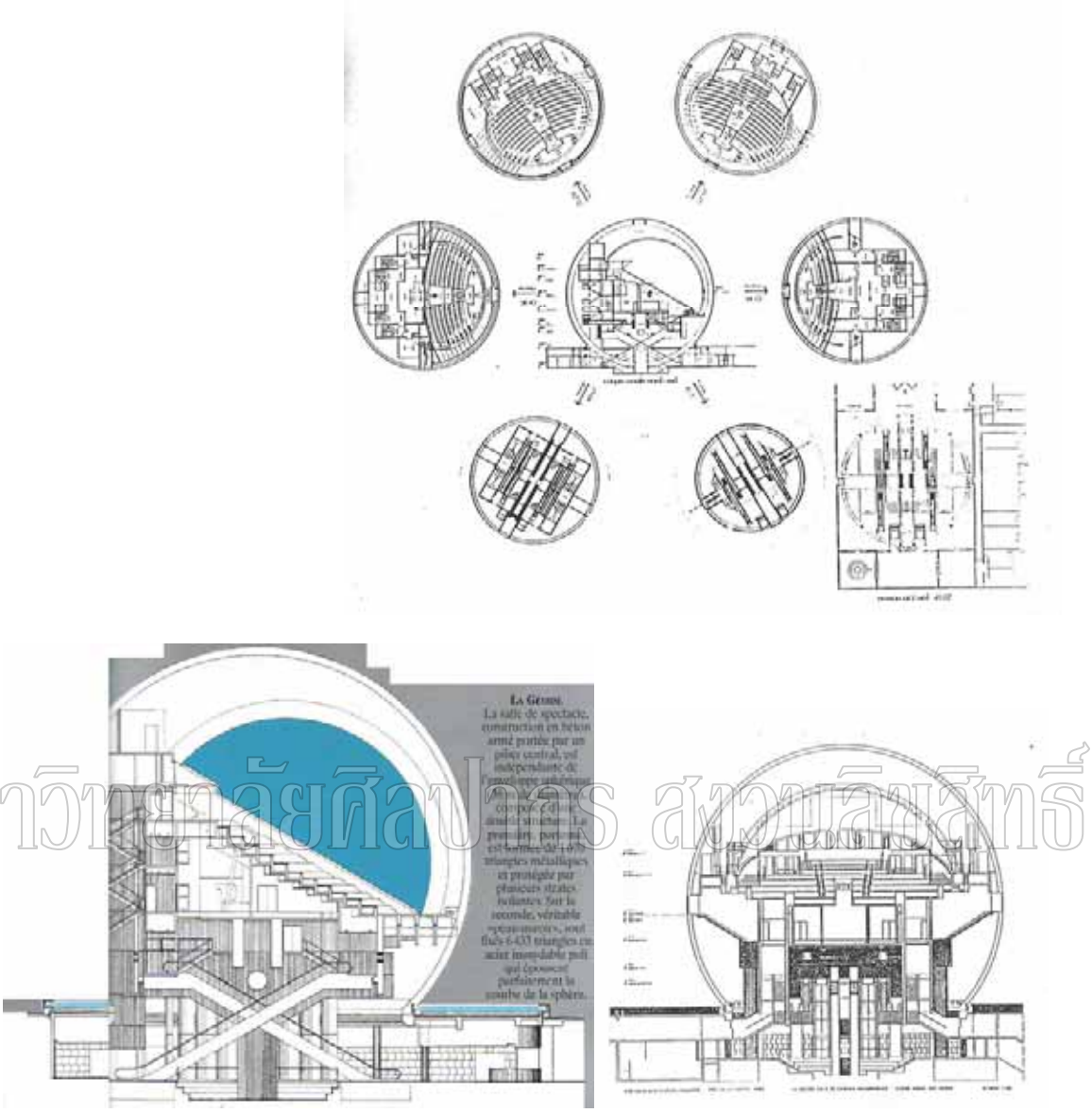


Figure 218 *The section of Geode dome*
Source: *La cite' des sciences & de l' industrie*

The gigantic industrial building covering the area of the museum interior has several interesting features:

- In the *Explora*, you can pilot an airplane, step inside a camera, travel through the human body, visit an Ariane rocket, and much more.

- The *Argonaute* is an attack submarine open to visitors.

- The Omnimax movie theatre is equipped with a 1000 square meter screen.

- The *cinaxe* is a simulator outfitted with the same equipment used to train airplane pilots and engineers.

The body of the Museum building is a vast rectangle with a blue roof. Entering the first floor, visitors will see escalators to the left and the right in a symmetrically balanced design with a large void in two wide skylights above. Natural light reaches the activities on the first floor. Moreover, visitors on both upper and lower floors can see each other through this broad, wide space. In other words, the newcomer can see activities both on the first floor and on upper floors. Features hang in the void above. At the same time, visitors on upper floors can see activities below. This experience is very dynamic, teasing visitors to enter with delight and to interact with the museum exhibits and activities.

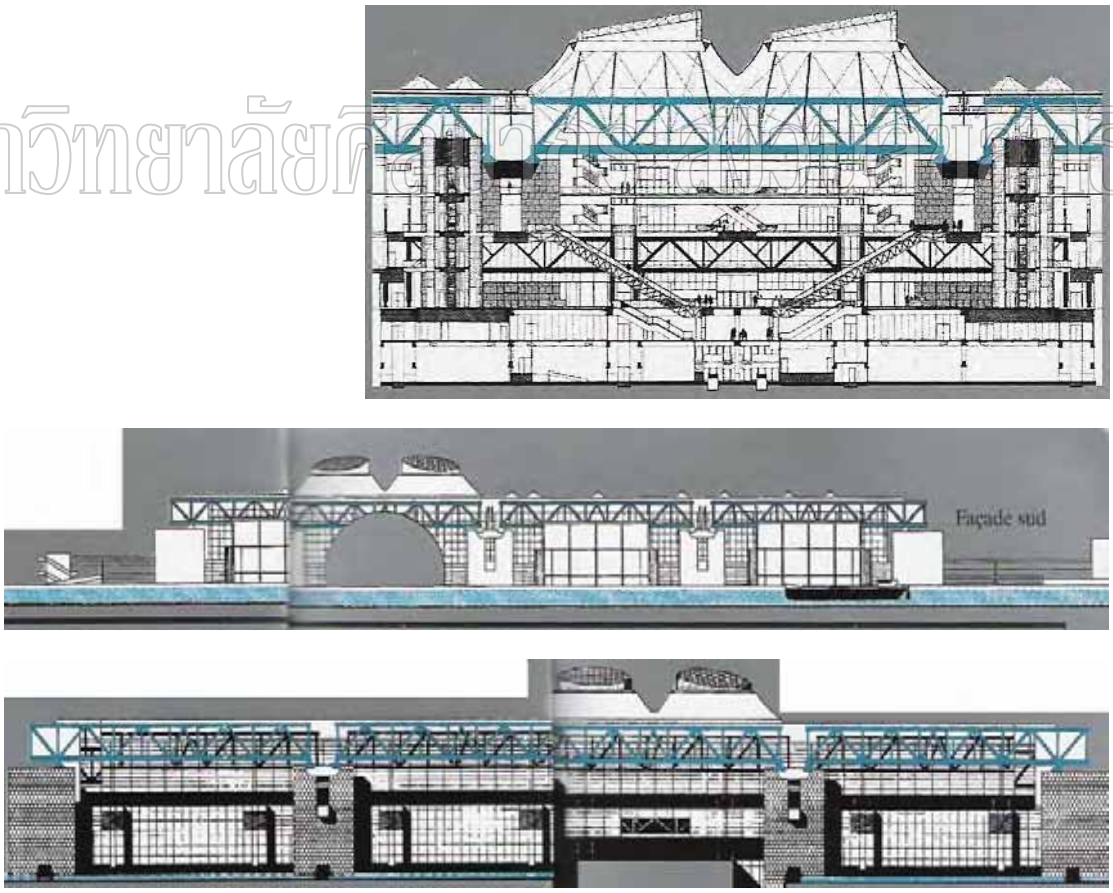


Figure 219 *Section and elevation of Main Building*
Source: *La Cite' des Sciences & de l' Industrie*

In 1986, the Cite was regarded as the largest science museum in the world. The area opened to the public covered 95,000 m^2 with 40,000 m^2 for permanent exhibitions and new exhibit objects with updated techniques and interpretations. In addition, there were areas for other relevant activities, including a conference center. The Cite addresses topics in communication, environment, health, astronomy, computers, etc., via exhibits, shows, models, conferences and interactive games. There is a Planetarium, a Mediterranean aquarium, a cinema (3D films) and a media library.

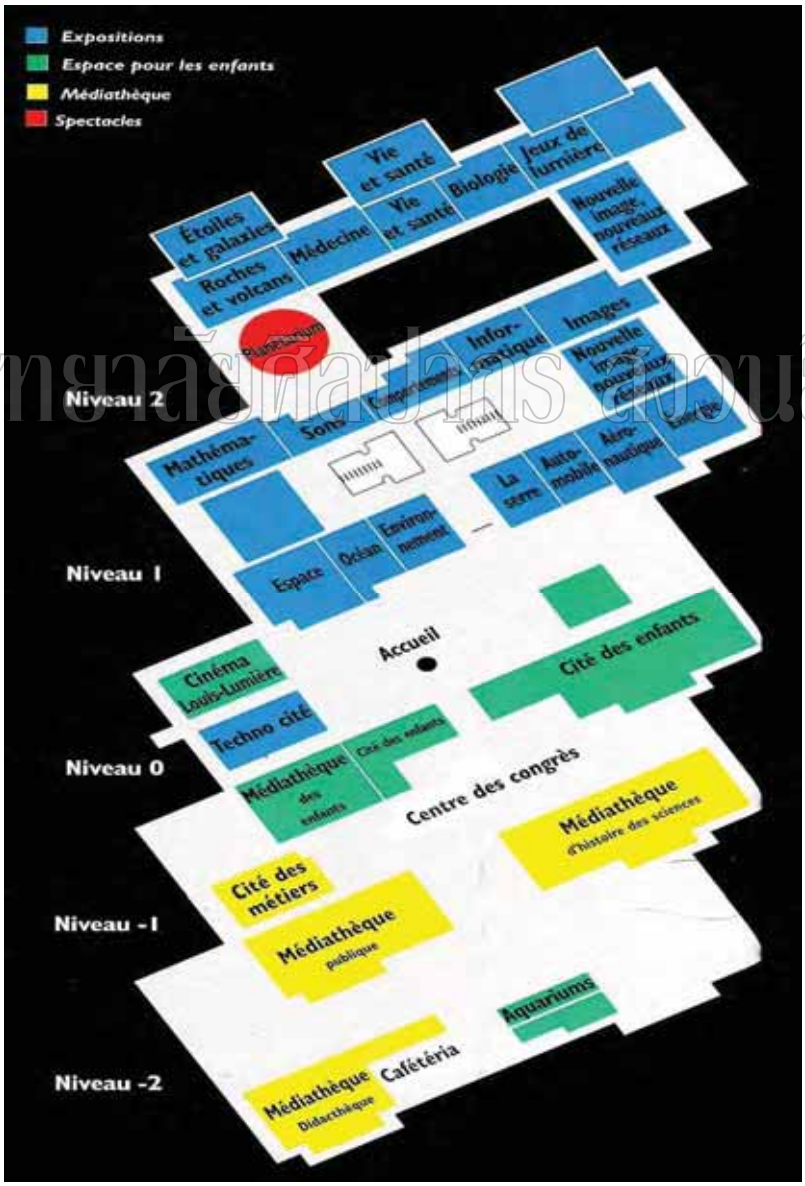


Figure 220 *Zoning of the Main building*

Source: *La Cite' des Sciences & de l' Industrie*

The Main Building has four primary zones (Figure 220). The first (green) floor has many activities for children. The children are encouraged to learn by playing with the exhibitions. Children and adults soon discover the “Cité des enfants” (City of children), including Louis Lumiere’s cinema with its 3D projections. The circulation among these exhibits is managed appropriately. There are two lower floors underground. These yellow areas include functional rooms, multi-purpose areas, and media library areas. The second floor lower presents a giant aquarium, the mediatheque (media library) and a cafeteria. The two upper floors comprise a blue zone for general exhibition areas. The remainder is the red zone - the IMAX and the planetarium area which are used for scientific demonstrations.

