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Master's Thesis
Academic Year 2017

Economic Maze: Guidance to Japan's Economy
for Foreign Residents

Keio University Graduate School of Media Design

Heng Xin

A Master's Thesis
submitted to Keio University Graduate School of Media Design
in partial fulfillment of the requirements for the degree of
MASTER of Media Design

Heng Xin

Thesis Committee:

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Abstract of Master's Thesis of Academic Year 2017

Economic Maze: Guidance to Japan's Economy for Foreign Residents

Category: Design

Summary

Confronted with the increasing number of foreign residents in Japan, a particular guidance of present Japan's economic situation, Economic Maze, comes up to help them with their economic activities. It is a learning design in form of a website which introduces Japan's economic status from three aspects: overall economic performance, economic phenomena and economic policy. Aware of the academic difficulty of the topic and preference of the learners, visualization is implemented as the main methodology to encourage active learning of the users.

This thesis introduces Economic Maze by following DIME Model (Design, Interaction, Media, Evaluation). Firstly, with the increase of foreign population in Japan, it witnesses a lack of information resources of Japan's economic performance. Secondly, it is pointed out that present existing learning materials are varied from content to visualization, bring both advantages and disadvantages to learners. Learning design, as literature review, frames the concept of Economic Maze. Thirdly, methodology of Economic Maze and its detailed content design, visual design and interaction design is reported. Last but not the least, evaluation of Economic Maze is analyzed from the perspectives of content evaluation, visual evaluation and interaction evaluation. The result shows that most participants found it insightful and informative. It is mentioned that it helped the participants solve some concerns while making them aware of more aspects. In the end, analysis of the project as a whole and its further possibility is summarized and discussed as the expansion of content and the deepening in knowledge.

Keywords:

Learning Design, Economy of Japan, Visualization, Website Design

Keio University Graduate School of Media Design

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Chapter 1

Introduction

1.1. Background

In the recent decade, an increasing number of 12.2 percent of foreigners come and stay in Japan, more than 1/3 of whom live in Japan temporarily. [23] Facing the issue of whether to stay in Japan in a long term or not, there is a wide range of guidance available ranging from Japans culture, society, education, to health care. However, there is rare particular source to cover the aspect of economy.

It is no doubt that national economy is an essential factor to our life. It has a wide profound influence on our daily activity, career and future. Especially for foreign residents who have to compare their opportunity in Japan and other countries, getting to know the performance of Japans economic prospect is very necessary. However, there is rarely suitable learning material for them to get to know Japans economic environment.

1.2. Concept

To compensate the issue above, Economic Maze is designed to introduce Japans recent macro-economic performance to foreign residents in Japan to help them with decision of long-term residence and other economic activities in Japan.

Economic Maze is a website-based English learning material that explains Japans recent economic performance from three sections: Overall Performance,

Economic Phenomena and Economic Policy. Overall Performance includes numerical and structural introduction to Japan's GDP, GDI, and GDE. Economic Phenomena specify the overall performance by explaining common economic situation of Japan and their interrelation. In section of Economic Policy, Abenomics and its three-arrow policy are introduced.

It aims at young English-speaking foreigners who just arrive and are expected to stay in Japan in a short period. This group of people come to Japan for the purpose of studying Japanese, entering Japan's academies, working in internship, etc. After having a relatively intensive experience in Japan, they have the high potential and challenge to decide whether to stay in Japan or not.

Therefore, with the assist of Economic Maze, it is hoped that these foreign residents are able to familiarize themselves with Japan's present and future economic situation, and make their decision from a more comprehensive point of view.

1.3. Structure

The following chapters is going to introduce Economic Maze in detail. First of all, literature review of related topics and relative works are to be presented and discussed. Secondly, Economic Maze is to be described following design thinking theory. Three main parts of its design, namely content design, visual design and interaction design, are going to be explained in detail. Thirdly, evaluation is going to be analyzed from user tests and feedback. The evaluation is in the combination of questionnaire and interview, and is carried out from the aspects of content, visualization and user experience. Last but not the least, possible future development and improvement of Economic Maze is going to be summarized in the last chapter.

Chapter 2

Literature Review and Related Works

In the chapter of Literature Review and Related Works, background studies of methodology of learning design, common structure of introducing Japan's economic status, and visualization of economy are to be discussed.

2.1. Literature Review

2.1.1 Learning Design

Economic Maze aims at introducing Japan's present economic status to new foreign residents in Japan in form of a website. Despite the format, the core content is to distribute a learning materials. Thus, it is essential to arrange learning design of the project. Learning design, according to Koper [17], is the application in development of a concrete unit of learning, such as learning event, lessons or courses. In process of learning design, creating a script of the learning situation helps the design of learning environment and interaction of the users [17]. The script model includes the following components:

- Metadata. Metadata refers to the descriptive data which is not included in the learning materials, but the supplement and support of it. [17] In case of Economic Maze where all learning material is organized on the website, references of the sources are attached to each cited content as metadata.

- Roles. It refers to learners, instructors, tutors and other actors in the script. [17] Economic Maze highlights learners, who are the users of the website. As a self-learning material, the instructor is not involved in the script. However, the instructor can be contacted via e-mail indirectly.
- Act. Act is the interaction of the roles in the content. [17] Learning design guides and predicts possible acts from roles and achieves learning objective via the acts. It is in the format of visual design and interaction design of Economic Maze to instruct users to learn through the website.
- Setup of Environment. Roles of actors act under certain circumstance. [17] Virtual environment and actual environment are both crucial to the development of Economic Maze. For example, the accessibility of the website, the attached domain, the valid browser and devices affect the act of the roles.
- Role-part. Role part describes the act of corresponding actors on a certain time. [17] As a self-study material, every learner is expected to do solo learning performance. Role-part literally equals to act in this case.
- Sequence of Activities. The role actor follows the order of content in the order of time. [17] The design of the content shall follow the learning pattern of certain materials to particular learners. There are three steps in the design of Economic Maze. Step 1 introduces overall economic performance of Japan by GDP, GDI and GDE; Step 2 describes economic phenomena of Japan and their interrelation, which are the causes of Step 1; Step 3 gives a general information of Japan's present economic policy. It covers the three arrows of Abenomics as the countermeasure of Step 2.
- Condition. Condition is not decided by instructors but the learners. It is the reaction to certain possible act from the learners. [17] Economic Maze has anticipated multiple possible reaction of website users and listed them in form of buttons or links, which allow users to select their condition and view corresponding content.

The keywords for learning design are effectiveness, efficiency, attractiveness and accessibility as determinants of level of learning outcomes. [18]

- Effectiveness reflects the degree to the achievement of the learning objective. [18] There are three levels of objective of Economic Maze: understanding the learning content smoothly, completing all three steps and reflecting the content in the future.
- Efficiency measures the cost and gain of the learning design. [18] Cost includes labor consumption of instructors and material consumption of content. The efficiency of Economic Maze can be reflected by the times the content is learned by website viewers, though it might not cover all aspects.
- Attractiveness is how appealing the content is to the learners. [18] Economy has long been stereotyped as a boring and difficult subject. To make it interesting and easy to understand is crucial to the design of Economic Maze. It will be practiced in Chapter 3 and 4.
- Accessibility is how approachable it is to all roles involved. [18] Economic Maze is based on the Internet in the form of an individual website. It is open to everyone basically, and can be reached from various devices as computers, tablets and mobile phones.

2.1.2 Economy of Japan

Macroeconomics, polar to Microeconomics, is the study of the economy as a whole. In introduction of economy of a nation, macroeconomics is often implemented as the basic structure. The following sources present the basic aspects to cover when it comes to Japan's economy.

In the introduction to Japan's economy, as summarized in the book Japan Economy [10], its economic performance is categorized in the following perspectives:

- Land and Population
- Economic Growth and Cycle
- Industry and Industrial Structure
- Fiscal and Financial Policy

- Company Management and Operation
- Exportation and Foreign Relations.

In the book Introduction to Japan's Economy of economist Noguchi [27] , present Japan's economic status is described from the following aspects

- General Analysis of GDP
- Industrial Structure
- Employment Change
- Income Distribution
- Price Index
- Fiscal Policy
- Aging Society and Health-care
- Government Budget
- Technology i Future Development.

Apart from the references above, arrangement of Nikkei Test is also taken into consideration in selection of content. Nikkei Test is a national test of economy in Japan organized by Economy News Press of Japan. The test covers five aspects to evaluate knowledge of economy and practice of participants, which are basic knowledge, practical knowledge, broad of horizon, logic of knowledge and implementation of knowledge [36].

2.2. Related Works

2.2.1 Economic Visualization in Traditional Media

Among all educational materials of economy, visualization of the content is an essential part. Visualization, as a methodology to implement images, diagram or animation to the content, conveys a certain message and assists learners to

understand the content [24]. It has been deeply implemented in both traditional media and new media.

Traditional media refers to mass media before information era, for example, television, newspapers, magazines, radio, television, and so on. [35] It still enjoys a huge popularity among readers.

- Image-related Visualization

In terms of visualization in images of economy, a trendy method is through manga. Manga is an essential element in pop culture of Japan, which is heavily image-based, entertaining reading materials. The implementation of manga in economy education has a positive effect to deduce abundant text-based content. The accompanying implementation of storytelling also makes the content more appealing to readers.

An insight we can draw from these materials is that in most books, the content arrangement follows the structure of "manga-text-manga-text", where visualization and text are separated from each other. The implementation of manga still serves the purpose of storytelling and guidance to the content. However, the real issue with the heavy content is not solved.

- Diagram-related Visualization

Diagram is another shape of visualization including chart, graphic and schematics. It is for purpose of arranging the data information and major to data visualization. [9] In the book Industry Map of Japan's Economy, diagram is largely implemented as a method to delivery economic information of Japan [37], whereas in the book Introduction to Japan's economy by Noguchi, diagram is the only visualization.

The following is a list of visual-implemented learning materials in introduction to economy.

2.2.2 Economic Education in Digital Media

In recent decades, with the popularity of the Internet, many online learning materials has emerged to meet the demand of various groups of learners. Digital media refers to any media that is encoded in a machine-readable format. Most common examples of digital media are digital videos, e-books, websites and so on.

Table 2.1: Learning Materials of National Economic Status with Visualization

Title	Author	Year	Visualization Method
JAPAN Inc.: An Introduction to Japanese Economy	Ishinomori Shotaro	1988-2014	5-10 pages of manga with 5-10 pages text
Industry Map of Japan's Economy	Nikkei News Press	2016	one diagram with 100-word text
Understanding Economic News in an Interesting Way	Ikegami Akira	2016	one page of illustration with one page of text
Wisdom of Economics	Zhang Donggang	2000	half page of illustration, half page of diagram with half page of text
The Cartoon Introduction to Economics	Yoram Bauman, Grady Klein	2010	a illustration with one-line text

Table 2.2: Examples of Economic Guidance to Foreigners in Japan

Title	Content	Method	Features
Tofugu.com	society, language and travel	blog	a short article with unified theme illustration
ABENOMICS - The Govern- ment of Japan	Abenomics	government report	simple and content to explain Abenomics itself
Japantimes.co.jp	news, so- ciety, and leisure	news	integration of news with latest in- formation of activities
GaijinPot Chan- nel of Youtube	travel, study, and work	video	5-min short videos of various as- pects of Japan, different from its individual job-hunting website
Japanese Cul- tural Studies 101	culture	online course	6 month of online class of compre- hensive knowledge on Japan with tuition

There are two different approaches of implementation of economic education in digital media. The first is through format change in the medium, for example, to make a e-book edition of the original paper book, to record a course and put it on the Internet and so on. Another approach is developing original learning design via electronic advice. For example, creating of economic-related website, writing economic blogs, editing own videos of economic knowledge and so on.

The following is a small list of example of the variety of implementation of guidance to foreigners living in Japan on digital media. They are all economic-related, but not particularly serve for the purpose of assisting foreign residents in Japan with their economic activities. Besides, it is encouraging to witness the growing methods of introduction of national economy.

Chapter 3

Content Design

3.1. Design Objective

Design thinking, as a catalyst to realize innovation, integrates people, business and technology in problem design. [19] In the theory of design thinking, setting the design objective is the initial step.

Philosophy setting is essential in presenting the simple reason and trigger to make the product or service. The issue is that for new foreign residents in Japan, they seldom have guidance to Japan's economic status of Japan in decision of long-term residence. Therefore, it is expected that it is approachable for them to get guidance to current Japan's economic status. Vision is another important foundation of the whole design thinking process, which is a rough definition of what to realize in terms of Philosophy. In this case, the Vision is that it is desirable that there is an open platform to introduce current Japan's economic situation and policy for foreigners in Japan.

3.2. Target Persona

In both user experience design and design thinking theory, target persona refers to a fictional representative who might use the particular design service or product [20]. It is representative of the key users to the project, but it does not necessarily refer to all users. In this case, the target persona are foreigners in

Japan who have the following features:

1. They are new short-term (0-6 months) residents in Japan who have a high potential to stay in Japan in long term. For example, they might be students to Japan's universities, Japanese language schools, special colleges, or employees who have short-term internship in companies and so on. The table attached shows the list from Ministry of Justice of all categories of short-term resident purposes of foreigners to Japan.

2. They have a relatively high level in English. For many new residents to Japan, language is a barrier to access to guidance of future plan. Since English is the most universal language, the project aims at the majority English-speaking foreigners who have more than conversational level in English.

3. They are considering whether to live in Japan for a long term. They are in the status of trying to make the decision of whether to start their career in Japan or not, or just make up their mind to do so. They are in need of guidance to know Japan's culture, society, as well as economy. "For a long term" refers to more than 5 years, which might be decisive or influential to their future life.

3.3. Content Design

To introduce Japan's macro-economic performance is a complicated project. In terms of content, it involves diverse economic elements from various aspects. First of all, macro economics, as a branch of economics, deals with the performance, structure, behavior, and decision-making of an economy as a whole [33]. It sets the frame and structure of the content. Secondly, since Japan is a unique country with unique economical features, it is important to focus on Japan's national status other than trying to cover all economical aspects. Thirdly, based on the national economic status, corresponding economic policy is carried out to tackle the economic issues. For foreign residents in Japan, it is important to explain the policy for future purpose.

3.3.1 Methodology

The key words of content design are simplicity, easy understanding, logic and personalization. They are the principles of content design of Economic Maze.

