Sustainability of gas stations: consideration of operational profitability and demand

Michimasa OHYAMA [a], Haruo ISHIDA [b], Naohisa OKAMOTO [c]

[a,b,c] *Graduate School of Systems and Information Engineering, University of Tsukuba, 1-1-1, Tennodai, Tsukuba, Ibaraki, 305-8573 Japan*
[a] *Graduate, E-mail: s1620459@sk.tsukuba.ac.jp*
[b] *Professor, E-mail: ishida@sk.tsukuba.ac.jp*
[c] *Professor, E-mail: okamoto@sk.tsukuba.ac.jp*

Abstract: In recent years, gas stations have been decreasing remarkably in Japan and there is a possibility that they will further decline. The rate tends to decrease not only in depopulated areas but also in urban areas. This research discussed the sustainability of the gas station based on the analysis of demand and profitability. On the demand side, analyzing the difference of the private vehicle ownership and usage in each region; considering the locations of the gas stations. On the operational side, the analysis of the profitability is conducted. Setting assumption for income and expenses, the business conditions of each gas station could be measured based on the demand analysis. Thus, there is a possibility described in this research which is the decrease of gas stations in the urban areas, and resident management is related to sustainability of gas stations in the depopulated areas.

Keywords: Gas Station, Operation, Private Vehicle, Fuel Consumption, Sustainability

1. INTRODUCTION

In recent years, the number of gas stations have been tending to decrease in Japan after reaching the peak numbers in 1995. According to the Agency for Natural Resources and Energy, of the Ministry of Economy, Trade and Industry (2015), the number of gas stations has been decreased from 60,421 in March, 1995 to 33,510 in March, 2015 across the country. This means about 27,000 gas stations have decreased within 20 years which is 44.5% has been decreased. Looking at the rate of decrease in number of gas stations in each prefecture in Japan from March 1995 to March 2015 (Figure1), the highest is Tokyo 59.2%; and lowest is Okinawa 22.1%. The depopulated areas have decreasing number of gas stations because of less demand. However, urban areas also show high percentage of decreasing numbers such as Tokyo, Osaka, Kanagawa, Aichi. In the future, there is the possibility that the number of gas stations will be declined.

As above, with background of gas stations, this research attempts to describe the decreasing number of gas stations, and to consider the sustainability of gas stations. In addition, it aims to assist each entity to consider measures to ensure stable fuel supply. In this research, considering the difference of private vehicle ownership and usage depends on regions; an analysis of the demand for gas stations is conducted. In addition, to analyze the profitability of gas station, to understand the management of each gas station is needed. Considering analysis of the demand and profitability; identifying the management status of each gas station and discussing the sustainability of the gas stations.
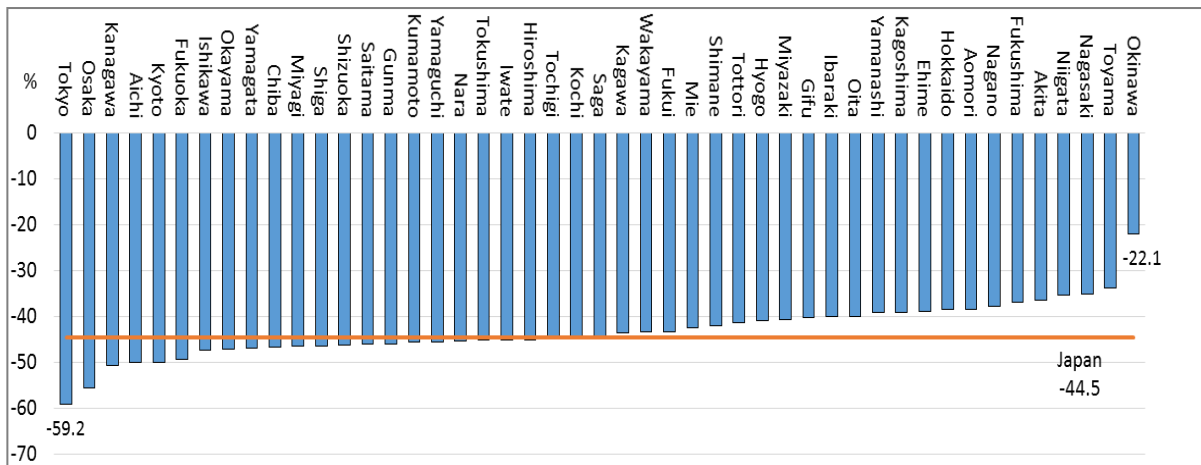
Figure1. Rate of decrease in number of stations in each prefecture from March 1995 to March 2015