The space of this Science Museum is large, open and very flexible. It is easy to categorize the zoning of the Museum. The museum interior opens in a void to the ceiling, revealing the various activities on each floor and filling the Museum with dynamic movement. Audiences find the Museum space very stimulating.

Figure 221 *Temporary exhibitions*

Source: *La Cite’ des Sciences & de l’ Industrie*

Figure 222 *Permanent exhibitions*

Source: *La Cite' des Sciences & de l' Industrie*

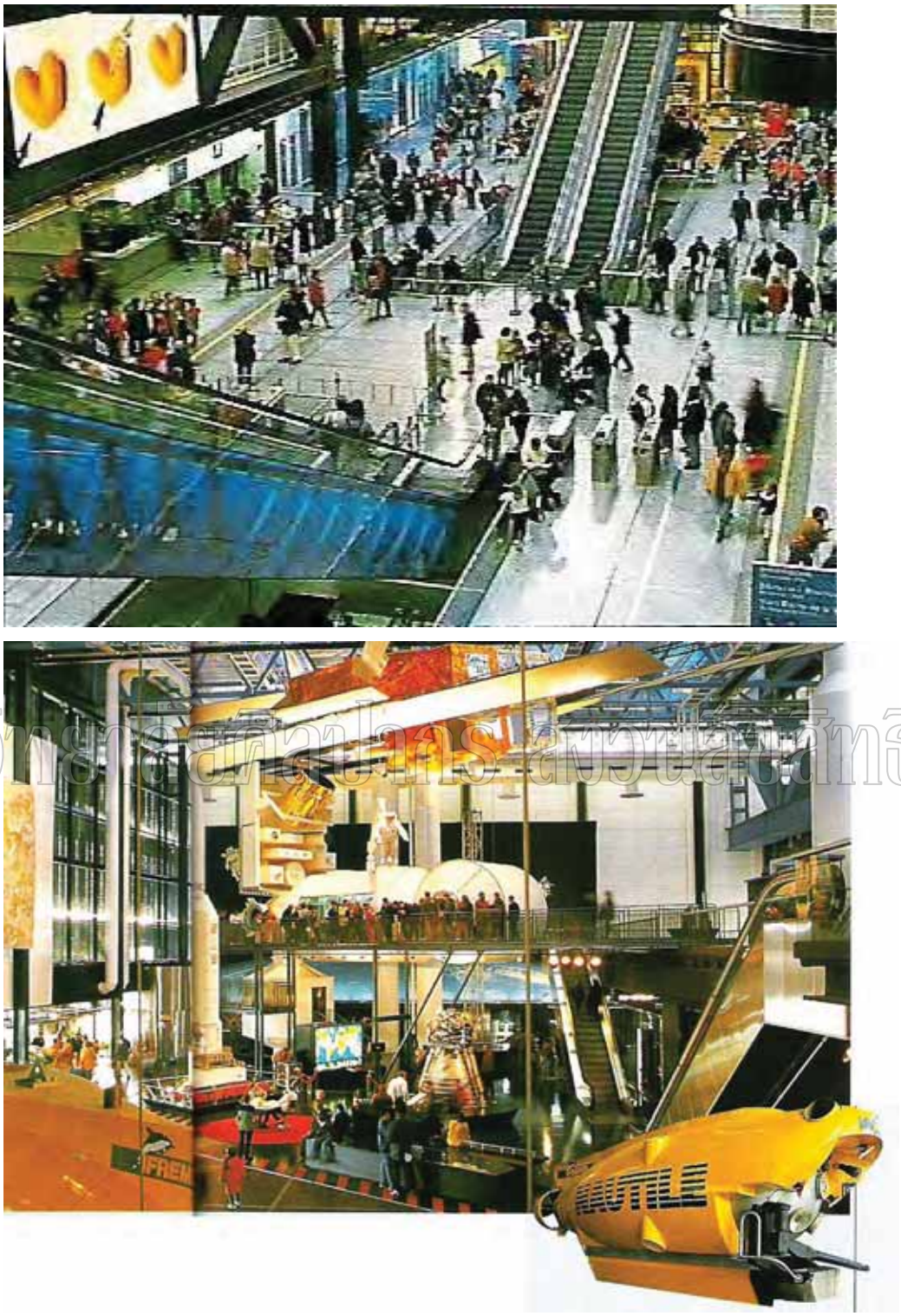


Figure 223 *Escalators in the hall*

Source: *La Cite' des Sciences & de l' Industrie*

Figure 224 *Various activities for children*

Source: *La Cite' des Sciences & de l' Industrie*

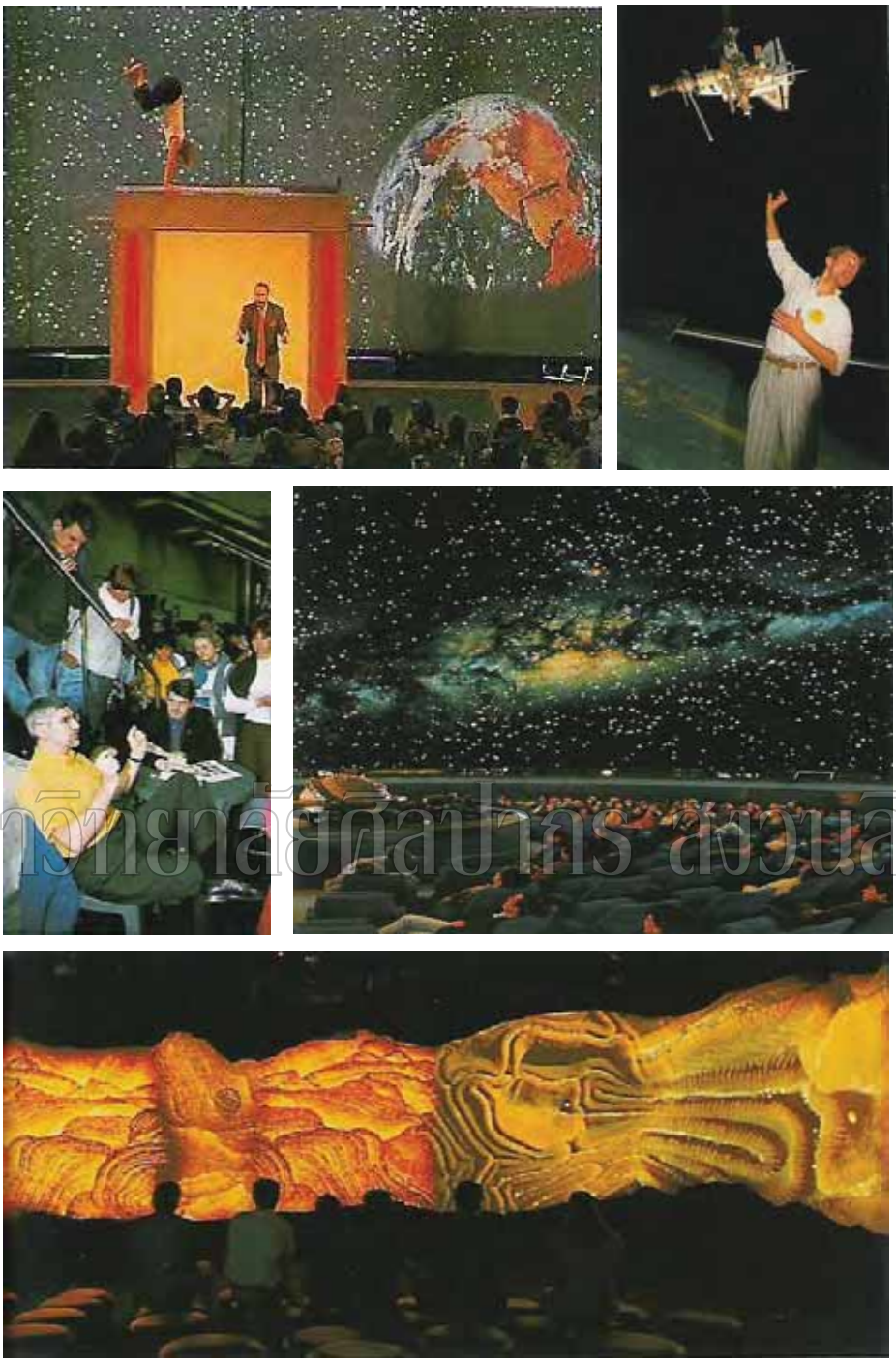


Figure 225 *Science shows, planetarium and demonstrations*

Source: *La Cite' des Sciences & de l' Industrie*

Figure 226 *Multi media library for children of age 3-12 years old*
Source: *La Cite' des Sciences & de l' Industrie*

To sum up, the Main Building is composed of:

1. Permanent exhibitions. These areas present basic knowledge relevant to science, emphasizing humanity and the environment. They occupy a quarter of the total area. "Discovery" is an area for children. In addition, there is a science club with a Friendship hall, a Reading corner, a Teachers' center and an Observation center, as in Japan's National Science Museum.

2. Temporary exhibitions. This area comprises various exhibits occupying about 2,500 m^2.The temporary exhibitions keep apace with recent science news.

3. Inventorium. This area is for activities for groups of children aged 3-6 years and 6-11 years. Both children and adults will be intrigued by the "Cité des Enfants" (City of children).

4.The multi-media library features VCDs, computers, etc. This area is located on the first floor and on a lower floor.

5. The planetarium provides areas for space exhibits and displays.

6. The international conference center is dedicated to studying scientific progress. It consists of a main hall which seats 955 visitors. A smaller hall has 440 seats and two seminar rooms which contain 96 and 56 seats each.

7. The training center offers scientific training for teachers and for the general public. The Science Section of *Contemporary Issues in Technology and Teacher Education* is sponsored by the Association for Science Teacher Education (ASTE). The unique purpose of this journal is to publish peer-reviewed research and theoretical articles on the use of innovative technologies in science teacher education. The publication encourages manuscripts that deal with the education of pre-service or in-service science teachers, as well as college level science faculties. The online journal allows authors to include interactive technologies as part of their manuscript. This gives readers more direct access to sample technologies. On-line presentations can present video images, audio, animation, besides offering external links. In addition, an extended virtual dialogue is possible, as commentaries on published works are encouraged. Such dialogues have already taken place on subjects such as appropriate guidelines for use of technology in teacher education.