Simplicity refers to the volume of the content. In study of different academic sources, it is discovered that light content is preferred. The purpose is not to turn users into expert of Japan's economy but help them generate a big map of how it looks like. Thus, only content that is special to Japan's economic situation is selected out, which are generated into key words like GDP, industrial structure, aging society, deflation and so on. In terms of easy understanding, the explanation of Japan's economic performance shall not contain a lot of professional terms and if so, include a simple explanation around. It is not supposed to be a project for economic experts but the common people. Logic is another difficulty for readers to understand economy. Thus, the interrelation within the elements and their cause and effect shall be carefully explained. Personalization stands for the suitable needs to the target users, which means the content should target at foreign residents in Japan.

This project picks up the most frequently mentioned content. It can be summarized in the points which is going to be discussed as follow.

3.3.2 Content Generation

In order to provide straightforward information of the concerns of foreigners, generation of related information is essential to the content design. Related surveys have already been carried out among target users with non-working visa in Japan, including foreign students, training employers or interns, relatives of Japanese and so on. When it comes to their concern of staying in Japan, ten to thirty percent of their concerns are about Japan's macro economy. Most frequent concerns of them are put hereafter:

- Japan's economic perspective
- Relationship between Japan and home country
- Average salary in Japan and its comparison with home country
- Future Challenge and Chances in Japan
- Most potential and fast-growing industries in Japan
- Working environment for foreigners in Japan

- Most potential and fast-growing industries in Japan
- Government's future policy with its economy and foreign residents
- Most potential and fast-growing industries in Japan
- Possibility to work globally with companies in Japan
- Price standard in Japan and future trend in comparison with home country

In analysis of all questions related to macro economic performance of Japan, related knowledge are extracted and can be structured from the aspects of GDP, GDI and GDE. As three "containers" of equal shape and different perspectives, these economic elements can be divided and generated into each "container". The containers and their inner structure are discussed in the following section.

3.3.3 GDP

- General Overview

In macro economy, the principle of three equivalent aspects refer to the theory that GDP, GDI and GDE are equal to each other in terms of total amount. In Economic Maze, they serve as containers to set the structure of economic elements of target users' concern, thus it is not the purpose to introduce them.

Gross Domestic Product, namely GDP, is the total volume of production of a nation. It can be differentiated as Nominal GDP and real GDP. Nominal GDP is evaluated at the current market price which does not take price index into consideration, while real GDP is adjusted to inflation or deflation. [22] The GDP hereafter refers to Nominal GDP.

GDP is made up of production of all industries within Japan. In 2015, agriculture took up 1 percent of total GDP, which remained the same portion for decades. Manufacturing industry took up less than 20 percent, which declined from 23 percent in 2000 and 36 percent in 1970. In contrast, the portion of service industry increased from 52 percent in 1970 to 79 percent in 2015. [38]

Japan's GDP ranked No.2 in the world before China surpassed it in 2011. [40] It remains the third in the latest data of 2015. Even though it has the world third

largest economy, the number of its GDP (4.1 trillion) is 2/5 of that of China (10.8 trillion) and 2/9 of that of the United States (18 trillion). [40]

Besides, Japan's GDP per capita ranked No.26 in the world in 2015. It is expected that in 2020, Japan's GDP per capita would be 2/3 of that of the United States. [29]

The growth rate of Japan's GDP was 3.3 percent in 2015, which increased from 2.1 percent in 2014. [38] In 2011, Japan witnessed the negative growth rate of -1.8 percent due to the Tohoku Earthquake, while the worst in the recent decades happened in 2009, which was -6 percent due to Lehman Brothers Shock. [36]

- Main Influential Factors

GDP is made up of production from the three main industries: agriculture, manufacture and service industry. According to Introduction to Japan's Economy, the stagnation of manufacturing industry contributes to the slow growth of production. [29]

In terms of quantity, production of manufacturing industry declined from 114,281 trillion yen in 2006 to 108,354 trillion yen in 2015. In terms of portion to total GDP, its contribution dropped from 31 percent of 2006 to 20 percent in 2015. [5] The stagnation of manufacture is rooted from these factors: IT Revolution and Industrialization of NICs and industry structure of Japan. [29]

IT Revolution, or information revolution, started in the late 19th and 20th century. [15] characterizes in the popularization of personal computer and the Internet, which has largely changed the society, as well as manufacturing industry. It has lowered the cost of information processing, which allows small-and-middle-size companies to tackle information in the circumstance as large companies. It has also fastened the speed of data transmission, which enables distant cooperation and thus deepens global competition. [29]

NIC is the abbreviation of Newly Industrialized Countries. In the late 20th century, along with IT Revolution, industrialization started thriving in China, India, Malaysia and other developing countries. [15] They do not only offer more inexpensive labor force, but also witness fast developing speed in technology. Therefore, they have taken more market than before and depressed manufacturing industry in Japan. [29]

Manufacturing stagnation is also rooted from the industrial structure of Japan itself. The low Return on capital of manufacturing industry and the difficulty of developing intensive service industry set barrier to the development of manufacturing industry and transform of the whole industry.

3.3.4 GDI

- General Overview

GDI (Gross Domestic Income) describes a nation's economy size from the aspect of Income. It is made up with income of employees, net operating surplus, consumption of fixed capital and taxes.

From the data in 2016, we can see that nearly half of national income (49.3 percent) came from employees, 19.9 percent from net profit of companies and 30.8 percent from other sections. [3] Employee income and net operation surplus are the two most important sections of GDI, and thus will be introduced in detail.

- Main Influential Factors

GDI is formed of income from employees, profit of companies, consumption of fixed capital and taxes. The slow growth of GDI is mainly influenced by employees' income, profit of companies and taxes.

Income of employees in Japan decreased from 70 percent of GDP in 2000 to 67 percent in 2015. [3] It has a negative influence on consumption and demand of products. The decrease mainly came from the aging society and the stagnation of manufacturing industry. The reasons are as follow:

Firstly, owing to aging society and slow birth rate, the number of people in working age of Japan has decreased 6 million compared to 2010, and is expected to cut half in 2060. [38] This decreases the number of employment, which directly lowers the income of employees.

Secondly, structural change in employment also caused decrease of total income. Because of the increasing elderly, the number of employees in health-care is expected to increase 25 percent. Along with the stagnation of manufacturing industry, the number of employees in this field has decreased from 20.7 percent in

2000 to 15.9 percent in 2016. Manufacturing industry has a comparatively high average income (311,000 yen). (The average is 293,600 yen.) [26]

The decrease of employment in this field lowered the total income. Moreover, with the growth of service industry, unofficial employment increased 1.7 million from 2012, whereas official employment decreased 0.4 million. Taking into consideration that the average income of unofficial employment is only 95,000 yen, it contributes to the decline of total income, as well as the corresponding tax. [26]

Apart from income of employees, profit of companies also has a huge impact on GDI. Return of capital, or Return on Capital, as an index to net profit of employers, refers to principal payments back to "capital owners" that exceed the growth (net income/taxable income) of a business or investment [11]. In the recent decade, Japan's return of capital retained less than 20 percent. The reasons can be traced back to the decrease of oil price in 2014 and the stagnation of manufacturing industry. [26]

In 2008, Lehman Brothers Shock sent oil price up to 145 US dollar per barrel. With the recovery of the crisis, oil price dropped sharply from 108 US dollar in January in 2014 to 56 US dollar at the year end. [32] The drop of oil price resulted in the decrease of price of industrial products worldwide, including products from Japan. Along with the stagnation of its manufacturing industry, return of capital in Japan remained a low rate.

3.3.5 GDE

- General Overview

GDE is the abbreviation of Gross Domestic Expenditure, which is the spending aspect of a national economy. In Japan, 56.6 percent of GDE came from private consumption sector in 2015, while government consumption reached up to 1/4 of the total GDE. Investment and inventories made up of 18.8 percent, whereas net export was negative (-0.4 percent). [4] the content design, private consumption, government consumption and net export are explained in detail.

- Main Influential Factors

Private consumption, government consumption and net export are the three main influential elements to Japan's GDE. The devaluation of Yen has a great impact

on private consumption and net export, while government consumption is tightly connected with government budget deficit. [25]

Devaluation refers to the decrease of value of a currency. The devaluation of Yen happened recently from 2007 to 2012, during which it was dropped from 117.75 to 79.79 to US dollars. [7] The reason can be traced back to the recovery of Euro Debt Crisis.

Euro Debt Crisis took place in the European Union in 2009, when many members were unable to pay back the government debt. It started to recover in July 2011 when the European Central Bank announced its new policy. Euro also bounced back to 133 yen in 2013 after reaching the bottom of 95 yen in 2011. [39] With the recovery of European Debt Crisis, Investment to Euro that escaped to Japan started flowing back to Europe, which resulted in the decreasing demand of Yen, and thus caused the devaluation of Yen. [25]

According to Macro-economy, the devaluation of Yen should have brought more advantage to the export, since the product price became relatively cheaper. However, the reality was that even though the profit increased, the total amount of exportation didn't change accordingly. On the other hand, devaluation of Yen also made it more expensive to buy foreign products, which resulted in increasing cost of import. As an import-oriented country, the devaluation of Yen had negative effect in Japan. From 2011 until 2015, net export of GDE in Japan remained negative. [4]

In terms of government consumption, the huge budget deficit is the main contributor. As one of the top government-debt countries in the world, Japan's government shoulders a huge amount of budget deficit that it almost reached 240 percent in 2015 to its GDP, higher than most other developed countries. [13] In terms of budget, if government's revenue surpasses its expenditures, it reaches budget surplus; if not, it becomes budget deficit. The causes of the huge budget deficit of Japan's government are its aging society, low return of capital and low average income.

Japan has NO.1 aging society in the world with elderly people taking up to 27.7 percent of total population, [38] which implies that in every four Japanese, there is one elderly. The aging society results in the increase of health-care expenditure of the government, which reached 33.1 percent in 2016. [4] In terms of revenue,

The slowly decreasing income of employees and low return of capital of companies bring less tax income to the government.

3.3.6 Structural Organization

To organize the above information extracted from the books, it is essential to figure out their interrelation and level of importance.

Generally speaking, GDP, GDI and GDE are the outcomes of all the phenomena; IT Revolution and Industrialization of NICs, Industry Structure, Decline of Oil Price 2014, Recovery of Euro Crisis and Aging Society are the initial events that have profound influence to Japan's economy; the other phenomena are the results of the events and the causes to GDP, GDI and GDE status of Japan. The overall structure of the selected content can be organized as below.



Figure 3.1: Content Design: Structural Overview of Content

Chapter 4

Visualization and Interaction Design

Content design determines "what" to present, while visual design and interaction design determine "how" to present. This chapter is going to give detailed description of visual design and interaction design of Economic Maze, as well as its implementation to the content design.

4.1. Visual Design

As a sheer abstract subject, economy needs visualization to explain itself clearly. However, on the other hand, economy is also deeply rooted in our daily activity. Thus, visualization is helpful to convey abstract information through concrete scenario. Moreover, since logic plays an important role in economy, interrelation among academic knowledge and practical phenomena shall also be carefully processed and explained.

Therefore, visual design is very crucial to the introduction of Japan's macro-economic performance. It is hereafter explained from the aspects of methodology, visual style, maze design, illustration design, icon design and data design.

4.1.1 Methodology

As stated in Chapter 2, there are various methods to implement visualization in economy. In the anatomy of economy, the challenge lies in the understanding of complicated and highly strict professional terms and theory, the broad economic phenomena, and the interrelation in between. Thus, the emphasize of visualization shall pinpoint at these issues. Intensive adaptation of visualization is thus introduced to convey the content.

4.1.2 Visual Style

In visual art, style is a "distinctive manner which permits the grouping of works into related categories" [12]. Thus, before detailed implementation of prototype, deciding a guideline of overall visual style is essential. It is hereafter introduced from the aspects of art style, color theme and font theme.

- Art Style

In terms of art style, target users and content are two determinant keys. Since the target users are young foreign residents in Japan who are in their 20s or 30s, visualization shall suit the age taste, be easy to understand and be interesting.

Japan is unique for its pop culture, which is derived and transformed from Western countries and can be traced back from Pop Movement in 1950s. [1] In combination of Pop Art and traditional art of Japan, Japan's pop culture has always been an attraction to foreigners. Its spread in animation, game, movie and so on has become one of the biggest export of Japan. Therefore, the visual style of Economic Maze simulates Japan's pop style. In terms of character creation, three main characters are introduced in the concept of investor profile in economy.

According to Bank of America, investor profile reflects investors' behavior in the way they categorize themselves, set objectives and analyze the risk. Investor profile has three main categories: conservative, moderate and aggressive. Everyone is an investor in their economic behavior. Thus, by utilizing economic profiles as main characters can make users feel familiarized. The following three figures are created as main characters.

Figure 1 is the representative of the conservative investor profile. Since the conservative investor usually seeks for low risk and low return potential, this figure has a relatively large size with sluggish movement.

Figure 2 represents the moderate investor profile. Investors of moderate profile are in pursuit of higher risk and return potential than conservative investors. Therefore, Figure 2 is depicted slimmer than Figure 1 and is the closest to common people within all three figures.

Figure 3 stands for the aggressive profile of investors. They share the features high risk and high return potential pursuit, and thus is demonstrated in a slim and swift figure.

The original three characters are colored in ink blue, grass green and water-melon red. To match with the visual style and color combination, they are colored in black and white in the final prototype. The creation of the three figures and their implementation to Economic Maze are shown as below.



Figure 4.1: Profile All

- Color Theme

The usage of color is always essential to visual design, for its strong impact on the convey of information. It is said that color is the strongest tool for designers to impact the viewers. [16]Users explore the work initially by its color. In color psychology, different colors arose people emotionally in general. [2]

The color of yellow represents optimism, creativity and information, for its wavelength is relatively long and essentially stimulating. It is a strong emotional color, which is often implemented to informative content to alert and stimulate attention. Thus, to arouse attention and remain attention of the target users, yellow is used as background color. However, as the strongest color, pure yellow is not suitable for long-time reading. Amber yellow (RGB 255:192:0), as a warmer and deeper yellow, is implemented and set as the main color.

To decrease the powerful amber yellow background, black and white are the two main colors for images and words. On the one hand, the good construction of white to amber and black to amber makes it clear to read. On the other hand, amber as background adds liveliness to the black and white combination.