All exhibitions in the Cite' are directed at children and emphasize interactive activities in preference to the traditional one-way flow of information from teacher to learner. Knowledge from the exhibitions comes from empirical learning in the exhibition. An exciting and colorful atmosphere surrounds visitors. The large central open space with escalators is important in creating this atmosphere.

Referring to notions from the oversea museums above, the research critiques and compares their similarities and differences. In addition, the researcher compares museums with Thailand's NSM in the following table (Table 2). The analysis of data relevant to this table is discussed in the next chapter.

Table 2 *Comparing oversea museums with NSM Thailand*

Issues	**National Science Museum, Ueno, Tokyo**	**National Museum of Science and Industry, Parc de la Villette, Paris**	**National Science Museum, Patumthani,**
Site location & Urban conditions	*Centralized (city center)* *Various functions linked to Natural and Cultural recreation areas*	*Sub centralized (well located on the public transport system)* *Built new and linking various functions with culture*	*Decentralized (out bound)* *Connected to other science organizations*
Journey & Traveling	*Electric train*	*Metro*	*Bus*
Building, Architecture and Surroundings	*Existing old building in harmony with the new and integrated with the surroundings* *Museum linked to community and environment*	*Dominant in surroundings* *Deconstruction* *Museum linked to community and environment.*	*Dominant in surroundings* *Modern architecture* *Museum linked to Government offices - Ministry of Science and Technology*
Museum Interior and Exhibition	*Science is linked to Industry.* *Science Museum is educational.* *Showing nationality* *Emphasis: Natural history*	*Science is culture* *Emphasis: Physical Science*	*Science is to improve Industry* *Science Museum is educational.* *Emphasis: Physical Science*

Chapter 7

Analysis, Discussion, and Conclusions

This last chapter discusses the summarized information from each of the earlier chapters in search of ideas on interpretation and notions more generally concerning the idea of a science museum. The analysis of data is relevant to both the overseas museums and the NSM, within their contexts. The researcher brings together what is good and what is bad, along with suggestions from observations, the questionnaire and the interviews in Chapter 5 to compare with the overseas museums. The additional information to complete this chapter is from websites and other relevant sources. In addition, this chapter discusses the information obtained concerning the Research Questions. Finally, the researcher arrives at the dissertation conclusion. This chapter is in three parts:

Data Analysis and Results

Discussion of the Research Questions

Conclusion

Data analysis and results

In this section, the researcher sums up the results from Chapter 6 and analyzes them briefly. The information is discussed regarding the research questions for the next item and for the final conclusion. Table 2 provides a revealing comparison between the oversea museums and the NSM in three categories. These are:

a). Site location, Urban conditions, Approach and Travel

b). Buildings, Architecture and Surroundings

c). Museums Interiors and Exhibitions

a). Site location and Urban conditions, *Approach and travel*

- ***Site location and urban conditions*.** The table below (Table 3) contains partial information excerpted from Table 2. It compares the site location, urban conditions and museum travel in the cases of the Science Museums in Paris, Tokyo and Patumthani.

Table 3 *Site Comparison*

Issues	**National Science Museum, Ueno, Tokyo**	**National Museum of Science and Industry, Parc de la Villette, Paris**	**National Science Museum, Technopolis, Patumthani**
Site location & Urban conditions	 *Centralized (Urban condition - city center of Tokyo)* *The various functions link recreation areas, both Natural and Cultural*	 *Sub centralized (Urban condition - away from downtown Paris)* *Built completely new With various functions linked to Culture more broadly*	 *Decentralized (Suburban condition, semi rural & out bound)* *Connected to other science organizations*
Museum Approach & Travel	*Electric train*	*Metro*	*Bus*

Although growth and extension move out from the center of the Bangkok Metropolitan area, the urban planning policy of the governor emphasizes the north - eastern sector, as we have seen in government administrative office zone and other private spaces, for example: with the Ministry of Science and Technology, Thammasat University, A.I.T, Rajamangala University, as well as state and private museums, Rangsit University, Bangkok University, Northeastern University, Thanyarak Hospital, Thammasat Hospital, the National Library, Tai market, Dhammakaya temple, Future Park and Zeer plazas, and two or three mega-stores within the designated boundaries. Apart from the above mentioned, there are various private offices and factories. This neighborhood enlarges itself via the activities of local communities and the planning policy of the Thai government. This zone is one of various districts which

extend out from around Bangkok. It is decentralized, away from the center. The NSM was built on its present site in an area belonging to the Science Ministry Department, which promotes various science organizations. Visitors who come to the NSM must past through other buildings of the Science Ministry. The journey resembles a trip to a government office rather than a visit to a museum. *To better prepare visitors, the NSM should have its own main entrance, independent of the premises of the Ministry of Science and Technology.*

- Approach and Travel. Visitors should arrive at NSM by car, since buses do not pass directly by. There is no underground or electric train link, as they have for the Paris and Tokyo Science Museums. When coming by bus to the NSM, visitors must transfer to a mini bus in order to reach the museum. It is much easier to go by private bus or car. As a result, most of NSM visitors are schools and coming in family groups. The Thai government has enlarged the Bangkok Metropolitan area without providing for travel convenience. The streets do not efficiently facilitate traffic, nor has any planning policy extended the MRT or BTS to the NSM. *Clearly, the authorities should make the journey to the museum more convenient, since pleasant and easy travel to the site is a central requirement for attracting visitors.*

Like the Thai NSM, the Cite' of Paris is also located far from downtown, but Parisians can use the Metro to take them out from the center city. Visitors can easily arrive at the Science Museum from the Metro, by bus or by car. The National Museum of Science and Industry in Paris is also well prepared to attract visitors from downtown. Besides the Museum, there is also a public park with various *cultural activities* to delight people who visit the museum from all over. The large park is also a market which brings visitors to the Cite'. The development, which does not try to hide this history, is striking.

Tokyo put their Science Museum in the middle of the city, a central location which differs from the Cite' and the NSM. Even though the Tokyo electrical train goes everywhere around the country, Tokyo still maintains their museum as one of the various functions in Ueno, an urban community park. The people use this area for many activities both *natural and cultural*. Visitors can visit other museums or enjoy other kinds of recreation nearby. With so many contiguous activities, a visitor can spend a whole day at Ueno Park including seeing the Tokyo Science Museum.

What we learn from studying these overseas museums is that the Science Museum should be easily accessible to visitors coming from reasonably far distances.

There should be comfortable and convenient bus and/or commuter train service passing directly to, or at least near to, the museum.

b). Buildings, Architecture and Surroundings

- Buildings, Architecture. Architecture is one of many ways to make statements to visitors. It informs visitors of the aims and meanings they will find inside the buildings. Museum architecture can help visitors enrich their understanding. It should help communicate the ideas and feelings which the museum wants visitors to receive. This section analyzes the buildings, architecture and surroundings of the three Science Museums, and how they make interpretations and communicate to visitors.

The front building of the Tokyo National Science Museum is old and elegant with a red brick tile veneer. This building was completed in 1930. It is the first building seen and is the main entrance of the Science Museum. There are two newer buildings adjacent to this older one. None of them communicate a particularly 'scientific' feeling. However, the areas near these buildings have displays of a *Lamda rocket launcher, a Blue whale, three engines, a D51 steam locomotive,* and a *commemorative stone pillar* which announce the importance of science themes. Seeing this out-door exhibition, visitors understand that they are approaching a Science Museum. Although the exteriors of the buildings and the architecture of the *Tokyo National Science Museum do not communicate or interpret what is to be found inside, the museum attempts to reach out to visitors who are approaching the buildings by placing some interesting exhibits outside, as a sort of prelude.*

The Cite' of Paris is a landmark of the city's northeastern sector. The Geode dome of polished stainless steel is the dominant feature of the surrounding area and contrasts with the main building which is rectangular and has a truss structure. The Museum architecture is *deconstructed* in style, experimenting with differences by maintaining the old and integrating with the new. Bernard Tschumi is one of the architects who used the *deconstructive* approach. The architectonic notations of Bernard Tschumi brought about the National Museum of Science and Industry and Parc de la Villette.

Table 4 *Buildings, Architecture and Surroundings Compared*

Issues	**National Science Museum, Ueno, Tokyo**	**National Museum of Science and Industry, Parc de la Villette, Paris**	**National Science Museum, Technopolis, Patumthani**
Buildings, Architecture	 *Recycled old buildings in harmony with the new and integrated with the surrounding (Re-use)*	 *Iconic Dominant in surroundings Deconstruction*	 *Iconic Dominant in surroundings Modern & Mathematical*
Surroundings	*Museum linked to community and environment*	*Museum linked to community and environment Large landscape & beautiful site*	*Museum group linked to Government & Ministry offices*

The Main building of the Cite' used to be a slaughterhouse. This is now a hybrid, since the Museum integrates the re-used structure with new components of a very high technology building. Unlike the Thai case, the French willingness to re-use old buildings has brought about many interesting examples of architecture all around the country. The d'Orsy Museum, which is a renovated railway station, is an example. The cultural concept of re-using old buildings is generally not admired in Asia, and Thailand is no exception. This would happen, probably, only in hotels. Re-use is a way of conserving treasured architectural heritage. In addition, with open and large spaces, it is easy to create iconic buildings, as in the NSM and the Cite'. The mixture of the Cite' buildings and architecture also communicates and interprets attitudes and feelings about *Art* and the cultural re-use of buildings, as well as *Technology* in the science and industry of France. Visitors' perceptions include ideas and feelings about science as they gaze upon the Museum buildings and architecture.

The NSM building was designed and constructed with a geometrical form. The building is composed as three cubes. Each one is 20 x 20 x 20 meters in size, popping up with sharp corners, like dice, and likewise not standing on any flat base.

The building looks like a large, floating cube which dominates its surroundings. This modern mathematical architecture attracts the visitors with its distinctive form. The surface of the building is steel with a ceramic covering. The design of the building also saves energy. A perfectly cubed building is very expressionistic. All of the characteristics of the museum architecture communicate *progressive building technology*. *In terms of the visitors' perception, we can say that the NSM building communicates a scientific feeling.*

***- Surroundings*.** The Tokyo National Science Museum shares its site with other museums and recreation zones which serve both Japanese and foreign visitors. In terms of their surroundings, there are other old museum buildings in the neighborhood, such as the National Museum, the Museum of Western art, the Art Museum etc. *This shows that the Japanese government has tried to link these museums to the community and the environment.*

The Parc de la Villette in the Cite' environment is in the midst of a very large landscape The park integrates various cultural functions such as a music hall, art exhibitions and a performance theater. The French government connected this cultural park to the Cite'. As discussed above, the French authorities look after everything which reflects on *art and culture*. They link the Science Museum with culture. *European countries treasure their history, culture and liberty. Most countries have their own language and are proud of their history. Their heritage of art and architecture is a significant issue for French people generally.*

The NSM was built in the area of the Science Park. There are three other relevant museums and two centers nearby, as follows; *National History Museum, Information Technology and Telecommunications Museum*, *Ecology and Environment Museum*, *Science and Technology Edutainment Center*, and *Thai Artificial and Industrial Products Exhibition Center*. The buildings in this Science Park are for discovery and learning. In the future, whenever visitors come to the NSM, they will find the other Science Museums and educational centers as well. This group of museums is attached to the Ministry of Science and Technology. The ministry and the museum buildings are connected together. Before entering the NSM, visitors must pass through the corridors of the Ministry of Science and Technology. All are on the boundary of *the Technopolis*. The government categorizes the group of museums as one part of a single organization. They do not look at museums as a part of the community or a place for recreation. As a result, the NSM differs from the Cite' and the Tokyo National Science Museum in terms of relations to surroundings.

c). Museum Interiors and Exhibitions

This section discusses the results of the discussions in Chapter 6, in which comparisons are made between museum interiors, exhibitions, presentations and displays. The varied methods used to exhibit in each science museum reflect the different aims of each museum. The researcher discusses the outcome of these considerations vis-a-vis the research question in the following.

- Museum interiors. As to the interiors of the three Science Museums, they are distinctively different. The spaces inside the Tokyo Science Museum are as typical and straightforward as the building's architectural form. The Museum interior is rectangular in shape. The museum is a recycled building, which limits the possibilities for its interior. Surrounded with buildings being preserved as part of a historic community, it becomes difficult to change the museum's interior spaces. There are connecting walkways among these buildings, which tend to make visitors feel as if they always remain in the same building. We could say that the Tokyo National Science Museum is more emphatic in arranging their interiors than in their architectural exteriors. This is not like the Cite' and the NSM, which have uniquely designed forms and spaces. Both of the latter have more interesting spaces linking their museum interiors and exteriors. The two Science Museums were created with new forms relevant to their surroundings, free of the limitations restricting the Ueno community and context.

The Cite' has a large interior space. It has an open void from the ground floor to the ceiling, which gives the museum a very vigorous inner space. Visitors can quickly see the many activities going on inside. The Museum layout is straightforward. It is easy for visitors to navigate. In addition, the distinctive interior space of the Geode dome fits its function as an IMAX simulation. All the spaces are hierarchical, centering around a void which is the core of the building. The smaller spaces are added on to make the whole more complete. In short, the Cite' has a lively and colorful atmosphere with various and complete spatial components.

The NSM has a unique architectural form with varied interior spaces. There are smaller and wider components. Each floor has a different size and shape. The spaces of the NSM are smaller and more varied than in the Cite'. The component spaces are neither unique nor hierarchical, as in the Cite. Rather, the NSM's varied and different spaces on each floor entertain visitors. The NSM links each floor by escalators in a central location. The exhibits follow a one-way corridor through the museum interiors. Visitors can follow easily to enjoy all they want to see.

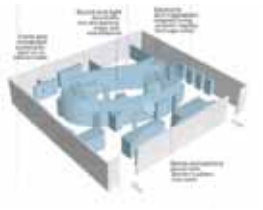
- Exhibition contents. The researcher found that the Tokyo Science Museum has varied contents in its three buildings. Every part is clear and easy to understand. The Main building and the Midorikan building have many exhibition objects and real specimens as, for example, in window displays. Most of them present information about animals and humanity. In the New Building, the exhibits are about Natural History and Physical Science. This shows that most of the exhibits in the Tokyo National Science Museum are relevant to animals and humanity. They emphasize Natural History in their museum, while the Cite' and the NSM emphasize Physical Science.

Moreover, the Tokyo Science Museum has various exhibits relevant to the *nation,* since it is the *National* Science Museums. By contrast, the NSM addresses nationality only on the 6th floor, in the exhibits on *Traditional Technology* and on the 4th floor, *Science and Technology in Thailand*. The Paris Science Museum does not exhibit objects which directly address the issue of nationality. After interviewing visitors, the researcher is of the opinion that the national identity is best confirmed by calling it the *National* Science Museum.

In the Cite, the exhibit contents emphasize physical science and knowledge of high technology knowledge for children. At the NSM, there are many kinds of content categorized by floor. NSM identifies science by the content of the history of science, science in Thailand, science in everyday life and traditional technology. The exhibition contents emphasize improving technology and developing the country.

- Presentations and displays. All three science museums are interactive but distinctively different in details. For the Tokyo National Science Museum, the exhibits in the New Building are simulations and more interactive than in the other two buildings because of the realistic atmosphere. The exhibitions in the Midorikan and the Main building look like window displays with real specimens. As researcher mentions in Chapter 6, "*All four parts of the New building are presented differently from the Main building and the Midorikan building. In the New building, visitors are in a simulation of the real atmosphere. The children who visit enjoy themselves with interactive reproductions, unlike the two buildings in which visitors walk by and see exhibited objects as in window displays".*

Table 5 *Museum Interiors and Exhibitions Compared*

Issues	**National Science Museum, Ueno, Tokyo**	**National Museum of Science and Industry, Parc de la Villette, Paris**	**National Science Museum, Technopolis, Patumthani**
Interior Space	 *Typical and straightforward*	  *Open void from the ground. Spatially unique*	 *Varied spatiality*
Exhibition contents	 *Emphasis: Natural history*  *Extremely nationalistic Real specimens*	 *Emphasis: Physical Science. Models & Simulations*	 *Emphasis: Physical Science. Models & Simulations*
Presentations and displays	 *Interactive and participatory activities. Real Specimens*	 *Science shows*	 *Descriptions by Curators*

The Cite' exhibits are directed at children, emphasizing interactive activities. Knowledge gained from the exhibitions is based on the empirical evidence presented. In addition, all the exhibitions, presentations and displays, the planetarium and the multimedia library in the training center emphasize stimulating the interest of children in science and technology.

Cite' and NSM presentations use panel boards, models, and simulations. Most of the exhibited objects are inventions. In the NSM exhibits, there are various methods of presentation and display. Panel boards and exhibited objects are on the ground floor. Apart from these, there are opportunities for self-learning with simulated experimental equipment. Visitors learn from and interact with exhibits about applied science, via panel boards, graphics, illustrations, and specimens. One thing which the researcher observed is that curators are present beside every exhibited object. In addition, the 6th floor simulations create a real atmosphere for traditional technology. Apart from these interactive presentations, issues of Thai nationality are also addressed.

While there are simulations and interactive displays in the National Science Museum, there are original objects preserved in the National Museum. Although the purposes and contexts of the National Science Museum and National Museum are different, *if we could use real examples in the science museum exhibition, they will always be more interesting than replicas.* With this reasoning, the Tokyo National Museum uses real examples. It may be that Japanese people like to collect things. Their exhibited objects are national treasures which can be seen in their Science Museum. This is another way to dramatize their national identity.

What we learn from these overseas museums, compared with the NSM is as follows. Science Museums provide science education, which is different in each country because of the different purposes and philosophy behind Science education in different societies. For Europeans like the Parisians, Science is a branch of knowledge; they put the Cite' with other buildings relevant to their culture. They look at Science as a part of culture. In Asian countries like Japan, Science is more closely linked to industry. Apart from Natural History, they try to educate their children with the knowledge relevant to technology and industry. For Thailand, Science and Technology are significant primarily because they improve industry and help develop the country.

Table 6 *Summary Comparison*

Issues	National Science Museum, Ueno, Tokyo	National Museum of Science and Industry, Parc de la Villette, Paris	National Science Museum, Technopolis, Patumthani
Philosophy	*Science Museum is educational* *Science is linked to Industry*	*Science Museum is educational* *Science is linked to the culture*	*Science Museum is educational* *Science is needed to improve Industry & develop the country*

Discussion of the research questions

The research questions guide the inquiry toward the research solution. These research questions are discussed following the data analysis and results, and are relevant to the framework in Chapter 4 regarding the NSM context. For this dissertation, seven research questions will be discussed, as mentioned in Chapter 1 and 3. In this part, the researcher briefly refers to them again and discusses them, one by one, as follows:

1. ***What is the official policy of Thailand's National Science Museum?*** *What are the objectives of the National Science Museum Foundation? How does official policy translate into the museum's themes, displays and exhibitions?*

The Science Museum was established with the requirements of the country in view. Since the scientific and technological development of Thailand is far behind various developing countries, the objectives of the NSM are many, and could be summed up as follows;

a). The main objective of the NSM is to respond to Her Majesty, the Queen's interest in reviving and preserving traditional Thai handicrafts. These initiatives have led to the creation of job opportunities and improved standards of living for the poor in rural areas. The projects have progressed satisfactorily.

b). The NSM was also established to show the progress of science and technology in Thailand. Developing a science museum became one of the country's

major projects. The NSM is a research center for developing science and technology. It brought about improvements in the ability of Thai people, helping to bring them up to a par with other developing countries. Moreover, it is a center for researchers, experts and specialists.

c). One purpose of the NSM is to function as an edutainment center for youth at every level. The NSM aims to benefit Thai youth and the general public. NSM facilities and services are arranged to appeal to people of varied status and background. In cooperation with other organizations, both in Thailand and abroad, the NSM helps disseminate knowledge for the benefit of education, research and technological advancement.

d). The other objective of the NSM is to make Thai people realize more clearly the significant of science and technology.

The policies and objectives of the "Science Museum Project" were initiated by the Ministry of Science, Technology and Environment. There are exhibitions on folk craft and technology relevant to the royal projects. Apart from this, the exhibitions address science and technology in everyday life, the development of agricultural technology and modern industry, ecological systems, natural environment, and aeronautical technology. The exhibition designs focus on communication between the exhibit and the visitor. Visitors are allowed to interact with exhibits by touching, playing and trying for themselves the various types of presentations such as interactive, hands-on exhibits, video presentations, graphic panels, and artifacts in different forms. The exhibits are designed to be easy to understand and to blend well with the whole exhibition design concept in order to function as a credible and attractive center of knowledge in science and technology for the public.

2. ***How does the National Science Museum fit into that policy?***

According to the official policy (http://www.thaigov.go.th), the NSM exhibitions were to be designed to achieve the stated interpretation goals in order to reach their policy objectives as follows:

a). Science and Technology must be presented as exciting and vital principles and processes. The way in which this is done must capture and hold the visitor's attention and must always entertain, stimulate and educate.

b). The museum must be a "Centre of Influence". It must be original in the way in which the themes are presented to the visitor, but its popularity must be based on sound scholarship. Novelty for its own sake must be avoided.

c). The museum must always encourage visitors to think of the human, social and environmental consequences of new developments in science and technology. Science museums world-wide see this as being one of their main responsibilities.

d). Science is today ever more complex, compartmentalized and specialized and is therefore often difficult to understand. Many people feel small and ignorant in the face of so much complex information. The Museum must therefore encourage and build confidence in visitors. Exhibitions must explain clearly without being patronizing.

e). The discoveries, new understanding, and genius of past generations of scientists, inventors and engineers have played a big role in making the world what it is today. The roles of these influential scientists must be explained to the visitor in a way which instills a sense of wonder about things that we too often take for granted. The historical framework will allow the visitor to relate the present to the past and to understand that science and technology are in a state of constant evolution.

f). Although many scientific discoveries and technological developments in the past originated in the Western world, messages within the exhibition must, whenever possible, be related to examples drawn from the history and culture of Thailand.

g). The exhibition must be related to the teaching of science and technology in Thailand's educational system. The contents of the relevant parts of school curricula must be taken into account and be reflected in the exhibition.

h). The spaces within the Museum building are large and impressive. They offer great opportunities. The exhibitions must be of a scale which is equally impressive.

i). The Museum should employ all appropriate forms of communication technology and should be interactive in ways carefully balanced with the messages to be conveyed to the visitor. The media must not dominate the message. The Museum must appeal to visitors of both sexes and of all ages. Disabled people should be able to comfortably visit just as easily as the able-bodied.

j). The museum must offer value for money and must encourage long visits so that maximum financial return is assured. The visitor's enjoyment should also lead to repeat visits and should encourage recommendations.

k). The success of exhibitions will depend on the efforts of all parties concerned. Participation and collaboration will be incorporated in the design process.