Figure 4.2: Color Combination

- Font Theme

On the base of color combination of amber yellow, black and white, the selection of font, font color and font effect should be able to bring readers the same image. The emotional and persuasive function of fonts can influence readers' perception of content. [14] It is evident that if the appearance of font is contradictory with the content, it can result in less attraction, misunderstanding and slow reading speed of readers. [8]

As the color combination of art already has the image of informative, active, clear and neat, the color of font is set as either black or white, as it brings contrast, attention and unity. Moreover, to compile with the amber yellow, special color 3D effect of font is implemented to bring more dynamic and variety. This 3D effect

duplicates the word twice in red and blue with 20 percent transparency, where the blue layer is set as the second layer to the bottom right of the original word, while the red one the third to the top left. This effect is the simulation of sun refraction, which creates the kind of 3D effect that brings movement to the font, but not so strong as to destroy the neat atmosphere. Besides, it also helps to create space between background and content.

In terms of font selection, Arial Black, Futura Light and Helvetica Light are the main three fonts. Arial Black, for its thick and impactful image, is for main titles; Futura Light, contract to Arial Black, is the trendy thin type, which is used for sub-title and image description; the thickness of Helvetica Light is in the medium, which is most suitable for main content.



Figure 4.3: Font Design

4.1.3 Maze Design (1)

In the design of the maze, as stated in Content Design, three steps are set to introduce overall performance (GDP/GDI/GDE), economic phenomena and economic policy respectively. Among all the three steps, the step of economic

phenomena is the main focus as it is the explanation and outcome of general performance and the reason for economic policy. Therefore, Maze Design of Step 2 is the main focus, while that of Step 1 and Step 3 is the supplement.

To introduce Japan's macro-economy, as mentioned in Chapter 3, simpleness of content, clarity of logic, and evidence of the correlation as a unity are highly essential. To organize the content and present it visually as a unit, it is necessary to figure out the features of the content:

- All aspects (industry structure, employment structure, distribution of income, price index, society and government policy) all flow to GDP, GDI or GDE.
- From the starting facts until results in GDP/GDI/GDE, the number of elements involved is from 1 to 4.
- The number of the starting facts and the number of their direct results are both 5.
- Some elements can be both reasons and results, and are included in more than one logic line.

Based on the above features, for the complexity of elements and their relations and unilateral direction to GDP/GDI/GDE, the circle is chosen as the main shape for the overall picture. All elements would be placed from the edge to the center, which is the "destination" as GDP/GDI/GDE.



Figure 4.4: Step 2: Circle Structure

The second step is the organization of all units outside the center, which can be categorized as follows:

- Level 1. Level 1 units refer to the 5 starting facts of domestic phenomenon and overseas events. They are IT Revolution and Industrialization of NICs, Industry structure, Decline of Oil Price 2014, Recovery of Euro Crisis and Aging Society.
- Level 2. Level 2 units refer to the 5 direct results of Level 1. They are Stagnation of Manufacturing Industry, Low Return of Capital, Devaluation of Yen, Huge Budget Deficit of Government and Numeral and Structural Change in Employment.
- Level 3. Level 3 units are the results of Level 1 and Level 2, which can also be reason and results of each other. They form the closest circle to GDP/GDI/GDE as elements of deflation in Japan, which are income, profit, price index, demand and consumption.

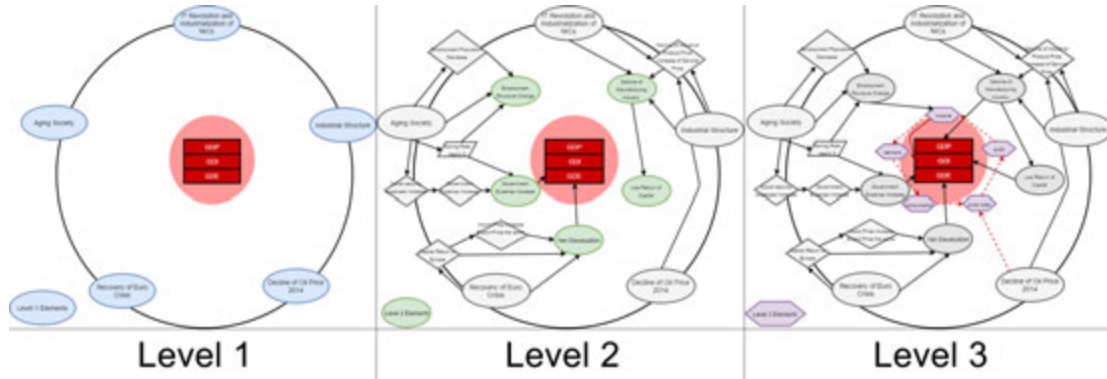


Figure 4.5: Step 2: Level 1/Level 2/Level 3 Units

In order to put all elements in organization, intersection unavoidable. Two versions of main layout are designed (as follows). Version 1 is in use of the elastic telescopic ball where level 2 and level 3 elements are hidden in close status and shown in open status. However, Version 1 cannot avoid the drawback of unclear indication of direction from Level 1 to center, which might arouse confusion for

users. Besides, the lack of variety makes it difficult to solve the complicated correlation and interaction of elements.

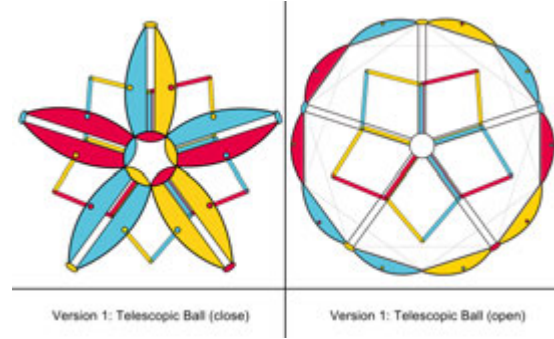


Figure 4.6: Step 2: Version 1- Telescopic Ball

Therefore, Version 2, the maze version, comes up to solve the above problems. In Version 2, Level 1 elements are set as starting points of the maze, Level 2 and level 3 are stops within the maze, whereas GDP/GDI/GDE are set as the destination in the center.



Figure 4.7: Step 2: Version 2 - Maze

The maze does not only demonstrate the direction of reasons and results, but also is highly flexible to connect elements from different direction. All logic lines are visualized as different paths to the destination.

The paths are as follows.

- Path 1. It is the path following Logic Line 1, which covers all elements which effects GDP structure. It covers IT Revolution and Industrialization of NICs (level 1), Industry structure (level 1) and Stagnation of Manufacture (level 2).
- Path 2. Path 2 is the path following Logic Line 2, covering all elements that contribute to GDI. It covers Aging Society (level 1), Decline of Oil Price 2014 (level 1), Employment Structure (level 2), Stagnation of Manufacture (level 2), Low Return of Capital (level 2) and Income (level 3).
- Path 3. Path 3 represents Logic Line 3, which includes all elements resulting in GDE, which are Aging Society (level 1), Recovery of Euro Crisis (level 1), Low Return of Capital (level 2), Government Deficit (level 2), Devaluation of Yen (level 2) and Income (level 3).
- Path Deflation. Path Deflation is a relatively unique path compare to the above ones, which is in accordance to Logic Line Deflation. It covers the following elements: Decline of Oil Price 2014 (level 1), and all level 3 elements (income, profit, price index, demand and consumption).

In all, all elements from content design is arranged in a maze. The following is the complete visualization.

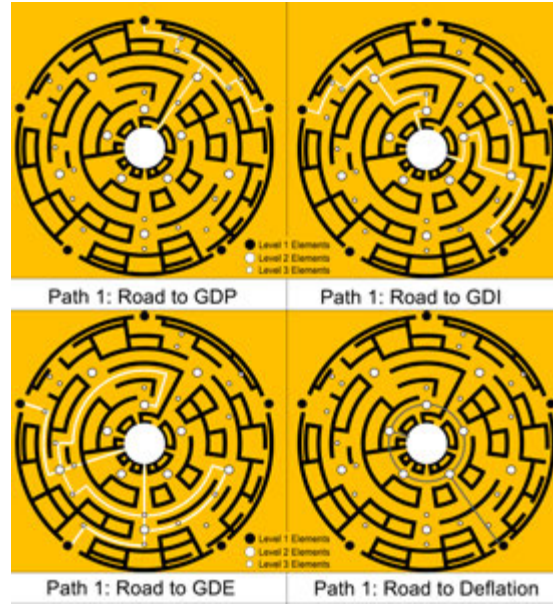


Figure 4.8: Step 2: Path Overview

4.1.4 Maze Design (2)

In supplement to the main maze to Step 2, Step 1 is the visualization of general performance of Japan's macro economy, namely, its GDP/GDI/GDE. The features of the content of this step is as follows:

- GDP, GDI and GDE are equal to each other in terms of quantity. According to Principle of Equivalent of Three Aspects in Macroeconomics, GDP, GDI and GDE describe a nation's economy from production, income and expenditure. They are theoretically equal to each other.
- GDP, GDI and GDE are three aspects of the same matter - national economy.
- The growth of GDP is closely related to GDP, GDI and GDE, which describes the total amount of national economy. GDP per capita and GDP World Ranking explain GDP further and location it worldwide.

Based on the above features, visualization of Step 1 is in shape of a perspective sphere. The shape of sphere is the coherence with the Maze structure of Step 2,

whereas its three planes are equal to each other in size and in all form the general performance, which is the visualization and metaphor of GDP, GDI and GDE. The separate elements of GDP per capita and GDP World Ranking are placed in the bottom right to the sphere as supplement to it.

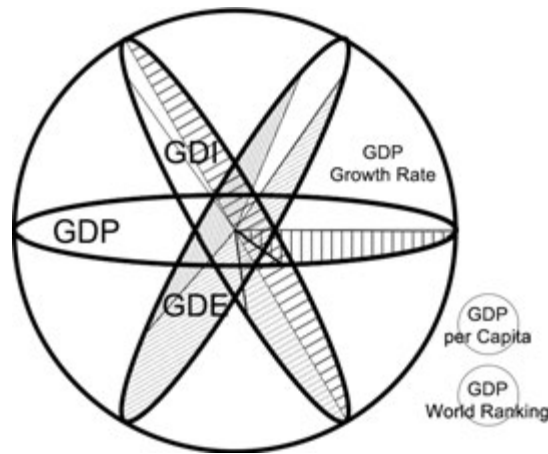


Figure 4.9: Step 1: GDP/GDI/GDE Overview

4.1.5 Maze Design (3)

Visualization of Step 3 is the supplement of Step 2, the main Maze. It demonstrates main economic policies and goals of Japan in face of its economic phenomena. According to Content Design, Abenomics and its three arrows are the content for Step 3, and they have the following characteristics:

Content of the three arrows covers all economic phenomena described in Step 2, including the three economic paths and deflation. The targeted elements of each arrow can form individual circles and don't overlap with each other. The elements do not include Level 1 elements, which are current events of recent years. Thus, same as Maze Design (2), the visualization of Step 3 keeps the size and shape of circle to be coherent to the maze in Step 2. Target used in archery is applied on the circle, while the placement of each element remain the same in use of the metaphor of arrow from Abenomics. Each arrow will be placed on the center of each circle that forms the content.

In detail, the First Arrow of Abenomics is aggressive monetary policy, which is expected to reach 2 percent increase in CPI, realizing inflation, and boosting

domestic demand and consumption by increasing the number of cash in the market. [21] The first arrow covers the elements of Deflation of Yen (Level 2), CPI (Level 3), Demand (Level 3) and Consumption (Level 3).

The Second Arrow in Abenomics points at flexible fiscal policy. It includes increasing budget of the government in public infrastructure development in order to increase employment rate and total income. [21] It also aims at tackling the heavy deficit of the government, thus it is expected to raise consumption tax rate up to 10 percent in the near future. [21] The second arrow covers the elements of Huge Deficit of Government (Level 2), Structural and Numeral Change in Employment (Level 2), Income (Level 3) and Consumption (Level 3).

The third Arrow is growth strategy including structural reform. By decreasing corporation tax among companies, encouraging high-tech development, innovative industry, and raise employment of women and foreigners, it is expected to realize upgrade of industrial structure of Japan and reach 3 percent GDP growth in the near future. [21] This arrow covers the elements of Stagnation of Manufacture (Level 2), Structural and Numeral Change in Employment (Level 2), Low Return of Capital (Level 2) and Profit (Level 3).

In all, visualization of Step 3 and implementation of three arrows of Abenomics are demonstrated as below.

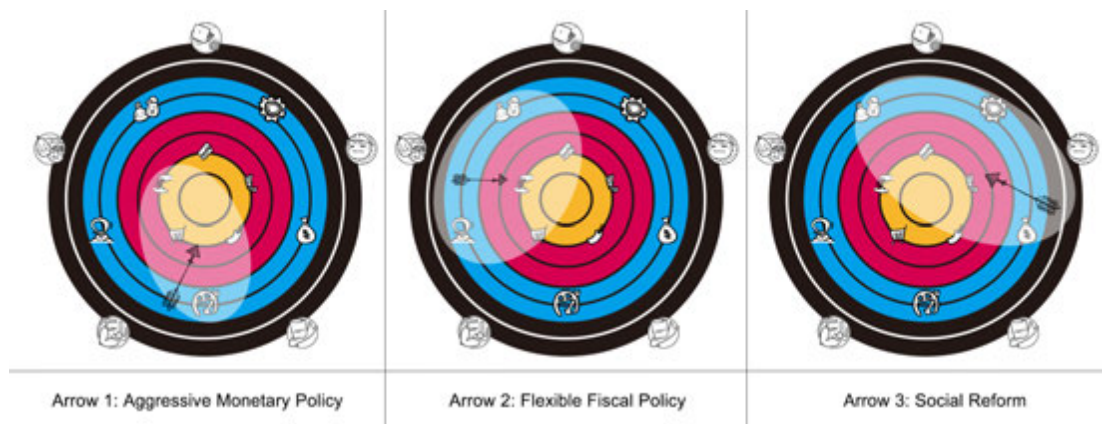


Figure 4.10: Step 3: Arrow Overview

4.1.6 Illustration Design

Since illustration has the features of better understanding, storytelling and recall, this methodology is abundantly used in the introduction of elements of level 1 and level 2, which are international events and economic phenomena of Japan. Level 3 elements are of less importance and relatively easier to understand, thus not especially illustrated.