From the researchers' opinion, the various aims of NSM could not achieve every goal in order to reach their policy objectives. Items a), f), g), h), and i) are achievable but these items are only the sub-issues of the significant points which would not effect the people. Items b), c), d), e), j), and k) are more significant but their objectives are not achievable. The problem is that visitors cannot reach the museum by public transport, therefore the NSM would not be the powerful magnet and force the visitors and people of Thailand would like to gain.

3. ***How does the National Science Museum fit into the Bangkok Metropolitan Area's regional planning*** *(and planning for Thailand generally)? Why has the museum been placed on the outskirts of the city rather than in central Bangkok? Presumably, its location is related to the concept of the "technopolis" (technothani). The technopolis, of course, is going to have to compete with similar developments elsewhere. How does the museum's location and planning fit this objective? There is also a question of balancing the need to create an "image" for the technopolis against the need to provide a readily accessible resource for children's education. In other words, the choice of location is necessarily a complex one.*

From the planning policy to establish Science Museums, apart from NSM, Patumthani, there are other Science Museums in provincial areas for the benefit of Thai youth and the general public. These include the science and culture museums in three provinces - Chiang Mai, Nakornrachasima and Songkha.

For the site location of the NSM, as mentioned in the last chapter, it is significant in regard to museum marketing. An appropriate site elicits the elegance of the museum architecture. Moreover, a fine location in the flow of urban planning contributes to traveling convenience, which affects marketing. Site location, historical background and urban conditions are all a matter of consideration here

The appropriate site location for a science museum, or for science and technology centers, should contribute to the continuing development of local tradition, moral standards and on-going education. The sample case studies of science museums lead the researcher to argue that the museum site should be an area which has the component features as discussed below:

a). If the museum were located in a community area like Ueno, it could benefit the public more than a standalone museum. A community space is able to handle many different functions and activities. For the Ueno, there are many distinctive public spaces on the site. The Parc de la Villette also offers various cultural

functions such as a music hall, and an art and performance theater etc. France's government connected this cultural park to the Cite'. It is a community area.

Figure 227 *Map of Patumthani, its Surrounding Provinces*

Source: *www.wikipedia.org*

A group of museums in Technopolis is to be preferred to one that stands alone. Although the Ministry of Science and Technology gathers a group of museums and centers relevant to the science activities centre in the *Technopolis*, it is not in a community setting like the Ueno and Parc de la Villette. Technopolis does not link the Museums to the people in their community. Nor are there different kinds of activities and functions in Technopolis as in the Ueno and Parc de la Villette, which serve people in the community and visitors from near and far.

b). One relevant issue to this research question is the ease or difficulty of traveling to visit the NSM. The NSM has been placed on the outskirts of the city, just like the Cite'. The difference between them is the convenience of traveling and visiting. The NSM should be placed in a zone that easily permits travel by bus, sky train, underground or car. Wherever it is located, there should be transportation links to the NSM for the convenience of visitors.

The researcher asked why the museum had been placed on the outskirts of the city rather than in central Bangkok? In Chapter 4 there is an illustration of the

Rangsit - Nakornnayok area or Northeastern Bangkok, i.e. Patumthani and Nakorn Nayok provinces. The government aims to support the growth of a new town here. There are various organizations, both of the state and the private sector with interest in this project. Not only has growth along a horizontal line on both sides of the highway taken place, but there has also been a decentralized extension from government nodes around the district.

NSM was established on a potential site in a suburban area which has sub-nodes apart from the downtown. There are fast cars with wide streets, far from residential areas. The residential areas are quiet and calm, with less traffic. There are fine parks all around the residences and connected to the street. There are public buildings for communities with kindergartens, playgrounds, and convenience stores. With its potential site location, the Ministry of Science, Technology and Environment is located on the boundary of Klong Luang of Rangsit-Nakornnayok. Therefore the construction of the various science organizations in the continuing area has been called the *Technopolis.*

The Technopolis or science park is a service center for scientific and technological research and development activities. The park aims to accelerate local human resource development on a par with global counterparts, and to become a hub for specialists and researchers from the various fields of industry. There are four national research centers with state-of-the-art equipment on the premises.

In addition, the other reason for placing the NSM or Science Park on this site is that this organization is adjacent to the Asian Institute of Technology (AIT), Thammasat University (TU) and Sirindhorn International Institute of Technology (SIIT). The combination of these institutions in one area makes it an ideal location for R&D (research and development) activities, whereby well over 1,000 researchers and a large pool of human resource are within reach of its occupants.

Occupants of the Science Park also gain access to facilities and amenities such as a convention center, exhibition areas, auditorium, meeting rooms with teleconferencing and video conferencing capabilities, research database in actual and virtual libraries and high speed telecommunication networks. Small and startup companies conducting research works can rent space in the incubation building at subsidized rates. Larger companies can choose between renting existing space and obtaining leasehold land to construct their own research facilities. Technical and technological , financial and human resources, and business and juristic supports are

provided to residents to make the total cost of research affordable to businesses located at the Thailand Science Park.

The concept of urban enlargement in the Northeastern area includes various minor projects. Technopolis is part of this suburban extension. There is a similar development project in Bang Pi in Southeastern Bangkok. This project aims to construct an energy-saving city where natural gas from Thai Gulf will be used instead of petroleum. However this project does not include government officer nodes like the Rangsit-Nakorn Nayok neighborhood. The similarity of these two cities lies in the fact that there are no convenient mass transit lines supporting either project. *As the researcher has pointed out, one factor for general museum marketing is linkage with expedient transportation.*

4. ***What are the exhibits in the National Science Museum trying to represent or say?*** *In light of the complex and possibly competing objectives of the NSM, what can be said about the exhibits, how they are displayed, and the experiences they intend to provide?*

The exhibits of *Pioneers of Science* on the first floor and *History of Science and Technology* on the second floor represent and identify what science is. *Pioneers of Science* mentions the various scientists and their discoveries and aims to inspire visitors. *History of Science and Technology* presents the historical background of science. There is a timeline of the scientific events which occurred, separating the science of the past from the present. These are basic guidelines for visitors seeking scientific knowledge. It presents children with basic science information. In addition, this exhibition offers basic knowledge and describes the scientific method of thinking. Visitors learn rational thinking by studying this exhibit. Although the Museum is a true achievement in itself, in terms of knowledge, libraries provide deeper information and more comprehensive and detailed knowledge. Visiting a museum should inspire visitors with general and introductory information and a rough education while entertaining them and awakening more interest in scientific knowledge.

The third to the sixth floors include *Basic Science and Energy* on the third floor, *Science and Technology* in Thailand on the fourth floor, *Science and Technology in Everyday Life* on the fifth floor, and *Traditional Technology* on the sixth floor. All are primarily concerned with applied sciences. Applied chemistry, physics and biology are represented with specimens to identify what Thai science is. Throughout four entire floors, the interiors and exhibits represent the progressive

movement of Thailand in developing science and technology. In addition, the NSM exhibits invite the participation of visitors with their various activities. Visitors can enjoy exciting new experiences that alert them to the importance of science and technology in the progress and development of the nation.

The exhibition designs focus on communication between the exhibits and the visitors. Visitors are allowed to interact with exhibits by touching, playing and trying for themselves the various types of presentations such as interactive hands-on exhibits, video presentations, graphic panels, and artifacts of different forms. The exhibits are designed to be easy to understand and to blend well with the whole exhibition design concept in order to function as credible and attractive centers of knowledge for the public. The exhibited contents emphasize improving technology and developing the country.

Apart from the museum interiors and exhibitions, the architectural design of the NSM itself is an inspiring modern mathematical form. The geometric shapes have been integrated by joining three cubes together, each of which is standing on one of its corners. This modern architecture impresses visitors with its unique form. The NSM building represents progressive building technology.

5. ***How are the exhibits used or enjoyed in practice?*** *Actual spatial practices can be studied by observing how people in various age groups move through the museum, how they behave, where they pause, what they look at, what they express, etc.*

For the eyes of most visitors, the NSM architecture is impressive. As noted, before, the mathematical form of the NSM makes visitors stop and contemplate its distinctive and unique design. And as mentioned above, this mathematical form refers to the progress of technology, communicating an image of Thailand's scientific development. In this section, the researcher excerpts and discusses the NSM interactive exhibitions and what is out-of-sight to visitors, with reference to responses to the questionnaire.

On the first floor of the NSM building, visitors find a model of the Science Museum, the "Cube Building". This area serves as a convenient meeting place for visitors with its central location. It is an illuminated scale model of the museum, and is surrounded by seating on an elevated circular base. The model and its surrounding seating is indeed a popular rendezvous point for visitors.

Figure 228 *Meeting point view from the second floor*
Source: *Photo picture from the NSM*

On the second floor, in a small space, there is an interactive model exhibit commencing with a life-size figure of *Lucy*. Lucy has been classified as the oldest hominid genus, Australopithecus, representing the appearance of human life on earth. The model is interactive. The push of a button accesses an audio description for visitors. The object exhibited overhead is a replica of da Vinci's famous design for a flying machine. It is out of sight to visitors, so few look up to seek it out. Moreover, the presentation does not give clear information about the gliders which were the precursors of airplanes. The other interactive exhibit in the second floor is *Fragile earth,* which is entered through the sphere of the globe. The shapes, forms and atmosphere bring together the visions of great scientists, presented in ways which are quite attractive to children. In the dark space, there are wide-screen monitors which display the imaginative visions of great scientists.

In the section on *Basic Science and Energy* on the third floor, the *Speaking Dishes*, two parabolic dishes, is especially addressed to children. The *Shadow show* presents objects which obstruct the path of light. Some light falls on the screen and some doesn't - hence, the shadows. Visitors can create their own shadows on a screen coated with a light-activated chemical which helps reveal the relationship between light and shadow. This exhibit section is interactive and allows visitors to become more directly involved in the learning process.

Figure 229 *Energy Tunnel*

Source: *Jarujin Nabhittabhata (editor). 2002*

The huge *Energy tunnel* is one of the exhibit objects in the third floor. This exhibition is displayed in a long tunnel located in an area apart from other exhibits. It is an interactive exhibition which attracts many curious visitors. *Muscular Energy* is in the first part of the tunnel. The final exhibit in the tunnel is the *Power of the Earth*. There is also an interactive highlight, as visitors' experience a shaking floor simulating what might be felt during a real earthquake. This display is supposed to treat the idea of harnessing the energy of an earthquake for useful purposes, but does not achieve this objective.

On the fourth floor, *Science and Technology in Thailand,* There is a model representing dinosaur fossils found in Kalasin which is much more successful. Many visitors can be seen to pause here (Figure 230). Moreover, the interactive exhibit in this area is *Earth's Structure and how it works*, a simulation model showing the core of the earth.

Figure 230 *Model represents dinosaur fossil in Thailand found in Kalasin.*

Sources: *Jarujin Nabhittabhata (editor). 2002*

Figure 231 *Earth's Structure and how it works.*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 232 *"Build a house" and "build a bridge" do it yourself model*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 233 *Models of human organ systems*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 234 *Genetics and inheritance*
Source: *Jarujin Nabhittabhata (editor). 2002*

Figure 235 *Heart operation model*
Source: *Jarujin Nabhittabhata (editor). 2002*

The exhibition of *Building and Structure* comprises various presentations. One of these, the *Structures and Foundation* exhibit, communicates well and is interactive. There are more interactive activities for children in the sections *"Build a house" and "Build a bridge"*. The *Do it yourself activity* introduces children to basic knowledge in construction. Overall, the fourth floor is very interesting in interpretation and exhibition.

On the fifth floor there are also interesting and successful exhibits. Visitors are clearly attracted. The first is *the Body and Health* exhibit. The display models human organ systems. These examples are well interpreted and communicate better than the genetics and inheritance exhibit. However, the researcher observes that the *Heart operation model* section is not directly relevant to the objective of the exhibit as a whole.

On the sixth floor, *Traditional Technology* is the final part of the exhibition. This section is distinct from the other floors in lighting, form, and color. These exhibits are part of the Queen's initiative to create supplementary work which provides additional income for people in rural areas. The entire exhibition consists of specimen models and simulations. Although the exhibit interests visitors, the presentations are not varied. None is dominant over the others. Only in the *Study Area*, which is reserved for specialists in various fields of Thai traditional technology, are shows presented. Presenters take turns organizing demonstration classes in rural environments. These exhibits are the final displays on this floor. All the presentations on this floor help visitors understand more about Thai native science and technology.

It could be concluded that visitors pause at interactive exhibits which have unusual presentations, activities, models or simulations. They are attracted to things which they have not seen before, things or activities which move their feelings and invite them to participate.

6. ***What are the disjunctions between spatial representations and spatial practices in the NSM?*** *Are the museum and its exhibits functioning as they were intended to function?*

The NSM interior spatiality follows the form of its geometrical architectural in shape. As noted, this building has a unique form of three balanced cubes. Each cube is 20 x 20 x 20 meters. They seem to float in their surroundings. The unique architectural shape brings about a distinctive and varied interior space.

The interior space of these cubes is divided across 6 floors with a total exhibition area of 10,000 square meters. The rest of the building, another 8,000 square meters, is designed for offices and workshops. The external appearance of the 'cube building' also allows a unique interior configuration on every single floor, enabling flexible interiors and exhibition designs on each floor. The NSM benefits from these varied spaces on each floor. It becomes very easy to create new interactive exhibitions.

Outside-in might be seen as the way to create this museum. The NSM building was created initially without being really clear about the interior function and the exhibition layouts. Although the building has a distinctive, modern and unique form, the method by which NSM exhibitions were created should have been from **Inside-out.** The NSM contents and exhibitions should have been initiated before the museum space was decided.

However, the Museum's interior spatial shapes are appropriate to the exhibition concepts. The Museum's architectural form brought about the extraordinary planar and spatial differentiation in each floor. The Museum's interiors and exhibitions were created after the architectural design was complete. The spaces easily excite and intrigue visitors. The NSM links each floor with an escalator in the central area. The museum interior should be a one way corridor since that would take the visitors to see everything. This design shows problem solving thinking in the NSM interior space and exhibitions. There are many kinds of content categorized on each floor. The NSM identifies science by the history of science, science in Thailand, science in everyday life, and traditional technology.

7. ***What assessment can be made of the success or otherwise of the National Science Museum in the light of national science policy?***

Science and technology are prime movers of the economic and social development of the nation, and are an important basis for a better life for Thai people. Science and technology play a vital role in all industrial processes. Since Thailand's limited natural resources have deteriorated because of poorly managed exploitation, measures for their rehabilitation and efficient use must be introduced. For this purpose, and to ensure a stable, long-term growth of the Thai economy and a steady improvement of the national life, it is crucial that Thailand promote the development of science and technology, not only to increase the national prosperity, but also create more knowledge and to stimulate innovation among Thai people.

The Ministry's task is to devise action plans, and to implement, monitor and evaluate on a continuing basis. All of the Ministry's plans and projects are regularly adjusted and updated in a constantly changing environment. The Ministry's major tasks are threefold: to develop local technology which can be used for production and marketing and to assist with the transfer of technology within the country and internationally; to set up plans and policies to address current and future environmental issues as well as to control and supervise their execution in cooperation with governmental and other agencies; and to formulate and implement measures for energy conservation and the development and promotion of safe and sustainable energy resources. Furthermore, the Ministry collects, analyzes and disseminates significant scientific data, compiling and publicizing research reports and other information on developments related to science, technology, energy and the environment.

With this policy, the NSM has facilities and services to appeal to people of all levels and backgrounds. In cooperation with other organizations, both in Thailand and abroad, the NSM can help disseminate knowledge for the benefit of education, research and technological advancement. The NSM is one of the Ministry's organizations. Together, they act as a team, driving ahead for the success of the government's science initiatives.

This research question brings the dissertation back to the original questions posed in items 1 and 2 above. Both items are discussed, including the NSM policy, objectives and actions in accordance with policy and objectives. To assess the success of the NSM, the outcome of the design solution in presentation, display and exhibition must be observed, along with the success of the aims or

objectives of NSM policy. In addition, the gains made by NSM visitors will be an important index of the NSM success.

NSM facilities and services are arranged to appeal to people of varied status and background. In cooperation with other organizations, both in Thailand and abroad, the NSM helps disseminate knowledge for the benefit of education, research and technological advancement. The administrative system of the National Science Museum is that of a state enterprise under the guidance of the National Science Museum Committee, as appointed by the Cabinet.

In any case, the NSM is simply a very basic, first inspiration in the science education of Thai youth. The exhibits represent and disseminate the policies and high ideals of the Ministry of Science, but these ideals must eventually find their way into practice if they are to have real effect in Thai society.

Conclusion

The previous sections of this dissertation discuss and illustrate various aspects of the topic, including the experience of visitors to the NSM, the responses of officials to questionnaires, interviews, and the researcher's own personal observations. In this final part, the main results are concluded. In this section, the research gathers together the analyses from items "Data analysis and result" and "Discussion to the research questions" The researcher's three-part conclusion also offers guidelines for application. The summary of the results present NSM interpretation guidelines and applies them generally for the museums of tomorrow. The researcher also offers suggestions for further research relevant to this dissertation. The three parts of this section:

a). Summary of Results

b). Suggestions for Future Research

a). Summary of Results

This section summarizes the data analysis and results in item "Data analysis and result" as well as the data from observations, questionnaires and interviews The summary of the results is in three parts:

- Site location, Urban conditions, Approach and Travel.
- Buildings, Architecture and Surroundings.
- Museum Interiors and Exhibitions.

- ***Site location, Urban conditions, Approach and Travel.***

1). The site appropriated for a science museum (or for any museum) should be in the area where the museum will be relevant to its neighborhood or community.

2). The museum should relate to other functions in the community such as groups of museums along the same boundary or cultural venues such as concert halls, stadiums, or public parks. This has impact on marketing, for the museum. Visitors are attracted by multiple opportunities for enjoyment.

3). The presence of other museums nearby attracts more visitors to see the NSM. However, there is a lack of convenient public transportation linking the museum with the general public. If we ask why the museum has been placed on the outskirts of the city rather than in central Bangkok, the answer is that the museum will serve almost anywhere, as long as there are efficient and convenient transportation links to carry visitors to the site. The government should therefore support an expansion of public transportation links to the NSM, the sky train, for example.

- ***Buildings, Architecture and Surroundings.***

Analysis of the relevant data is as follows:

4). The museum building itself should communicate to the visitors what kind of museum it is. Ideally, the architecture of the building will communicate what sorts of exhibits will be found inside. The visitors' perception of the building and its architecture contribute to their overall experience. The NSM building communicates ideas about high technology which relate to its objectives as a museum.

5). The surroundings of the museum should have the character of a recreational area where visitors can spend their leisure time with varied pleasant activities.

- ***Museum Interiors and Exhibitions.*** The literature and study on museum interiors and exhibitions is summarized in this section, as follows;

6). It is necessary to know something about the visitors coming to the museum in order to know how to communicate with them.

7). Museum policy should link with the contents of exhibits.

8). Exhibits in the National Science Museum should express the character of the nation.

9). Although the museum's interior space should reflect and respect the building's architectural form and shape, the contents of the exhibits should have continuity. The museum's interior zoning should be responsive to this.

10). Real specimens are more interesting in exhibits than are models or simulations. Most visitors find real objects or materials more interesting than computer presentations.

11). Simulations which are interactive in a realistic atmosphere are very desirable.

12). The varied presentation techniques should be appropriate to the content, spatial features and picture of the museum exhibition as a whole. All kinds of techniques and media can be mixed and mingled together in science museum exhibitions to respond to the learning needs of visitors.

13). In science museums, lighting should be interactive even as it is contingent upon the objective of each part and context of the exhibition.

14). Circulation and traffic depends on the various exhibitions and their contents. Various approaches may be integrated in a single exhibition, depending on the exhibit and the museum context.

15). Graphics and designs should show an understanding of the needs and responses of visitors. Museum curators and designers should know what visitors want, what kind of atmosphere is appropriate, and how many visitors will be using the space.

16). Narrative is verbal information. The most obvious approach for passing on such information to museum visitors is by means of verbal materials in the exhibits.

To sum up, this section addresses interpretation techniques and guidelines used in the exhibits and in the museum. To design exhibits for a museum, the designer must be concerned with the relevant contexts of particular techniques. Science museums need to integrate the media in their exhibitions.

b). Suggestions for Future Research

There are some directions for future research in relation to the National Science Museum which will be very advantageous for future study. The researcher found several relevant issues during the dissertation process:

1). Future research should be conducted on theories and relevant topics in Spatial Communication. The space used for any activity is composed of various factors which identify that space. It is interesting to know how users perceive this space and what are the indicators of the functions of each space. What is the difference between empty space and occupied space? Space is a kind of medium and must communicate the meanings which curators, architects or designers want to impress upon visitors. In this study, the researcher calls the medium *space* or *space media*, *event* or *spatial communication,* which tells the use of space, its function, or what it is, for example, the museum, the show, the theme park etc. Each space has a specific function. Without function, there is no space media, no communication, and no interpretation.

2). Research should also look more specifically into lighting for the Science Museum. This is another interesting issue relevant to this dissertation. Lighting is a significant element in exhibition space and atmosphere, and in the visitor's interactive experience. Lighting brings exhibited objects to life, illuminating labels, narratives, pathways, emergency exits and practical spaces generally. Lighting must take into consideration the heat generated. Planners must avoid problems with ultraviolet radiation, which tends to cause exhibit objects to degenerate. The question of appropriate lighting for Science Museums needs further investigation.

3). Future research should be more specific in studying *national identity*. National identity is a significant context which has been much discussed and debated and which also affects the contents of the museum's exhibitions. The question of national identity has a determining influence on exhibitions, particularly in the area of social and cultural studies. The suggestion for research recommends discussions or debates on national identity, linking these issues to the content, presentation and interpretation of NSM exhibitions in order to better understand the concept within the museum.

4). There is a relationship between the Museum and its community, between local urban area and mega city. Future research should investigate and clarify these relations.