- IT Revolution and Industrialization of NICs (Level 1)

IT Revolution, as described in Chapter 3, started in 1980s and has special influence on the stagnation of manufacturing industry of Japan. Industrialization of NICs has also brought challenges in labor forces and technology to the manufacturing industry of Japan. [29] To combine the two events is not only to simplify the content, but also to arouse the awareness of readers of their connection.

Thus, in the illustration of these two events, a person (Figure 2) holding a laptop conveys the message of the popularization of personal computer as a result of IT Revolution; the proud facial expression stands for the thriving of developing countries in Industrialization. To emphasize the pop culture of Japan, the concept of costume play is utilized as well. Costume play (cosplay) is an important element of Pop culture of Japan. Derived from costume tradition of Halloween from the Western Culture, it is an art performance where people dress in certain clothes to symbolize a specific character. The cloth of the person is a copy of a famous robot character in a Japanese animation, Chobits.

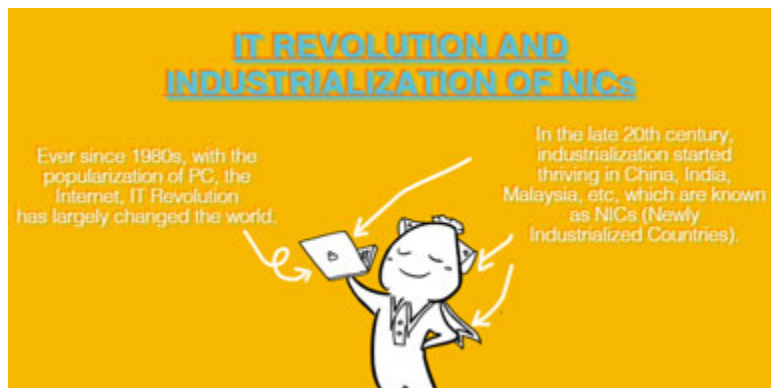


Figure 4.11: Illustration: IT Revolution and Industrialization of NICs

- Industry Structure (Level 1)

In the illustration of the industry structure of Japan, all three main characters are used to present three main industries: agriculture, manufacture and service industry. For the fact that agriculture in Japan only remained 1 percent of total GDP [5], which hasn't witnessed much change in the recent decades, it is depicted as a bystander in Figure 3 which has the slimmest body figure.

The rapid growth of service industry and shrinking of manufacturing industry make a great contrast. Thus, Figure 1 which has a heavy body, represents service industry, whereas Figure 2 represents manufacture. The movement of Figure 1 pushing Figure 2 against the wall is the use of metaphor and personification of the contrast.



Figure 4.12: Illustration: Industry Structure

- Decline of Oil Price 2014 (Level 1)

The decline of Oil Price is illustrated by Figure 2 for its mild characteristics. The burst of oil price and its sharp decline are depicted as a slide.

The parcel of petroleum is also personalized as a child in parcel playing with the slide, walking to the top and dropping down all of a sudden. The personification and storytelling can bring interest and better understanding for readers.

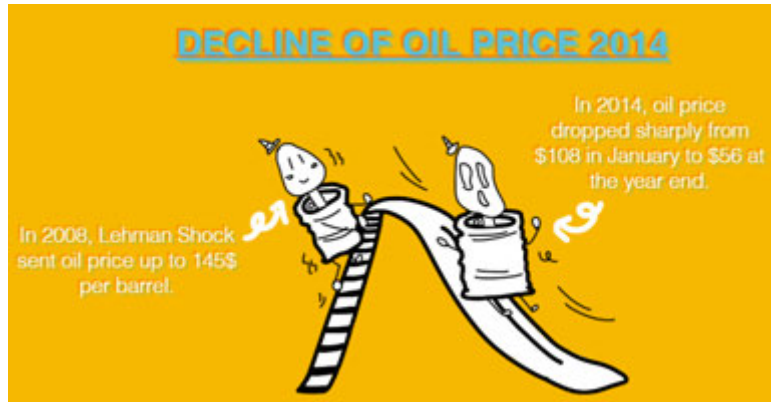


Figure 4.13: Illustration: Decline of Oil Price 2014

- Recovery of Euro Crisis (Level 1)

The Recovery of European Debt Crisis has two main characters, European Union (EU) and Japan. EU, as a unit, has witnessed the return of investment that escaped to Japanese Yen during crisis. Japan, on the other hand, lost this investment and witnessed the devaluation of Yen. [26]

The personification of EU is depicted as a man in suit (Figure 2), who is proud to see the return of investment, whereas Japan is depicted as a man (Figure 3) getting shocked to see the currency walk away from him.

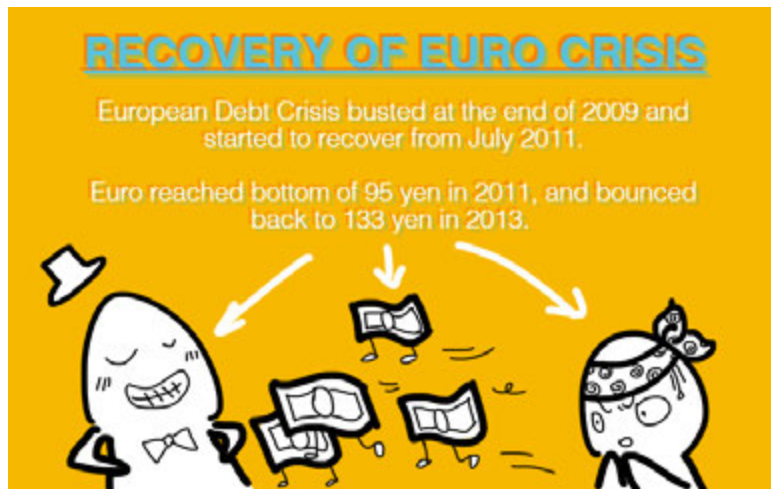


Figure 4.14: Illustration: Recovery of Euro Crisis

- Aging Society (Level 1)

As the world NO.1 aging society, Japan's economic performance is tightly connected to this social phenomenon. The percentage of elderly people in Japan reached 26 percent in 2015 [38], suggesting that in every 4 people there is one elderly. Accompanied the aging issue, the decline in birthrate is also essential.

Thus, in the illustration, four characters are presented as an elderly, a couple and a kid. The elderly (Figure 3) is twice the size of the others to emphasize the aging issue. The couple (Figure 2) and the kid are meant to reflect the fact of declining birthrate.



Figure 4.15: Illustration: Aging Society

4.1.7 Icon Design

Icon is an important element in visual design. It is the straightforward sign to instruct users the content and function. In the case of introducing Japan's economy, icon design has the functions of providing instant information, making the content more interesting and understandable, and creating motion.

The principle of icon creation is to simplicity, clarity and movement. Simplicity is for the purpose of instant notification and maintenance of overall interface; clarity means the direct transfer of information to shorten the time for readers; movement is the function of changing icon images while hovering or clicking on the button, which adds liveliness to the information.

In this case, all elements that displayed on the maze have their corresponding icons. Level 1 elements, for their importance, are put on 60*60 circles to emphasize their existence and illustrate their coherence; Level 2 elements are in 50*50 transparent square background; Level 3 is less connected with other elements and

closest to the center, thus they are made in 35*35 transparent square background. In terms of hovering and clicking movement, if the icon is a personified figure, the expression changes to interact with the users; if the icon is made of items, the items rotate to send back reactions for the movement of users.

- IT Revolution and Industrialization of NICs (Level 1)

IT Revolution is specified into a laptop, while Industrialization of NICs a gear. On the background of the circle, the world map is drawn to suggest the accompanied globalization of economy. For the image on hover and click, the two items are rotated 10 degrees.

- Industry Structure (Level 1)

To suggest the industry structure of Japan on the icon, manufacture industry is chosen to present. In use of personification, it is depicted as a construction-site labor in a sad face. The background also has raindrop to emphasize the atmosphere. On hovering and clicking, the figure changes facial expression while the raindrop falling down.

- Decline of Oil Price 2014 (Level 1)

Oil price is presented as the barrel container, while the abstract concept of "decline" is demonstrated as a bottom-point arrow. The change of icon in hovering and clicking status is the rotation of both the barrel container and the arrow.

- Recovery of Euro Crisis (Level 1)

The focus of this element is on the word "recovery". Thus, a masculine arm with a thumb-up is replaced on the bottom half of the word "E". The concept of "EU" does not have any representation, but directly shown on the icon for better understanding. The hovering and clicking status are the upraising arm with masculine highlighted.

- Aging Society (Level 1)

Aging Society is less of a abstract idea, thus relatively easier to present. Two figures (Figure 2 and Figure 3) are depicted as two happy elderlies. The background of sunrise/sunset shares the same energetic meaning. Once hovered on or clicked, the expression on the figures would be happily surprised. It is meant to depict the willingness of the elderly to be called by and communicate with young people.

- Stagnation of Manufacturing Industry (Level 2)

The point of this element is manufacture. Therefore, a gear is used to present this element. The hovering and clicking status is the rotation.

- Low Return of Capital (Level 2)

Low Return of Capital means the low profit in general. Thus, a small bag with a money icon is used to imply the concept of profit. The rotation of it is the hovering and clicking status.

- Devaluation of Yen (Level 2)

This element is straightforwardly presented as the Japanese character "yen" with a down-pointed arrow, suggesting its declining.

- Huge Budget Deficit of Government (Level 2)

This element uses the capital letter of the word "deficit", and the huge amount is depicted as a volcano which might burst anytime. The hovering and clicking image is the enlarged letter of "D".

- Numeral and Structural Change in Employment (Level 2)

Numeral and Structural Change in Employment is visualized by two professions. One is a nurse (Figure 1) who represents the increasing number of employees in health-care industry, while the other is a worker who represents the declining number in manufacturing industry.

To make it more interactive and fun, the hovering and clicking image is the change of facial expression. The change of expression from smile to hurt from the clicking.

- CPI, Profit, Price, Income, Consumption and Demand (Level 3)

Level 3 elements are all of Path Devaluation and the closest ones to the center. CPI is set as a price tag, which is the direct reflection of price change. A bag of money is presented as profit of companies. Income is depicted as a bank card, whereas consumption and demand are illustrated as hands of trade and shopping trolley respectively.

The following is a detailed presentation of all icon images with hover version as well.

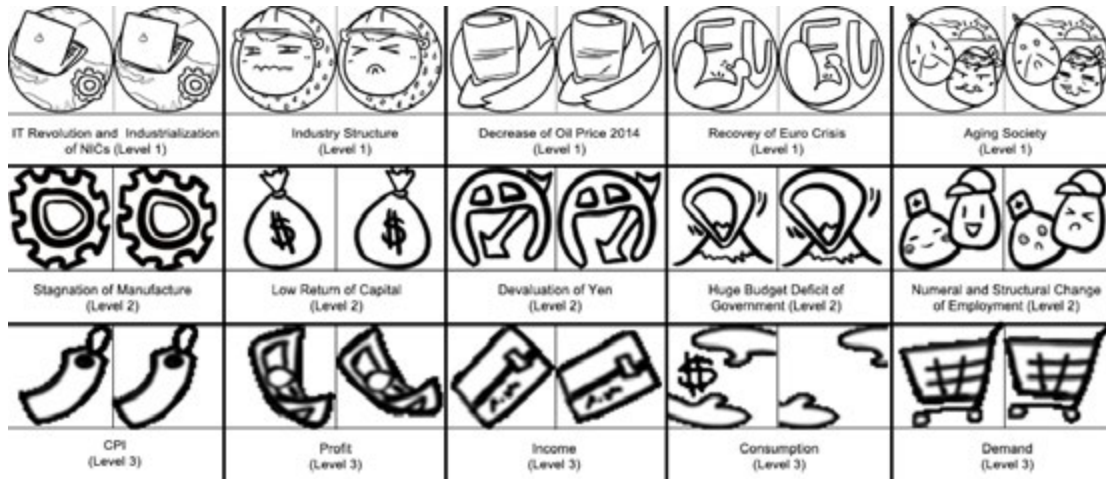


Figure 4.16: Icon Design: Icons of Level 1/Level 2/Level 3 Elements

4.1.8 Data Design

Data visualization is an important topic. Economy is a heavy data-based subject, thus the visualization of data is very essential. The principle of data visualization of economy is simplicity and emphasis. To make the data visualization as simple as possible, unnecessary data information is omitted. Emphasis means to highlight important information and make users able to notice at the first sight.

In the introduction of Japan's macro-economy, all level 2 elements are data-oriented. Thus, for unity and utility, Level 2 elements and the destination (GDP/GDI/GDE) implemented data design.

- Stagnation of Manufacturing Industry (Level 2)

The introduction to this element includes the stagnation in the amount of production and its falling contribution to GDP. In the data design, the annual production of manufacturing industry from 2000 to 2015 and its portion to GDP are shown in the form of line charts. Line charts do not only show the ups and downs of the performance of manufacture, but also present the change and their comparison.

The short text is embedded inside the chart to draw closer connection with the data.

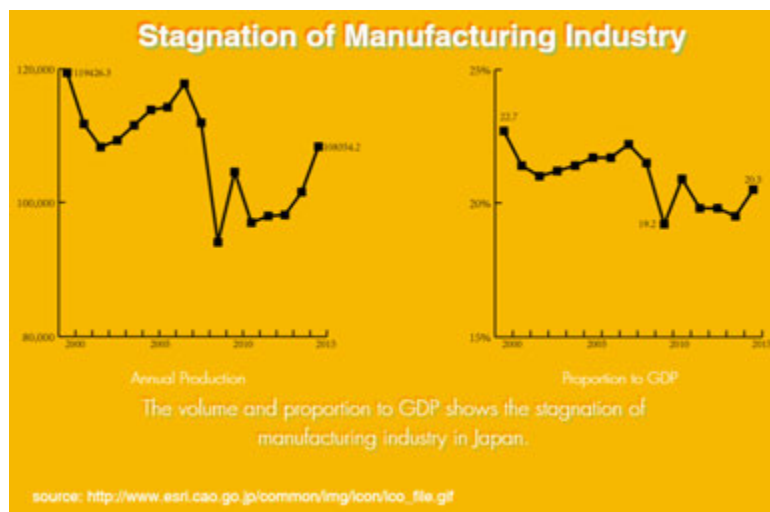


Figure 4.17: Data Design: Stagnation of Manufacturing Industry

- Low Return of Capital (Level 2)

The line chart is also utilized in the presentation of Low Return of Capital. It does not only show the actual number, but also show the tendency in the past 15 years. Line color is put in blue, which is different from the set color combination style in order to emphasize on its importance.



Figure 4.18: Data Design: Low Return of Capital

- Devaluation of Yen (Level 2)

The devaluation of Yen happened from 2007 to 2012. Thus, to show its declining tendency and contrast to its performance in the other years, data of Yen to U.S. Dollar from 2000 to the most recent March, 2017, is presented in line chart. Besides, since the number ranges from 79 to 126, it is unnecessary to start from 0 on the vertical axis.

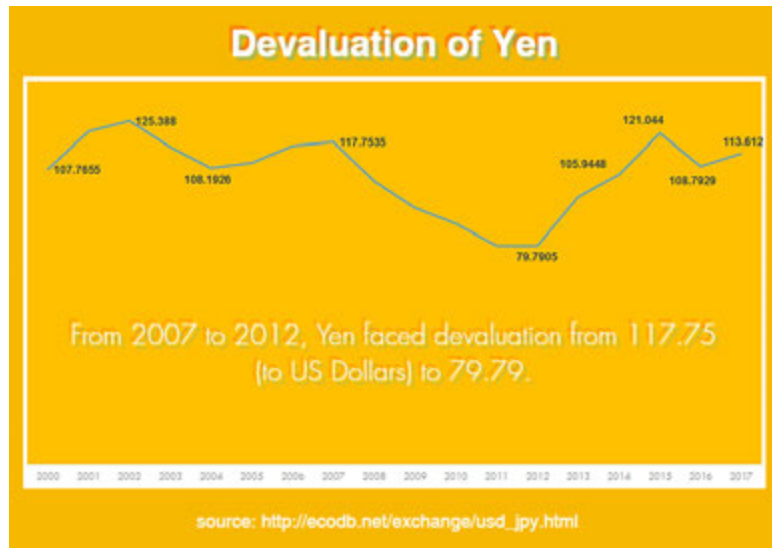


Figure 4.19: Data Design: Devaluation of Yen

- Huge Budget Deficit of Government (Level 2)

To reflect the abundance of budget deficit of Japanese government, the line chart is used to presents the amount and rapid growing status since 2000. To further demonstrate how huge it is, comparison to other main developed countries is also in the line chart. Deficit of government to GDP of Italy, France, U.S., U.K., Canada and Germany in the past years is much lower than that of Japan, which is clearly shown in the chart of their location.

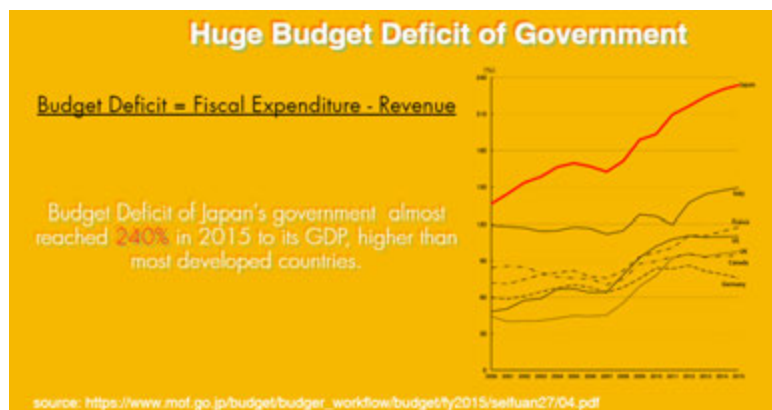


Figure 4.20: Data Design: Huge Budget Deficit of Government

- Numeral and Structural Change in Employment (Level 2)

This element contains two aspects of Japan's employment: change in the total number of employees and the flow of employment among industries. Therefore, two flow charts of population of working age and employment by industry are created to demonstrate the flow. Since the exact number of employment and its corresponding year is not essential in this case, they are omitted according to simplicity principle.

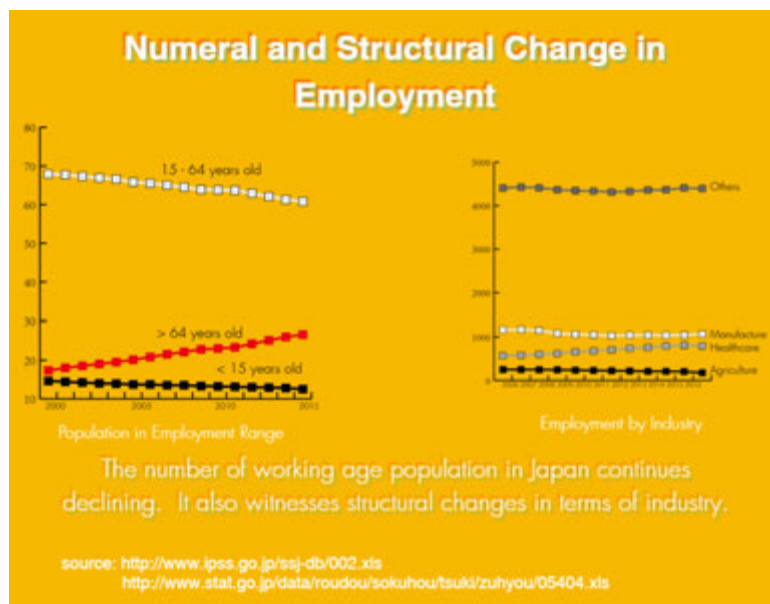


Figure 4.21: Data Design: Numeral and Structural Change in Employment

- Secondary Elements of Step 1

Step 1 is the main "destination" of all elements. It is the summary of the outcome of all economic activities and phenomenon of Japan. It includes introduction to GDP, GDI, GDE, GDP Growth, World GDP Ranking and GDP per Capita.

As explained in content design part, GDP, GDI and GDE are of equal amount. They explain Japan's overall economic performance from the aspects of production, income and expenditure. Thus, it is very essential to show this relationship among them in data design.

In the process of this data design, coherence to visual design is very essential. Thus, the same circle frame to the maze is implemented. In use of the knowledge that every surface crossing the enter within a sphere has the same size, three surfaces that cross the center are used to present GDP, GDI, GDE correspondingly. The horizontal circle represents GDP, the 60-degree rotated one stands for GDI, while the 120-degree rotated one is the GDE circle.

Not only the size, but also the unity of the visualization of GDP, GDI and GDE is very important. Thus, all three circles are made into pie chart to divide the structure within each elements. The filling pattern combination of these three circles are also the same.

GDP circle contains the elements of the production of all three industries. Since manufacturing industry is much more influential than the other two and has direct connection to the elements, it is highlighted in Yellow with strip patter.

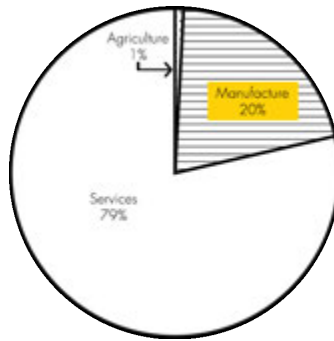


Figure 4.22: Data Design: GDP Circle

GDI circle is made up of compensation of employees, net operating surplus, consumption of fixed capital and taxes. Compensation of employees and net operating surplus are the two major parts, which are highlighted in yellow with the exact number shown on the pie chart.

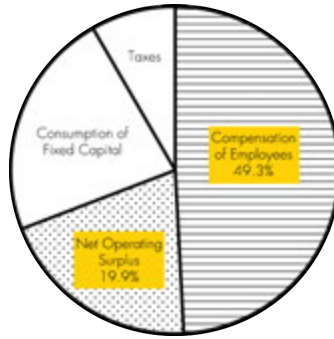


Figure 4.23: Data Design: GDI Circle

GDE circle is a pie chart including private consumption, government consumption, investment and inventories and net export. Since private consumption and government consumption nearly 82 percent of GDE, they are highlighted in yellow and will be explained in the maze. In 2015, Japan witnessed minus 0.4 percent of net export to GDP, which means its import has surplussed export. To demonstrate and emphasize this part, the circle is made incomplete in this area, where there is a notch to the while pie chart. The number is also shown.

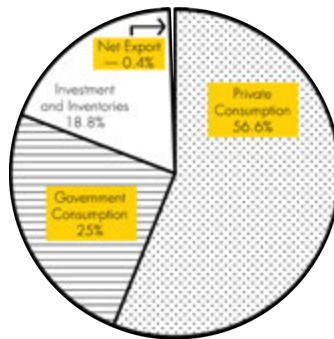


Figure 4.24: Data Design: GDE Circle

- GDP Growth

GDP Growth is also an important element in introduction to Japan's macro-economy. First of all, presenting the GDP/GDI/GDE amount and structure can only introduce the present status; secondly, Japan's recent economic performance should be analyzed for a longer-period of time than only one year. Thus, GDP growth of Japan from 2000 to 2015 are selected.

To present both the amount and the tendency of change, the line chart is put in utilization. However, unlike the line chart implemented in elements level 2, GDP Growth line chart is made into Graphics Interchange Format to guide users to follow the change. The reason for this difference is that time line is more emphasized in the change of GDP Growth.

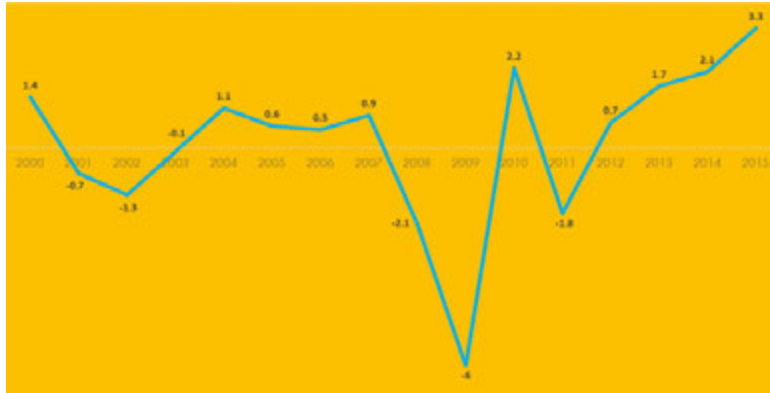


Figure 4.25: Data Design: GDP Growth of Japan 2006-2015

- World GDP Ranking

World GDP Ranking is another important information to present in introduction of GDP of Japan. It is essential to locate Japan's position in the world, and getting aware of how different it is to other countries.

In the research of people's knowledge of Japan's GDP position worldwide, most people already know that it is ranked NO.3 in the world, but hardly know the fact that it is 2/9 the size of NO.1 (the United States) and 2/5 the size of NO.2 (China). What else needs to be noticed is that in 2011, Japan was surpassed by China and became NO.3 biggest country in terms of GDP, which reflected the faster growing pace of China's economy and comparatively lower growth of Japan's.

Thus, to show the rank, size and growth is all important. To present three types of data all at once on data visualization, the use of Graphics Interchange Format is implemented on data design. The ranking of Japan doesn't change annually, thus is written by text; the size is presented as the length and width of the item that personified as GDP with its actual number written inside; the

annual growth is done by showing the Graphics Interchange Format, where the sizes of the three countries' GDP change every 0.3 seconds.

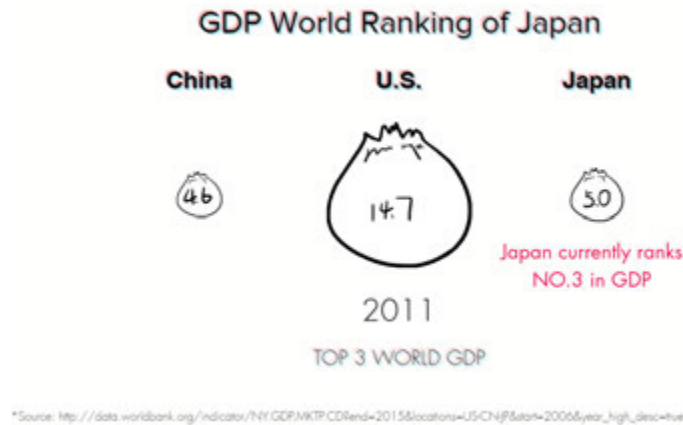


Figure 4.26: Data Design: GDP World Ranking

- GDP per Capita

GDP reflects a country's production, while GDP per capita shows how much each person can receive in general. Japan's GDP ranked NO.3 in the world in 2015 and its GDP per capita ranked NO.26, which hasn't changed dramatically in the recent years.

Thus, comparison to other countries is less necessary, whereas to present the stable status is the purpose. A line chart of the actual number of GDP per capita from 2000 to 2015 is shown.

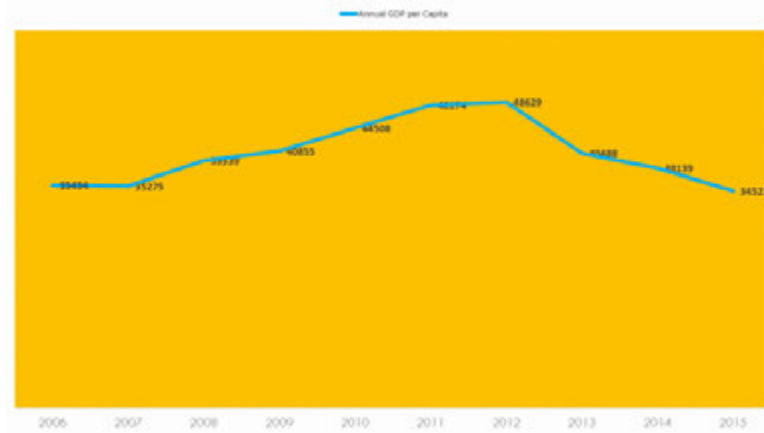


Figure 4.27: Data Design: GDP per Capita of Japan

4.2. Interaction Design

Interaction design is a very crucial subject in the introduction to Japan's macro-economy. It is the practice of designing interactive digital products, environments, systems, and services [6]. It builds connection among different elements and send instruction to users. The implementation of interaction design has been an important subject in the field of education.

4.2.1 Methodology

To introduce Japan's macro-economic performance, the principle, as stated in methodology of visual design, is to simplify the content and make it easy to understand. Apart from this, interaction design also shoulders the function of introducing and guiding readers smoothly to following the designed visiting path, which is the flow chart. Moreover, providing users a different, enjoyable experience is also one of the ultimate goals.