5). This dissertation process identified various organizations relevant to science. There are a number of science museums around Thailand. Future research should more clearly identify these organizations and categorize them for ease in management. The various science museums should not risk redundancy. Each one should have its own distinctive features.

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Appendix A

Structured Observation

Checklist used in observation for museum visits

Observation Date.....
Observer.....
Floor.....

(Sketch of Lay-Out, Legend, and the Titles of Exhibition Areas)

LEGEND

Area code	Exhibition title	Evaluate scale of exhibition Good	Fare	Poor	Remarks (Description)
1		o	o	o	
2		o	o	o	
3		o	o	o	
4		o	o	o	
5		o	o	o	
6		o	o	o	
7		o	o	o	
8		o	o	o	

Code of Area .....
Exhibition title .....

Evaluation of the National Science Museum

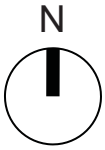
Lists of evaluation	Excel	Good	Fare	Poor	Remarks
1.The exhibitions are attractive and impress and stimulate the viewer.					
2.The presentations in the NSM are pleasant, amusing, and entertaining.					
3.The use of color in the design of the exhibitions is appropriate.					
4.The use of lighting is appropriate to the content of the NSM exhibits.					
5.The techniques used are varied and appropriate to the NSM exhibit content.					
6. The use of materials is appropriate to the exhibition.					
7. The exhibition topics are consistent with NSM policies and objectives.					
8. The exhibition topics are relevant to each other.					
9. The contents of the exhibitions are relevant to the topics.					
10. Topics, titles, and narratives are clear.					
11. The use of materials and equipment to lead the visitors to clearer understanding					
12. The participative or interactive exhibition to the visitors.					
13. The circulation and traffic through the NSM exhibitions is convenient					
14. The contents of the exhibition fit in with the museum's space.					
15. There is appropriated open space among the exhibitions.					
16. There are resting areas between the exhibitions.					
17. The exhibitions are striking and unique.					
18. There are officers interpreting and explaining the exhibitions to visitors.					
19. The information and promotional materials are appropriate.					
20. The symbols, signage and directories in the NSM are clear.					
21. The other science activities such as demonstrations are effective.					
22. The outdoor exhibitions are interesting.					
23. The site location of NSM is appropriate.					

Remarks (The other objects which the observer gains and see.)
.....
.....

แบบสังเกตการณ์

เพื่อใช้ในการตรวจสอบการเข้าชมพิพิธภัณฑ์

วันที่สังเกต.....
ผู้สังเกต.....
ชั้นที่.....



(แบบร่าง ผัง คำอธิบาย เนื้อหาของนิทรรศการ)

รายการประกอบการประเมิน

พื้นที่	นิทรรศการเรื่อง	ระดับการประเมิน			หมายเหตุ
		ดี	พอใช้	ไม่ดี	
1		○	○	○	
2		○	○	○	
3		○	○	○	
4		○	○	○	
5		○	○	○	
6		○	○	○	
7		○	○	○	
8		○	○	○	

พื้นที่.....
นิทรรศการเรื่อง.....

ตารางประเมินค่าพิพิธภัณฑ์วิทยาศาสตร์

ประเด็นที่ประเมิน	ดีมาก	ดี	พอใช้	ผ่าน	หมายเหตุ
1. ความน่าสนใจ ความดึงดูดใจ ของนิทรรศการ การกระตุ้น ความประทับใจ ต่อผู้เข้าชมนิทรรศการ					
2. ความพึงพอใจ ความสนุกสนาน และความบันเทิงที่ได้รับจากพิพิธภัณฑ์วิทยาศาสตร์					
3. การใช้สีในการออกแบบนิทรรศการ					
4. แสงที่ใช้ในการจัดนิทรรศการมีความเหมาะสมกับเนื้อหา					
5. เทคนิคที่ใช้ในการจัดแสดงมีความเหมาะสมกับเนื้อหา					
6. การใช้วัสดุในการออกแบบนิทรรศการมีความเหมาะสม					
7. หัวข้อนิทรรศการเป็นไปตามเป้าหมายและนโยบายของพิพิธภัณฑ์วิทยาศาสตร์					
8. หัวข้อนิทรรศการ มีความเชื่อมโยงสัมพันธ์กัน					
9. เนื้อหาของนิทรรศการมีความเหมาะสมและสัมพันธ์กับหัวเรื่อง					
10.หัวเรื่อง ชื่อเรื่อง และคำอธิบายชัดเจน					
11.การใช้วัสดุ อุปกรณ์ ประกอบ ทำให้ผู้ชมเข้าใจ					
12.ตัวนิทรรศการเปิดโอกาสให้ผู้เข้าชมมีส่วนร่วม ตัวนิทรรศการมีการโต้ตอบกับผู้เข้าชม					
13.ทางสัญจรของนิทรรศการ ภายในพิพิธภัณฑ์มีความเหมาะสม					
14.เนื้อหาของนิทรรศการเหมาสมกับพื้นที่จัดแสดง					
15.มีพื้นที่เปิดโล่งระหว่างนิทรรศการ แต่ละหัวข้อ					
16.นิทรรศการมีลักษณะเฉพาะตัว ชัดเจน					
17.นิทรรศการมีลักษณะเฉพาะตัว ชัดเจน					
18.มีเจ้าหน้าที่คอยอธิบาย สิ่งที่จัดแสดงแก่ผู้เข้าชม					
19.มีการประชาสัมพันธ์ การจัดโฆษณาพิพิธภัณฑ์					
20.สัญลักษณ์ ป้ายบอกทางต่างๆ ภายในพิพิธภัณฑ์มีความชัดเจน					
21. มีกิจกรรมทางวิทยาศาสตร์ เช่นการสาธิตทางวิทยาศาสตร์					
22. นิทรรศการภายนอกอาคารมีความน่าสนใจ					
23. ที่ตั้งของพิพิธภัณฑ์วิทยาศาสตร์ มีความเหมาะสม					

หมายเหตุ (สิ่งอื่นที่สังเกตได้เพิ่มเติม)

.....

.....

Appendix B

Questionnaire.

Dear Visitor:

I am Ph.D. student in the International Program in Architectural Heritage and Tourism at Silpakorn University. This is the questionnaire relevant to my dissertation. You can help me by providing information about your visit to the National Science Museum to ensure it is meeting your needs. Thank you for taking a few minutes to complete this questionnaire. Your answers will be collect in an aggregated form.

Thank you for your assistance.

Charnkla Leerakul

Please tick the box that applies to you. Tick more than one box if you like. Please also write what you like for the other questions.

Little background about you

sex ☐ male ☐ female

age ☐ 6 – 11 ☐ 12 – 18 ☐ 19 – 22 ☐ 23 – 29

☐ 30 – 40 ☐ 40 +

Education ☐ primary ☐ secondary ☐ vocational

☐ bachelor's ☐ master's ☐ doctorial

Occupation ☐ student ☐ governor ☐ employee/private business

☐ others.....

Do you live in ☐ Bangkok ☐ others.....

How did you come to the National Science museum?

☐ private car ☐ bus ☐ others.....

How did you know the National Science museum?

☐ poster ☐ radio/television/ newspaper ☐ campus/Institute

☐ teacher/friend ☐ others.....

Have you ever gone to National Science Museum before?

☐ yes ☐ no

Your opinions on the exhibition

The visitors' opinions	most	many	medium	less	Remarks
1. The exhibition is attractive and impresses you.					
2. You like the exhibition in this NSM.					
3. The topics of the exhibition are suitable.					
4. The topics of the exhibition are relevant with the details.					
5. The participative or interactive exhibitions are suitable.					
6. The demonstration activities in science are suitable.					
7. The use of materials and equipment lead to clearer understanding.					
8. The topics, titles, and narrative are easy to understand.					
9. The NSM officers are explaining to the visitors are suitable.					
10. The use of colors in the NSM' exhibitions are appropriate.					
11. The light in the NSM exhibitions is suitable.					
12. The exhibition objects are durable.					
13. The circulation in the NSM is convenient and easily to walk.					
14. The resting areas between each exhibition topics are suitable.					
15. The NSM. documents, printed program are adequate.					
16. The site location of the National Science Museum is appropriate.					

17. Which topic area do you like the most in the National Science Museum and why?

.....

.....

18. Will you visit to the National Science Museum again?

☐ yes ☐ no

19. Have you ever visited a Science Museum abroad?

☐ yes ☐ no

20. a) If yes, which one ? .....

b) How about those comparing with this National Science Museum, Thailand

.....

.....

.....

21. Others recommendation.

.....

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.....

.....

แบบสอบถาม

เรียน ท่านผู้เข้าชมพิพิธภัณฑ์

ข้าพเจ้า นาย ฌานกล้า ลีระกุล นักศึกษาระดับปริญญาเอก โครงการหลักสูตรนานาชาติ สาขาการจัดการมรดกทางสถาปัตยกรรมกับการท่องเที่ยว มหาวิทยาลัยศิลปากร แบบสอบถามนี้เป็นเครื่องมือที่ใช้ในการทำวิจัยซึ่งเป็นส่วนหนึ่งของวิทยานิพนธ์ระดับปริญญาเอกของข้าพเจ้า เพื่อใช้ประกอบการวิเคราะห์หาแนวทาง การออกแบบพิพิธภัณฑ์วิทยาศาสตร์ที่เหมาะสมกับประเทศไทย ข้าพเจ้าขอขอบคุณท่านผู้เข้าชมพิพิธภัณฑ์ทุกท่านที่กรุณาสละเวลาในการตอบแบบสอบถามนี้

ขอแสดงความนับถือ

ฌานกล้า ลีระกุล

กรุณาทำเครื่องหมาย X ในช่องสี่เหลี่ยมตามที่ต้องการ และตอบคำถามโดยกรอกข้อมูลในช่องว่าง

ข้อมูลส่วนตัว

เพศ ☐ ชาย ☐ หญิง

อายุ ☐ 6 – 11 ปี ☐ 12 – 18 ปี ☐ 19 – 22 ปี ☐ 23 – 29 ปี

☐ 30 – 40 ปี ☐ 40 ปีขึ้นไป

การศึกษา ☐ ประถมศึกษา ☐ มัธยมศึกษา ☐ อาชีวศึกษา

☐ ปริญญาตรี ☐ ปริญญาโท ☐ ปริญญาเอก

อาชีพ ☐ นักเรียน นักศึกษา ☐ ข้าราชการ / พนักงานของรัฐ

☐ บริษัท / ธุรกิจส่วนตัว ☐ อื่นๆ(ระบุ).....

ท่านอาศัยอยู่ใน ☐ กรุงเทพมหานคร ☐ จังหวัด.....

ท่านเดินทางมาพิพิธภัณฑ์วิทยาศาสตร์โดย

☐ รถยนต์ส่วนตัว ☐ รถประจำทาง ☐ อื่นๆ(ระบุ) .....

ท่านรู้จักพิพิธภัณฑ์วิทยาศาสตร์ได้อย่างไร

☐ โปสเตอร์ แผ่นพับ ☐ วิทยุ / ทีวี / หนังสือพิมพ์ ☐ องค์กร / สถาบันการศึกษา

☐ อาจารย์ / เพื่อน ☐ อื่นๆ(ระบุ).....