The methodology implemented in interaction design is animation. In the project, animation is mostly implemented in the explanation of element correlation, as well as changes between two units. The goal is to reach maximal interaction among unites in utilization of minimum text explanation.

4.2.2 Flowchart

Design of flow chart determines the structure of the whole project. A flowchart is a type of diagram that represents work flow by presenting steps as boxes of various kinds, and their order by connecting them with arrows. This diagrammatic representation illustrates a solution model to a given problem.

To activate and follow the content design and visual design, the flow chart should follow the principle of simplicity and maximal interaction. Thus, it categorizes all elements once again into three groups in terms of their functionality.

- Group 1

Main interaction here refers to the stages that are highly individual and functional, where other elements are implemented on. Unites within Group 1 form the main structure of the flow chart.

In the content design and visual design, it comes up with the conclusion that three steps are necessary to introduce Japan's economic status: general situation (Step 1), Economic Phenomena (Step 2) and Economic Policy (Step 3).

Thus, there will be three main unites within Group 1: Introduction, Step 1 (GDP/GDI/GDE) Page Step 2 (Maze) Page and Step 3 (Target) Page. The main flow chart is shown as follows.

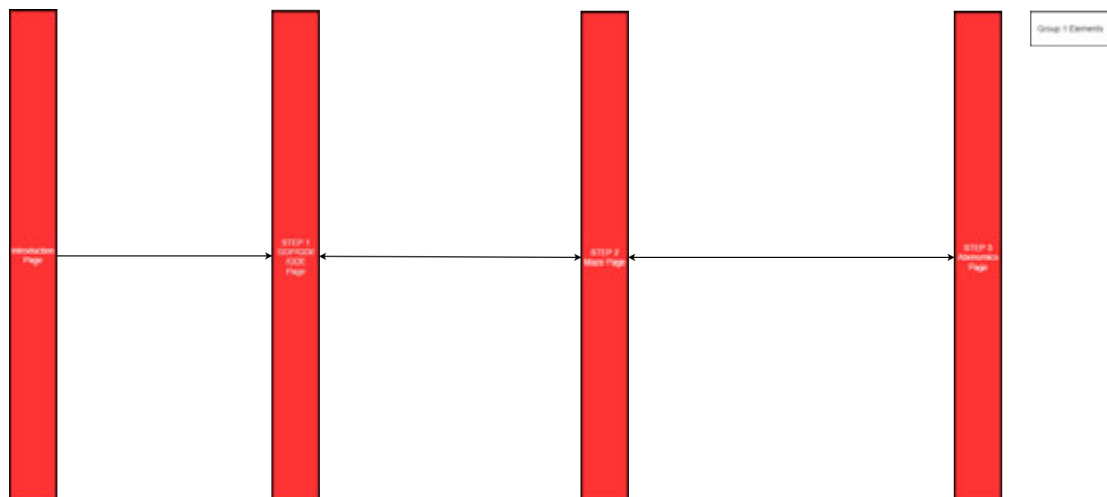


Figure 4.28: Interaction Design: Group 1 Flow Chart

- Group 2

Group 2, compared to Group 1, is more detailed flow chart design, which contains sub-unites including GDP, GDI, GDE and related pages of Step 1, detailed explanation of economic elements and introduction of "three arrows" of Step 3. It includes all elements in the first extension of elements in Group 1, and form individual loops within the Group 1 elements.

The Group 2 flow chart is shown as below.

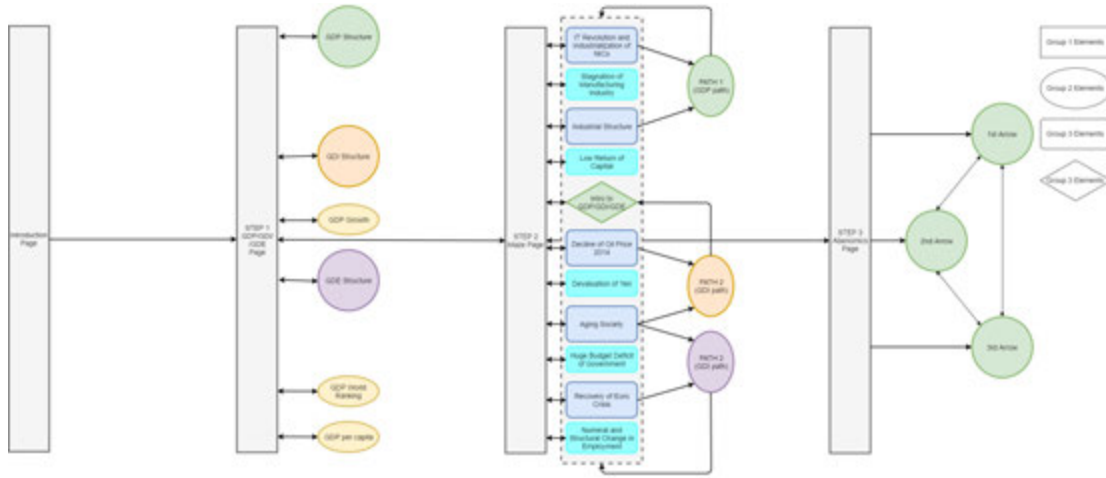


Figure 4.29: Interaction Design: Group 2 Flow Chart

- Group 3

Group 3 contains all the other elements. They are explanations of economic paths and elements themselves, as well as guiding and backup pages. They do not only form basic loops individually with their upper-level elements, but also work in the function of connecting all different loops. They are also implemented to guide the users to the maze and explain the icons and functionality.

In detail, Group 3 elements are made up with guiding page, quiz page, pages of Path 1.1 - Path 1.3, Path 2.1 - Path 2.7, Path 3.1 to Path 3.7, pages of introduction of Level 1 - Level 3 and pages of structural elements in GDP, GDI and GDE.

The flow chart of Group 3, which is the overall flow chart, is shown as below.

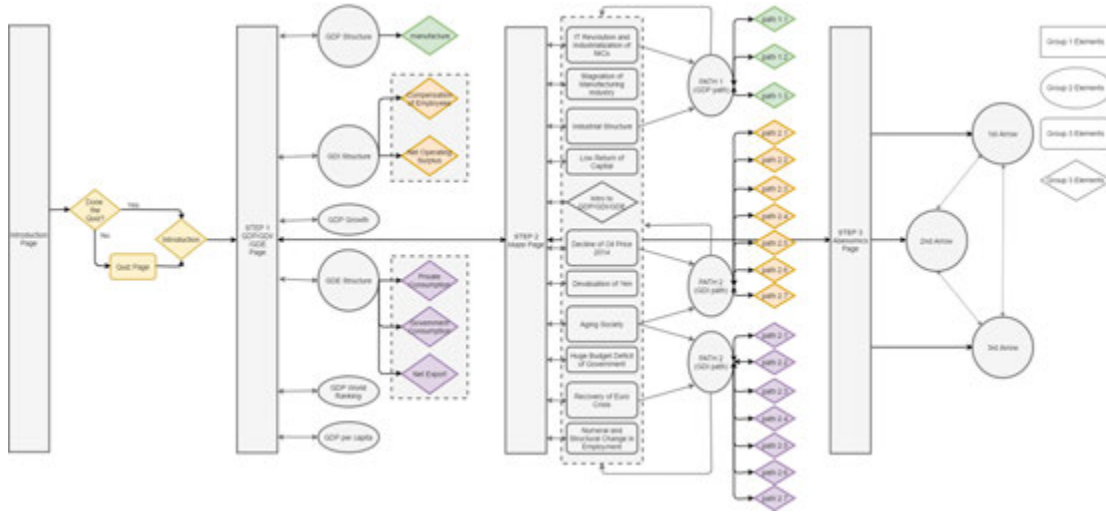


Figure 4.30: Interaction Design: Group 3 Flow Chart

4.2.3 Interface

Interface serves as the mediator for searching all sources of the website. [13] If the flow chart is the skeleton of interface design, the interface is the flesh of the flow chart. Thus, in the creation of interface design and interaction design, it follows the structure of the flow chart from Group 1 until Group 3 design.

- Group 1

All four pages of Group 1 are the main pages of the project. For the Introduction Page, which is also the home page, what the project is about is the most important information to deliver to readers. Thus, the title and an icon to the main page are the only two elements. The page information is shown as below.



Figure 4.31: Interaction Design: Interface of Introduction Page

Step 1 Page is the first content in the exploration of the website. All the other content spreads out from the general information of Japan's GDP/GDI/GDE fact. Thus, to guide the users smoothly to the first content, on the first page of Step 1, a white circle with animating line of GDP growth rate in Japan is presented in the center suggested as a beating heart. A little introduction is attached as well.

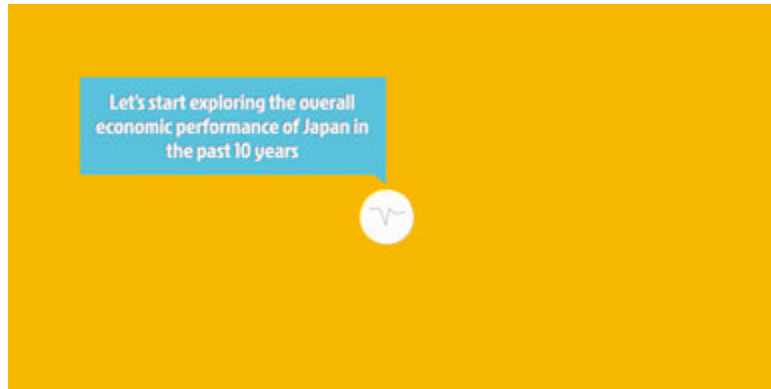


Figure 4.32: Interaction Design: Interface of Introduction Page of Step 1

For Step 1 page, namely GDP/GDI/GDE page, is in control of elements of GDP, GDI, GDE, GDP Growth, GDP World Ranking and GDP per capita. Thus, to maintain the common circle style with the Maze Page, and to categorize the elements, a circle of the same size as the maze is put in the middle, which takes GDP, GDI, GDE and GDP Growth Rate elements. Instruction to GDP, GDI, GDE are of parallel structure to the left side of the page. For the other two

elements, since their content are not so related, they are listed individually to the right side of the page. The whole page design is shown as below. The transfer of these pages utilizes the effect of fade-out and fade-in to smooth the transfer and emphasize their connection.

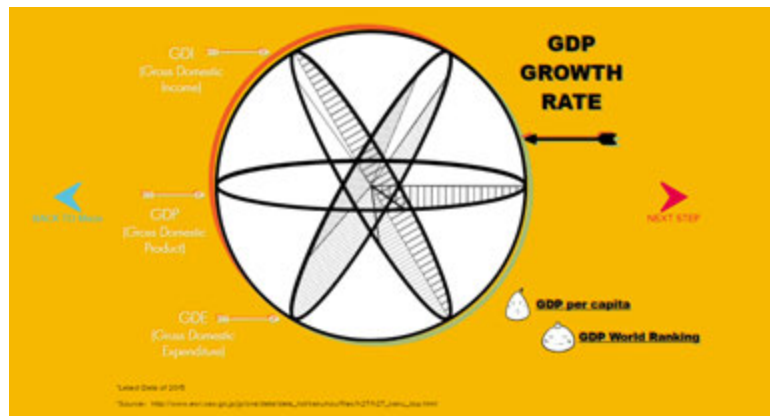


Figure 4.33: Interaction Design: Interface of Step 1

Among all three pages of Group 1, the maze page is the most important one, since it contains all information and link to other elements. Thus, how to show all information neat and straightforward is crucial. From visual design and functional user test, the maze, Level 1 elements, the destination icon and instruction is put onto this page.

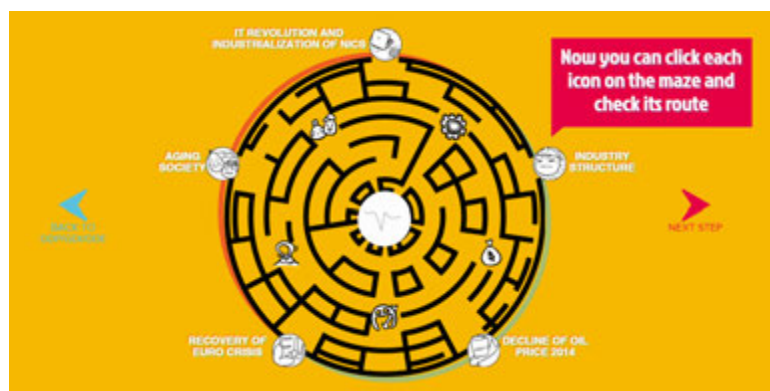


Figure 4.34: Interaction Design: Interface of Step 2

For Step 3, a target is in exchange of the maze with three arrows on it. The

center remained the same as Step 1 and Step 2 in coherence. The color of the target follows the normal color pattern of target, which is slightly adjusted to the color theme of the project.

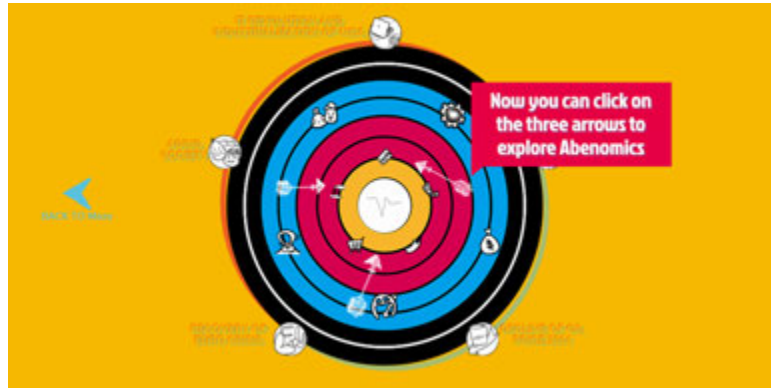


Figure 4.35: Interaction Design: Interface of Step3

- Group 2

Group 2 are the second most informative group of elements in the flow chart. Thus, they are also individual pages which connect to the main pages and Group 3. They are Step 1's secondary pages, all three economic path pages of Step 2 and arrow explanation of Step 3.

The secondary pages of GDP/GDI/GDE refer to pages of GDP, GDI, GDE, GDP Growth Rate, GDP World Ranking and GDP per capita. The interface of GDP, GDI, GDE pages is similar to each other. The overall interface is the same, while the corresponding cross-sectional circle of each element would enlarge into the full circle, where the structure of each element is demonstrated. The most important part of the structure is highlighted in amber yellow, while the other unnecessary elements fade into background color.

The animation for these three pages are the opening of the circle to indicate the enlargement and details.

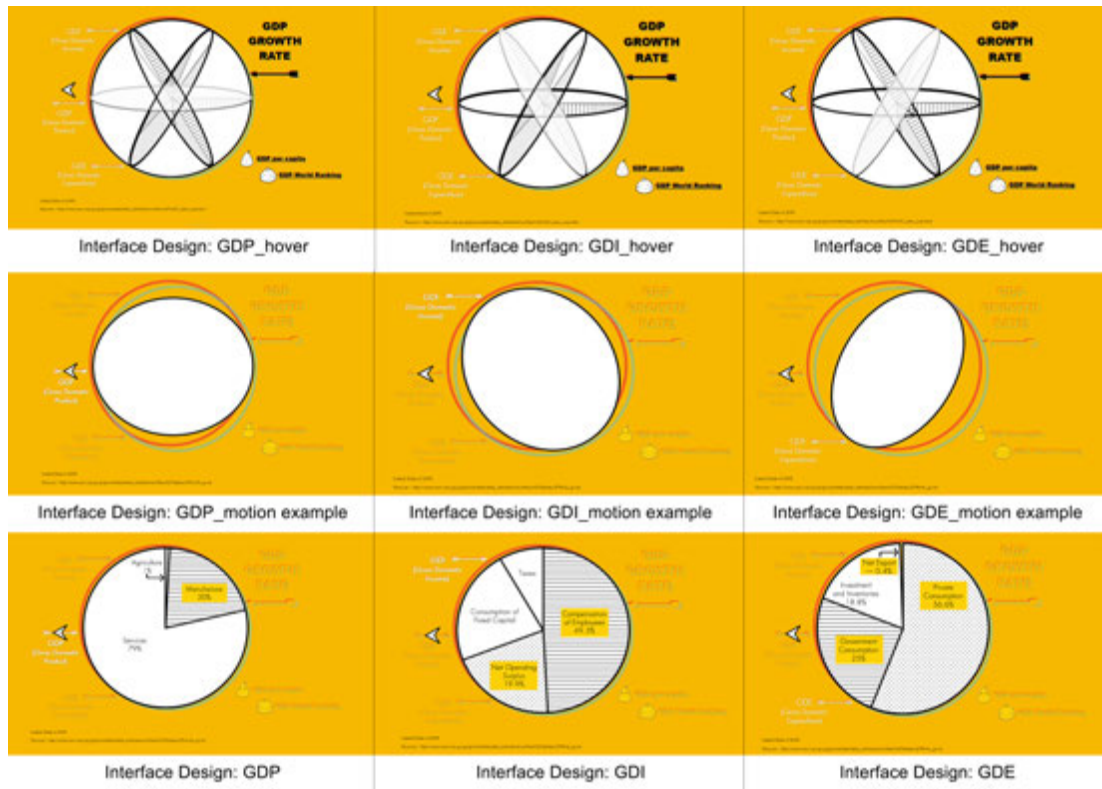


Figure 4.36: Interaction Design: Interaction of GDP/GDI/GDE Page

For GDP Growth Rate page, the trigger is the whole circle, since it describes GDP as a whole from a different chronological order. The interface of it is not an individual website page but a light box. The selection of a light box instead of a web-page is that firstly, this element does not contain much information; secondly, this is a unilateral element where it does not lead to any other direction; thirdly, the light box can largely decrease the complicity of the content and brings less burden to readers.

Thus, the corresponding designed data with explanation is shown on the light box unit. The example is as below.

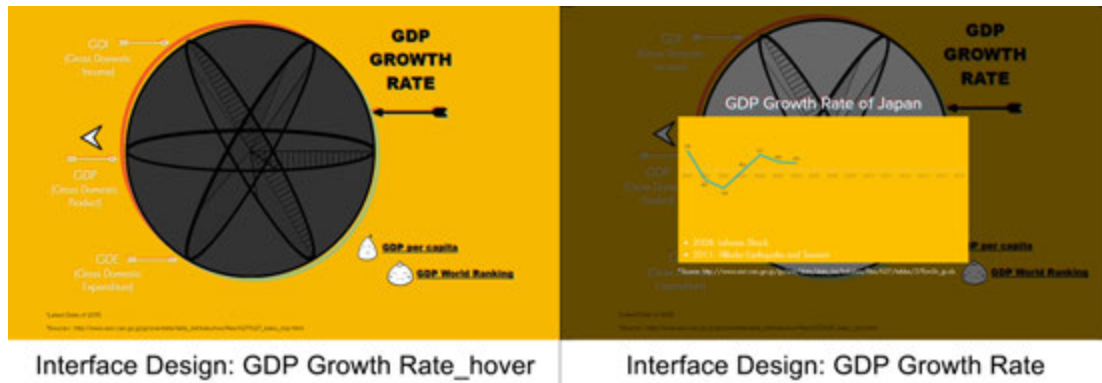


Figure 4.37: Interaction Design: Interaction of GDP World Ranking Page

For GDP per capita and GDP World Ranking, the interface is also in the form of light box where the corresponding data is shown.

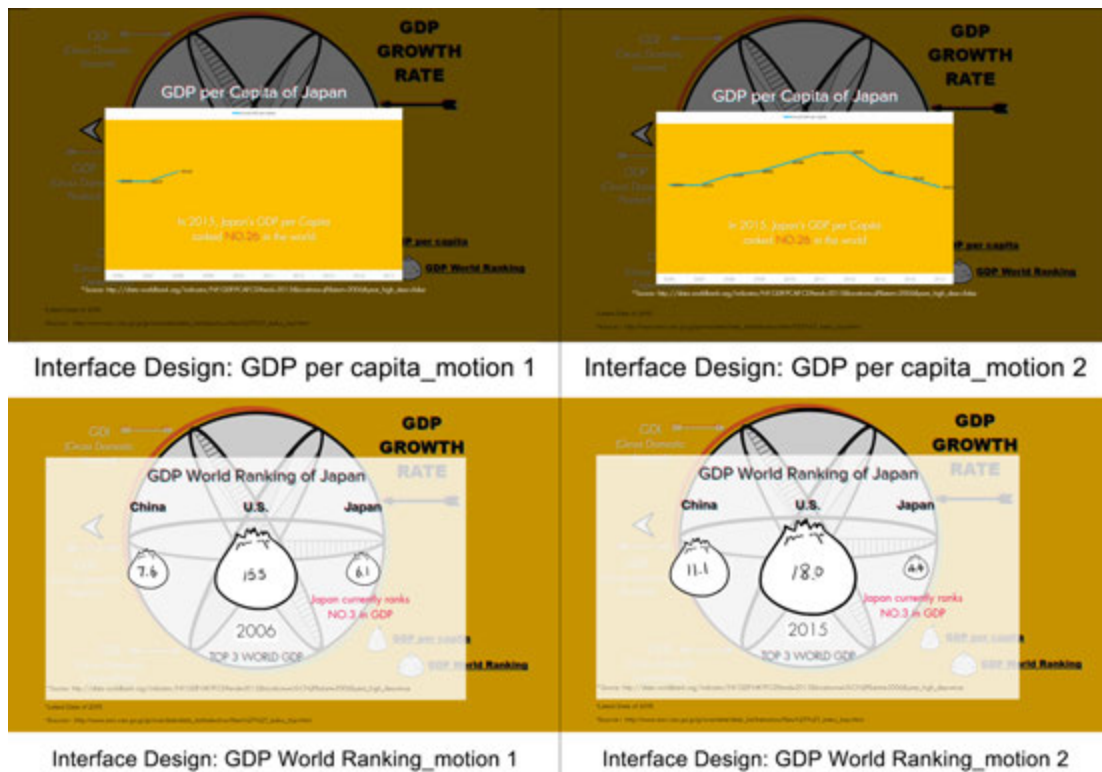


Figure 4.38: Interaction Design: Interaction of GDP per capita and GDP World Ranking Pages

For economic path pages, all three paths can be triggered by clicking related

Level 1 elements. The layout and interface of these pages follow the main Maze Page to minimize unnecessary variety for readers to understand. The path and related Level 2 elements appear on the interface, whereas the other unconcerned elements fade away by turning to the background color. There is also introduction of each functional element in text form against the background.

The interaction of the path is animated as the effect of spreading from the starting point and the terminal. In some cases, the starting point is not the Level 1 elements, while the terminal is not always the GDP/GDI/GDE destination. The interface and animation of the three paths are shown as below.

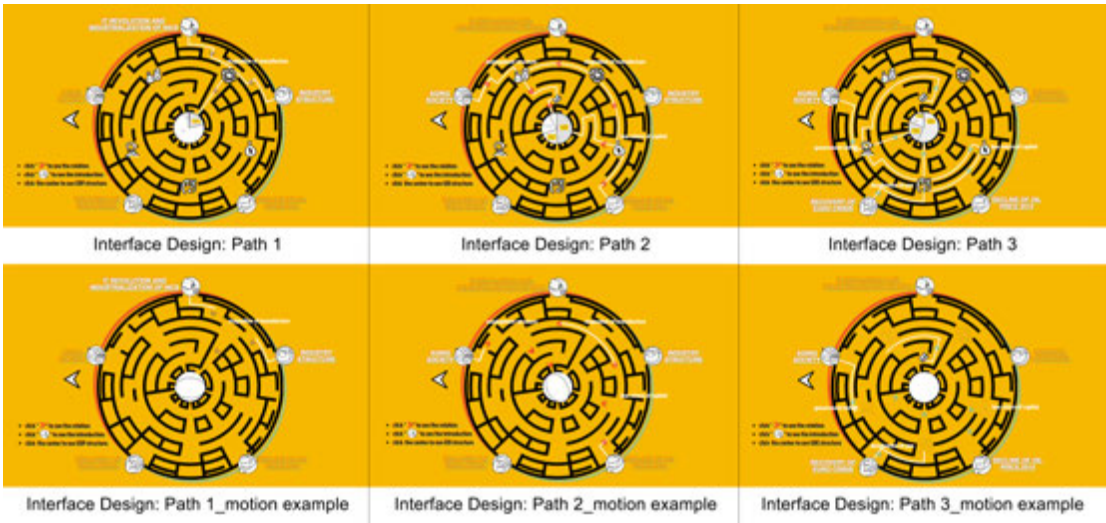


Figure 4.39: Interaction Design: Interaction of Path Pages

In Step 3, the interface of the three arrows are individual web pages with minor change to Step 3 Page. By fading the target and canceling unrelated unites to the particular arrow, it highlights the range of the arrow and the elements inside. Sentence of content of "the three arrows" is displayed under each element to explain the correlation of economic phenomena with the policy.

The interface and motion movement is as below.

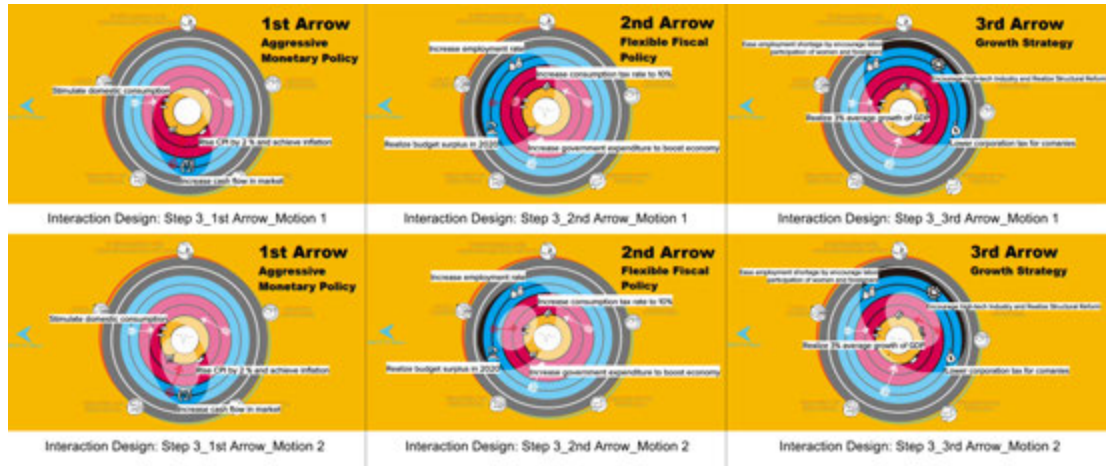


Figure 4.40: Interaction Design: Interaction of Step 3 Arrow Page

- Group 3

In Group 3, the interface covers all subtle pages, which can be categorized as element explanation pages, path explanation pages and guiding pages. They are all unilateral unites with minimal information, thus they are all in the form of light box.

For element explanation pages, they are not only to explain the meaning of the element, but also connect the element and the corresponding paths. Therefore, the light box of these pages is made up with data visualization, text and icons to lead users to the paths.

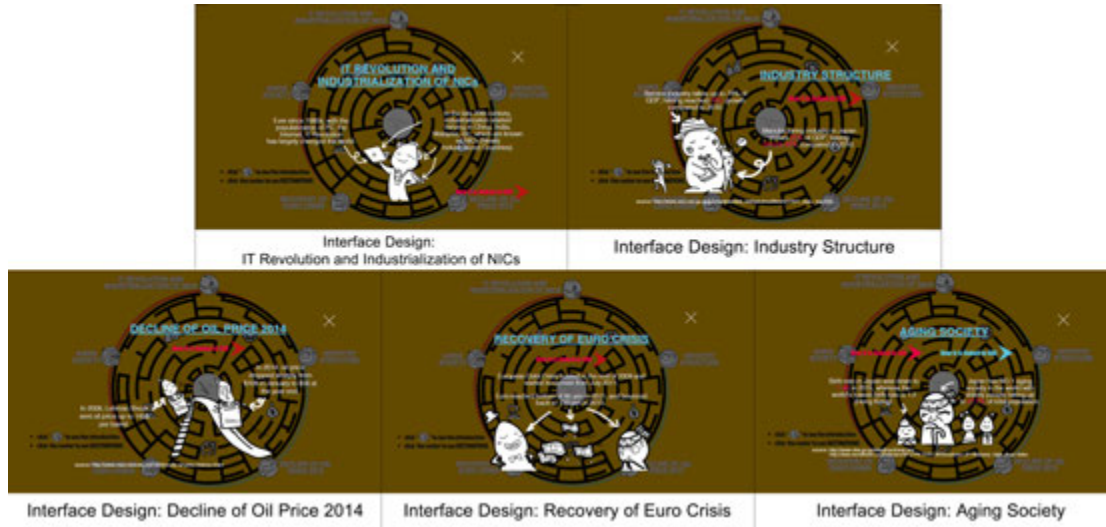


Figure 4.41: Interaction Design: Interface of Level 1 Elements

For path explanation pages, each path is separated into smaller road between the elements. The purpose is to explain to readers the logic of the paths and introduce to them the corresponding economic knowledge. Therefore, the path explanation page enlarges and animates the road and its direction with light-text explanation. The following is an example.