ท่านเคยมาพิพิธภัณฑ์วิทยาศาสตร์หรือไม่

☐ เคย ☐ ไม่เคย

ความคิดเห็นที่มีต่อการจัดแสดง

ความเห็นของผู้เข้าชมพิพิธภัณฑ์	มากที่สุด	มาก	ปานกลาง	น้อย	หมายเหตุ
1. ตัวนิทรรศการมีความน่าสนใจ ทำให้ท่านประทับใจ					
2. ท่านชอบนิทรรศการ ในพิพิธภัณฑ์แห่งนี้					
3. หัวเรื่องนิทรรศการมีความเหมาะสม					
4. เนื้อหากับหัวเรื่องมีความสัมพันธ์กัน					
5. การเกิดความมีการส่วนร่วมในนิทรรศการ กระตุ้นความรู้สึกของผู้เข้าชม					
6. การสาธิตทางวิทยาศาสตร์มีความเหมาะสม					
7. มีการใช้วัสดุ อุปกรณ์ ที่ช่วยให้ผู้ชมเข้าใจได้ดียิ่งขึ้น					
8. หัวเรื่องและคำบรรยาย เข้าใจง่าย					
9. เจ้าหน้าที่อธิบายให้ผู้ชมพิพิธภัณฑ์ได้อย่างเหมาะสม					
10.การใช้สีในการจัดแสดงนิทรรศการมีความเหมาะสม					
11.การใช้แสงในการจัดแสดงนิทรรศการมีความเหมาะสม					
12.วัตถุที่นำมาจัดแสดงมีความทนทาน					
13.ทางสัญจรในการจัดแสดง สะดวกและง่ายต่อการรับรู้					
14.พื้นที่พักระหว่างนิทรรศการแต่ละเรื่องมีความเหมาะสม					
15.เอกสาร ข้อมูลประกอบ การเข้าชม เพียงพอ					
16.ที่ตั้งของพิพิธภัณฑ์มีความเหมาะสม					

17. หัวข้อใดที่ท่านชอบมากที่สุด ในพิพิธภัณฑ์วิทยาศาสตร์

.....

.....

.....

18. ท่านจะกลับมาเที่ยวพิพิธภัณฑ์วิทยาศาสตร์อีกหรือไม่

☐ มา ☐ ไม่มา เนื่องจาก.....

19. ท่านเคยเข้าชมพิพิธภัณฑ์วิทยาศาสตร์ในต่างประทศหรือไม่

☐ เคย ☐ ไม่เคย

20. a) หากเคย เคยไปที่ .....ประเทศ.....

b) เมื่อเปรียบเทียบกับพิพิธภัณฑ์วิทยาศาสตร์ ปทุมธานี แล้ว มีความเหมือนหรือแตกต่างกันอย่างไร

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21.ความคิดเห็นอื่นๆเพิ่มเติม

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Appendix C

Structured Interview (with the NSM. officer, architects)

Interview date.....

1. Could you please tell the background of the National Science Museum?

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.....
.....

2. How many kinds of science museums in the areas of NSM and what are they?

.....
.....
.....

3. Do they have the master plan to link to those museums together?

.....
.....
.....

4. Could you please explain the processes and methods from the beginning of this project, both the programming or the requirements of the Museology in many ways? What was the process before the physical architecture as we see it today?

.....
.....
.....

5. Who did the main concept of this museum design?

.....
.....
.....

6. Who are the architects whose designed this group of museums?

.....
.....
.....

7. How did the designer coordinate with the technical officers of the NSM. in the object design of each part, both temporary and permanent exhibitions ?

.....
.....
.....

8. Do the architects who design the temporary and permanent exhibitions, belong to the NSM?

.....
.....
.....

9. For the architecture, we generally see that museum architecture should have some distinction from the general architecture such as reflecting the theme of interior presentation. How do you think of the contents have effected the pattern of this architecture?

.....
.....
.....

10. Comparing local museums with overseas museums, what do you think might be absent?

.....
.....
.....

11. What are the main problems that we see in the museum building ?

.....

.....

.....

12. How to maintenance the NSM exhibition?

.....

.....

.....

13. Did the NSM. organization have distinctive aims and requirements for each exhibition and objects for the architects in space planning?

.....

.....

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14. What is the duty of the NSM architects ?

.....

.....

.....

15. What are the activities for the NSM exhibition?

.....

.....

.....

16. Do they have science research activities at the NSM?

.....

.....

.....

17. Did the architects design the signage, symbols, the narrative and various graphics of the exhibition objects?

.....

.....

.....

18. Do you have any suggestions for the next Science Museums in the provinces?

.....

.....

.....

แบบสัมภาษณ์ (เจ้าหน้าที่พิพิธภัณฑ์วิทยาศาสตร์วิทยาศาสตร์ ภัณฑารักษ์ สถาปนิก)

วันที่สัมภาษณ์.....

1. กรุณาเล่าถึงที่มาของพิพิธภัณฑ์วิทยาศาสตร์แห่งชาติ

2. มีพิพิธภัณฑ์วิทยาศาสตร์ที่เกี่ยวข้องหลายพิพิธภัณฑ์บนพื้นที่เดียวกัน อะไรบ้าง

3. มีโครงการเชื่อมโยงพิพิธภัณฑ์เหล่านั้นเข้าด้วยกันหรือไม่

4. กรุณาเล่าถึงกระบวนการตั้งแต่เริ่มต้นโครงการนี้ ทั้งในส่วนของโปรแกรม หรือความต้องการในเรื่องของพิพิธภัณฑ์วิทยา ก่อนที่จะเป็นรูปร่างทางสถาปัตยกรรมอย่างที่เราเห็นในปัจจุบันนี้

5. ใครเป็นผู้กำหนดแนวความคิดหลักในการออกแบบพิพิธภัณฑ์

6. ใครเป็นผู้ออกแบบพิพิธภัณฑ์แห่งไหนในกลุ่มพิพิธภัณฑ์ขององค์การวิทยาศาสตร์ในพื้นที่นี้บ้าง

7. ผู้ออกแบบพิพิธภัณฑ์ประสานงานกับช่างเทคนิคในการออกแบบวัตถุแสดงของแต่ละส่วนทั้งนิทรรศการชั่วคราวและถาวรอย่างไร

8. สถาปนิก ภัณฑารักษ์ผู้ออกแบบนิทรรศการเป็นเจ้าหน้าที่ขององค์กรพิพิธภัณฑ์วิทยาศาสตร์แห่งชาติหรือไม่

9. ในทางสถาปัตยกรรม จะพบว่าการออกแบบพิพิธภัณฑ์ จะมีเนื้อหาของการจัดแสดง แตกต่างกับการออกแบบโครงการทั่วไป เช่นเรื่องการสร้างเรื่องราวในการนำเสนอ คุณคิดอย่างไรกับเนื้อหาซึ่งมีผลกระทบต่อรูปแบบ

10. เมื่อเปรียบเทียบพิพิธภัณฑ์ในบ้านเรากับต่างประเทศ คุณคิดว่าเราขาดอะไรบ้าง

11. ปัญหาหลักที่เราพบในจัดแสดงในอาคารพิพิธภัณฑ์คืออะไร

12. มีการดูแล ซ่อมแซม สิ่งที่จัดแสดงอย่างไร

13. องค์กรพิพิธภัณฑ์วิทยาศาสตร์กำหนดวัตถุประสงค์และความต้องการที่ชัดเจนของนิทรรศการแต่ละเรื่องเพื่อให้สถาปนิกใช้ในการออกแบบหรือไม่

14. สถาปนิกขององค์กรพิพิธภัณฑ์วิทยาศาสตร์มีหน้าที่อะไรบ้าง

15. มีกิจกรรมอะไรบ้างในนิทรรศการขององค์กรพิพิธภัณฑ์วิทยาศาสตร์

16. มีกิจกรรมทางด้านการวิจัยทางวิทยาศาสตร์ในพิพิธภัณฑ์หรือไม่

17. มีสถาปนิกออกแบบ ป้าย สัญลักษณ์ คำบรรยาย และกราฟิกของวัตถุที่จัดแสดงหรือไม่

18. มีข้อเสนอแนะในการออกแบบนิทรรศการของพิพิธภัณฑ์วิทยาศาสตร์ในต่างจังหวัดที่กำลังจะเกิดขึ้นอย่างไร

Biography

Name-Surname Mr. Charnkla Leerakul

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Education Background Master of Architecture (Interior Architecture)
King Mongkut's Institute of Technology Ladkrabang

Special Training

: Special course-graduated level studying in "Historic conservation, philosophy and practice" Faculty of Architecture,Chulalongkorn University,Thailand.
: Special course-graduated level studying in "Creative and critical thinking" Faculty of Architecture,Chulalongkorn University,Thailand.
: Special course-graduated level studying (Audit) "Methodological in architectural research" and "Body of the Knowledge in advanced architectural development" Faculty of Architecture,Chulalongkorn University,Bangkok, Thailand.
: Special course- graduated level studying (Audit) "Ideology of buddism in Thai Design" and "Semiology in design" Master of Fine Arts program in design, Faculty of Fine and Applied Arts, Rangsit University, Bangkok, Thailand.
: Special course- graduated level studying (Audit) "Ideology of Buddism in Thai Design" and "Semiology in Design "Master of Fine Arts Program in Design, Faculty of Fine and Applied Arts, Rangsit University, Bangkok, Thailand.
: Training in architect professional at Giner & Bono Arquitectos S.L. C/Hort dels Frares 7 46600 Alzilra, Valencia, Spain from March 3 to June 30, 2008.

Professional Experience

1999-Present : Core college lecturer, Division of Interior Design, Department of Industrial Art Technology, King Mongkut's University of Technology North Bangkok, Thailand.
1995-1997 : Interior Designer, Coordinator and Assistant Manager at Multitect Consultant Co.,Ltd. Bangkok, Thailand.
1992-1993 : Conceptual designer: P49 and Associate Co.,Ltd. Bangkok, Thailand.
1990-1992 : Interior designer at Bent Severin International Co.,Ltd. Bangkok, Thailand.

Publications

1. Article-Conservative Conception known as “Wat Anong Ka Ram” and its Historic Community in ASA 04:43 The Architectural Journal of Siamese Architect Under Royal Patronage,Thailand.

2. Article- “Thinking and Design” in Technical Education Development Journal of Industrial Technical Education Center at King Mongkut’s Institute of Technology North Bangkok, Thailand. Year 14 th No.40 October – December 2001.

3. Article-“What the Concept is” in Technical Education Development Journal of Industrial Technical Education Center at King Mongkut’s Institute of Technology North Bangkok, Thailand.Year 14 th No.43 July – September 2002.

4. Article-“Mode of thinking: Thinking in the New Millennium” in Technical Education Development Journal of Industrial Technical Education Center at King Mongkut’s Institute of Technology North Bangkok, Thailand. Year 15 th No.46 April – June 2003 and No.47 th July – September 2003.

5. Article-“Mode of thinking: Critical thinking” in Technical Education Development Journal of Industrial Technical Education Center at King Mongkut’s Institute of Technology North Bangkok, Thailand. Year 18 th No.54 April - June 2005.

6. Textbook. “Design Concept and Analysis” for Interior design students at King Mongkut’s University of Technology North Bangkok, Thailand. October 2004

Social and Scholarly Services

: Interior Architecture and Interior Design Academic Council of Thailand (IAIDAC) committee since 2001.