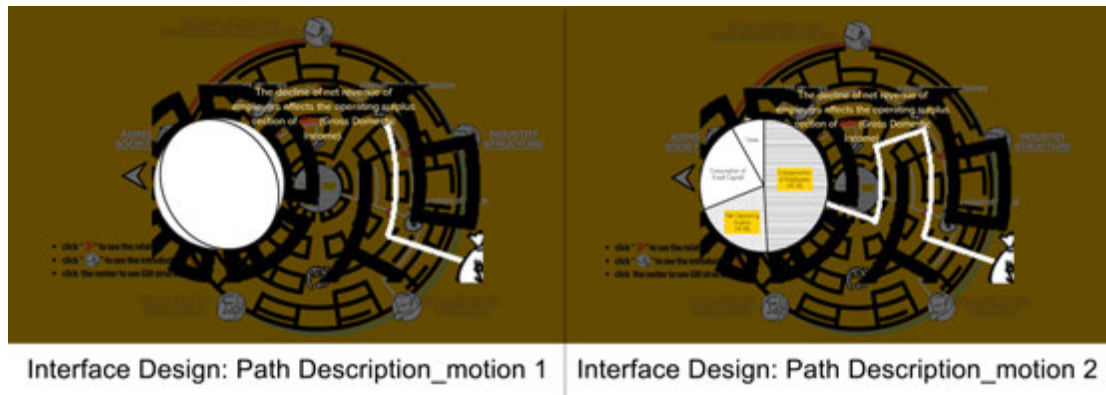


Figure 4.42: Interaction Design: Interface of Path Explanation Page (Example)

The guiding pages are for the purpose of smooth introduction of usage of the website. It cannot be blunt manual of the project but a user-friendly guidance. The first guiding page is the welcome light box with information about the survey

quiz. It is to let users do a small self-test of their knowledge of Japan's economic performance, arouse their awareness of their lack of knowledge in this field and trigger their interest to learn. As it is present directly after the Introduction page, the purpose of the website and its content is explained and the choices of doing the quiz or not is presented.

The quiz page is a separate one-page website different from quiz light box. It contains all 8 quiz questions and has a link to go back. The reasons to create a separate page is that first of all, the quiz page is a non-obligated page only applicable for readers entering the first time, which is a special process apart from the others. Secondly, a separate link can do good to analysis of the content. Thirdly, this reading process is much easier for return visitors who don't need to do the quiz for the second time. The interface is as below.



Figure 4.43: Interaction Design: Interface of Guiding Page and Quiz Page

Chapter 5

Evaluation

In the Chapter of Evaluation, detailed analysis of user tests is to be presented and discussed. It is to be taken as the result of functionality and user experience of Economic Maze, which is to be presented from three aspects of content evaluation, visual evaluation and interaction evaluation.

In the user test and evaluation, in total 10 participants from the target persona spent an average one and a half hours in exploring the website and doing the interview. It is noticed that limitation of the evaluation includes the number and variety of participants; time limit for on-site user test and longer time feedback of recall of the learning material. Taken this into consideration, the result of user test is discussed as follows.

5.1. Methodology

Evaluation is the process that assesses how things should go, how things are going, and how they can be improved. [34] In learning design, evaluation is the assessment of how learners are supposed to do and how they did.

As a learning material, Economic Maze serves the purpose of introducing economic situation of Japan to new foreign residents. The expected output covers three aspects: content, visualization and interaction.

Content evaluation detects the understandability of the content and its structure, the difficulty to understand, how the readers find it useful and appealing. Visual evaluation aims at analyzing how helpful the visualization is to convey and

delivery the content. It includes the visual organization of the content, its understandability and attractiveness. Interaction evaluation judges the smoothness and functionality of user interface and other interactive elements.

Evaluation is carried out in form of survey and interview, and it goes along with simultaneous inspection of on-site user test.

5.2. Evaluation

5.2.1 Overall Evaluation Result

With in total ten participants joining the user test, all of them mentioned that Economic Maze solved some of their concerns of decision-making of long-term stay in Japan. All ten participants find it interesting and helpful with eight participants mentioned that they were willing to pay a visit to the website again. Based on the interview before visiting Economic Maze of the interviewee's concern and their feedback afterwards, it is shown that averagely 70 percent of their economic-oriented concerns were solved after visiting Economic Maze. Moreover, some information of Economic Maze even helped them aware more of what they had not considered.

Generally speaking, it can be concluded that Economic Maze has managed to work as economic guidance to foreigners in Japan to provide them necessary information of economic aspects of Japan.

The implementation of maze and the generation of related economic knowledge also received positive feedback of the participants, which are reported in the following sections.

5.2.2 Evaluation of Content

Content is the core of the learning design. In Economic Maze, Japan's present economic status is introduced in three steps: general economic performance, economic phenomena and economic policies. General economic performance talks about Japan's GDP, GDI and GDE. Economic phenomena include the most important economic factors of Japan in a consequential order that leads to general

economic performance, as well as deflation of Japan's economy. Economic policies introduce Abenomics and its "three arrow" policy direction.

For content design, the evaluation standard is arranged in the following degrees:

- Level 1: going through group 1 and group 2 elements of all three steps of learning spontaneously and being able to understand them;
- Level 2: going through group 1, group 2 and group 3 elements of all three steps spontaneously, including maze exploration and quiz fulfillment, and being able to understand them;
- Level 3: going through all content of the website, being able to understand them, and find it interesting and easy to understand;
- Level 4: going through all content of the website, being able to understand them, and re-accessing the website in the future.

From the user test and interview, 7 participants have reached level 3 while 3 reached level 2. It needs to be notified that evaluation of level 4 requires longer time. From inspection of users' interaction with Economic Maze, 3 participants checked outside links of original sources and used 5 times of Google search of related information of their own country, suggesting the growing interest and inspiring possibility of the content. The following is some common feedback from the participants:

- Other than heavy-text based articles, the light content was easy to read and understand;
- Participants mentioned that they had learned interesting fact different from what they had thought before;
- It was easy for them to learn economy by "element-relation-overall view";
- The structure was clear and covered most difficulty in the content;
- There were not many academic terms, thus it was easy to understand the content;

- As young people, it is not easy to make a long-term decision of settlement, especially for those without official job yet. Thus, a short-term plan of 3-5 years is more rational for them.

5.2.3 Evaluation of Visualization

Visual design is very essential to Economic Maze. To conquer the academic barrier of economy and knowledge gap of the learners, visualization plays an essential role. Its design to introduce economy of a nation is also innovative to its field. Thus, evaluation also covers this aspect. Evaluation of visualization is mainly carried out in the form of interview.

There are several standards or goals in evaluation the performance of visualization:

- Level 1: being able to understand most of the visual content, including three maze design, illustration design, and icon design;
- Level 2: being able to understand all visual content and find it helpful with understanding of the content and its structure;
- Level 3: being able to understand all visual content, find it helpful and appealing, and reflecting them afterwards.

In the result, 8 participants have rated their experience of visual in Level 2, while 2 rated level 3. In the user test inspection, all participants followed the order of three steps and were able to navigate smoothly. The followings are insights in evaluation of visual design:

- The illustration of economic elements helped them with understanding of the content;
- Design of maze was innovative for them in learning economy, and it created another method of thinking;
- Icon visualization made the learning experience interesting and dynamic;
- Target design of "three arrow" helped them in understanding of Abenomics and see the reason of why these economic policies were carried out;

- Visual image was very helpful for them in understanding of the structure;
- In user test, due to different light adjustment of computer screens, font effect sometimes made the words difficult to differentiate.

5.2.4 Evaluation of Interaction

Interaction design of Economic Maze includes flowchart design, interface design, and related animation effect. It is the front design of the whole project which directly interacts with the learners in purpose of providing clear and multiple access and guidance to reader of the content.

During the user test, all participants successfully reach all website pages and out-source links. Two participants failed to notice buttons in Level 1 element presentation pages at the first time, while 1 participant failed to go back to Welcome Page to review the quiz.

To evaluate the interaction design, the following is the standard:

- Level 1: being able to understand most of the interface and related function of each page;
- Level 2: being able to understand all interface and understand clearly how to interact with it;
- Level 3: finding the interface helpful in learning, and relatively easy to navigate to expected content;
- Level 4: finding the interface and other interaction design attractive, and enjoying interacting with it more than once;
- Level 5: being able to recall the interface and related content.

Based on the above standard, 1 participant rated Level 5 for his user experience, while 7 participants rated Level 4 and 2 others Level 3. The following is their feedback of interaction design:

- The color combination of the website interface got highly appreciated;
- Interface was simple, fresh and attractive;

- Background color of light box of Level 2 elements decreased the contrast of back page and light box, which made it difficult to read the text;
- The animation of elements was helpful in understanding of the content;
- It would be better if there were instruction of where to start in checking different blocks of economic paths, since the direction was not always towards the center.

Chapter 6

Conclusion

6.1. Discussion

As a guidance for foreign residents in Japan, Economic Maze comes up to introduce Japan's current economic situation in three steps: overall economic performance, economic phenomena and economic policy. It aims at assisting foreigners in their economic activities in Japan, mainly in decision of whether to reside in Japan in a long term. This learning design is made up with content design, visual design and interaction design. To assess the effectiveness, efficiency, attractiveness and accessibility, user test is carried out to evaluate content, visualization and interaction.

The result of evaluation optimistic in user's understanding of the content, interest in the visual and smooth digestion of the knowledge. It also has a positive feedback of future recall of the content and design. Future insights include more detailed information of economic factors of Japan from micro-economic aspect, more utilization of illustration, adaptability of the color combination of the visual and practical mobile-friendly interface.

Owing to the limitation to macro-economy of the content, detailed practical economic facts of Japan is not covered. It would be useful for some foreign residents to Japan from another aspect to help their economic activity. However, it is believed that this might be another different angle to the same issue, which covers the short-term aspect. The color adjustment of visibility, namely delimitation of font effect of the interface, has received different voices from users. It is believed

that in the confrontation of aesthetic point of view and versatile point of view, to largely satisfy the demand of users is more important in order to reach wide audiences. In terms of interaction design, mobile-friendly version development is essential for better user experience.

6.2. Future Work

Generally speaking, development of Economic Maze has so far completed. From the insight of users, future development can be summarized from aspects of deepening and broadening.

To deepen the work of Economic Maze, the content focuses on introduction of Japan's economic status. The following shows possible digging-in of the content:

- Develop more economic paths to GDP/GDI/GDE by adding more economic phenomena of Japan;
- Build more details in economic policy introduction on the base of "three arrows" of Abenomics;
- Include micro-economic aspects in the content, for example, company performance, income tax, insurance standard and so on. It might need careful analysis, selection and logic evaluation of the content;
- Create more steps in introducing Japan's economic performance. So far only three steps are created from different aspects of economy. Knowledge in economic history, economic tradition and so on can be discussed in addition.

From the view of broadening the project, here are other insights:

- Translate Economic Maze to other languages to reach non-English-speaking foreigners in Japan, or edit the current website into Japanese to access to local users;
- Develop similar website of other aspects of Japan for foreign residents, such as politics, society, culture, language and so on. The same methodology of structure in content and style in maze design can be implemented for foreign residents to assist them in other aspects of life;

- Design and adjust Economic Maze for other countries' economic situation by using the same learning design pattern. Economic Maze for foreign residents in other countries might be able to assist foreign residents who face the same issue.

In all, it is believed that there is a huge potential in further development of Economic Maze by utilizing the same methodology of learning design, and the potential itself stands for the extension of learning design.

Acknowledgements

From ideation to evaluation, Economic Maze has received a lot of assistance from many professors and friends. Therefore, I would like to express my sincerely gratefulness to all those who have given a help hand to this work.

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Last but not the least, I have to appreciate my truly thanks to all participants in Economic Maze, from pre-survey to user test to final evaluation. Your participant has given me unexpected insight, to help me realize the neglect and potential of Economic Maze.

Economic Maze is not a perfect project. However, it is definitely one of the most devoting projects from my point of view. With the development of it, I inserted what I have learned from Media Design. I truly believe that when I look back from the future, it can be one of the most important milestones on my way to pursue the road of design.

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Appendix

A. Economic Quiz

A.1 Questions

- i. Japan's economy ranks () in the world. [40]
2nd 3rd 4th
- ii. Japan's GDP per capita is within () range in the world. [40]
TOP 10
11th-20th
21th-30th
More than 31th
- iii. Japan has the () largest aging population ratio (26.3 percentage) in the world. [38]
1st
2nd
3rd
- iv. Which event caused the biggest decrease of economic growth in Japan? [36]
1973 Oil Crisis
1985 Plaza Accord
1990 Asset Price Bubble
2008 Lehman Shock
- v. In 2016, the number of foreign workers in Japan surpassed 1 million. No.1 is China, No.2 is (). [31]
Brazil
Vietnam

Philippines

Peru

vi. Which of the following belong to the original "three arrows" of Abenomics?

(choose three) [21]

Dramatic Monetary Easing

Tightening Monetary Policy

Flexible Fiscal Policy

Prudent Fiscal Policy

Structural Reform

Social Security

vi. Market change influences the operation of Japan's industries. Which of the following is incorrect? [30]

Decrease of oil price - loss of companies that invest in oil field

Decrease of copper price - decrease of benefit in nonferrous metals industry

Increase of gasoline price - increase of cost in electronic companies

Decrease of yen currency - decrease of benefit in automobile companies

Additional Questions

Your Email Address: ().

Your Age, Position, and Length of Staying in Japan: ().

A.2 Answers

i. 3rd

ii. 21th-30th

iii. 1st

iv. 2008 Lehman Shock

v. Vietnam

vi. Dramatic Monetary Easing; Flexible fiscal policy, Structural Reform

vii. Decrease of yen currency - decrease of benefit in automobile companies