2. REVIEW OF PRECEDING STUDIES

Value Management Institute, Inc. (2011) conducted research on the withdrawal factor of gas stations. Questionnaires have been conducted with the 682 managers from different gas stations. The main reason of discontinued business was the "deterioration of profitability". The factors such as demand reduction; site environment changes and deterioration of management have affected the business. Thus, the management of gas stations has influence on withdrawal. However, considerations focused on both demand of spatial situation by gas stations location and profitability, are not mentioned in this research. Sanuki (2012), Sanuki (2012), and Sanuki (2013) analyzed the influence of facility withdrawal of gas stations, based on the accessibility of residents to the gas stations. However, the accessibility was evaluated by the population, not by the number of vehicles. It should be evaluated by the car users. Moreover, it was not considered from the view of the supply including profitability, only from the view of the demand. Bonkohara (2014) showed the appropriate quantity of gas stations by municipality, applying mathematical model on relationship between the population and the area. In this research, gas station was regarded as a public facility, however gas station is basically operated by private business.

Most studies discussed only on the side of the demand: the population of the gas station users. It is necessary to process the study by considering gas station users and identifying the demand of gas stations in terms of spatial coverage by using the number of vehicles, not the population. In terms of sustainability of gas station, it is also necessary to consider the profitability and sufficient management of each gas station. However, there are only a few researches that discussed the profitability aspect.

From a managerial point of view, few studies have discussed about sustainability of gas station, Tanimoto (2015) developed the method to use break-even analysis and showed the effectiveness of the method to make the effective measures for avoiding the withdrawal of the gas stations. However, the income of gas stations is only considered by selling gasoline and kerosene and the other service (car wash or oil change, etc.) provided by the gas station is not considered.

This research is to approach both the profitability and demand side and to discusses the sustainability of the gas station. On the demand side, analyzing the difference of the private

vehicle ownership and usage in each region; considering the gas station users depending on the location of gas station and spatially analyzing the demand for gas station. On the operational side, an analysis is conducted to understand the business condition of each gas station. According to the analysis of demand and operational side, the sustainability of the gas station is discussed.

3. DEMAND ANALYSIS OF GAS STATIONS

The demand of gas stations has been explained in this research. According to the demand analysis, the difference between distribution of gas stations and distribution of private passenger vehicles in each region have been considered. Estimating the usage of the gas stations in urban areas and depopulated areas, an analysis of the demand from each gas station is conducted.

3.1 The definition of gas station demand

This research mainly targets the private passenger vehicles. The demand of gas station can be analyzed by the number of private passenger vehicles. In addition, to consider demand for gasoline, the amount of gasoline fueling per private passenger vehicle should be calculated.

At the time of analyzing for each case, the number of private passenger vehicles need to be allocated to each gas station and annual amount of refueling gasoline per private passenger vehicle are regarded as the demand of gas station (Table1).

Table 1. Demand of gas station

Category	Notation	Unit
Number of private passenger vehicle to gas station	d_i	unit/station
Annual amount of gasoline to gas station	$d_i g_j$	L/station · year

3.2 Spatial analysis of private passenger vehicles

In Japan, private vehicle ownership and usage could vary in different region. Therefore, the data is used in this research which refers to the number of private vehicles in each municipality to estimate these numbers in the data of 500m grid (including number of private passenger vehicles and private light motor vehicles). The demand of potential gas station is based on the number of private passenger vehicles.

A procedure in estimating the number of private passenger vehicles in the 500m grid is to calculate the number of private passenger vehicles per household for each municipality. This can be calculated by using the number of private passenger vehicles divided by the total number of households in each municipality as a basic unit.

Using the calculated basic units and the data of 500m grid per household private vehicle in each municipality; the number of private passenger cars in the 500m grid unit are estimated. To estimate the number of private passenger vehicles in the 500m grid unit is multiplying the basic unit (the number of private passenger vehicles per household of each municipality where the center of grid that is located) and the number of households. Therefore, this can be analyzed the private vehicle ownership and usages in each region.

3.3 Estimation of the amount of gasoline refueling

In this research, formulate a hypothesis which is considering gasoline consumption as an amount of refueling. Therefore, the annual fuel consumption per private passenger vehicle can be seen as the annual amount of refueling per private passenger vehicle. It can estimate amount of refueling by conducting the data of fuel consumption and number of private passenger vehicles. The procedure to estimate the amount of gasoline consumption of per private passenger vehicle is the annual gasoline consumption divided by the number of private passenger vehicles in each prefecture of classification "passenger cars and light vehicles of private passenger automobile," the Ministry of Land, Infrastructure and Transport "automobile fuel consumption survey,". (Figure2). When capturing the calculated value as the annual amount of gasoline refueling per private passenger vehicle, albeit in units of prefectures, it can be confirmed that there is a difference in usage of private passenger vehicles by regions. It should be noted that the data of the fuel consumption is based on the national monthly survey "annual fuel consumption survey" that has been conducted by the Ministry of Land, Infrastructure and Transport. This survey has been carried out from 1960. The survey and aggregation methods were changed in 2010 and have been conducted continuously.
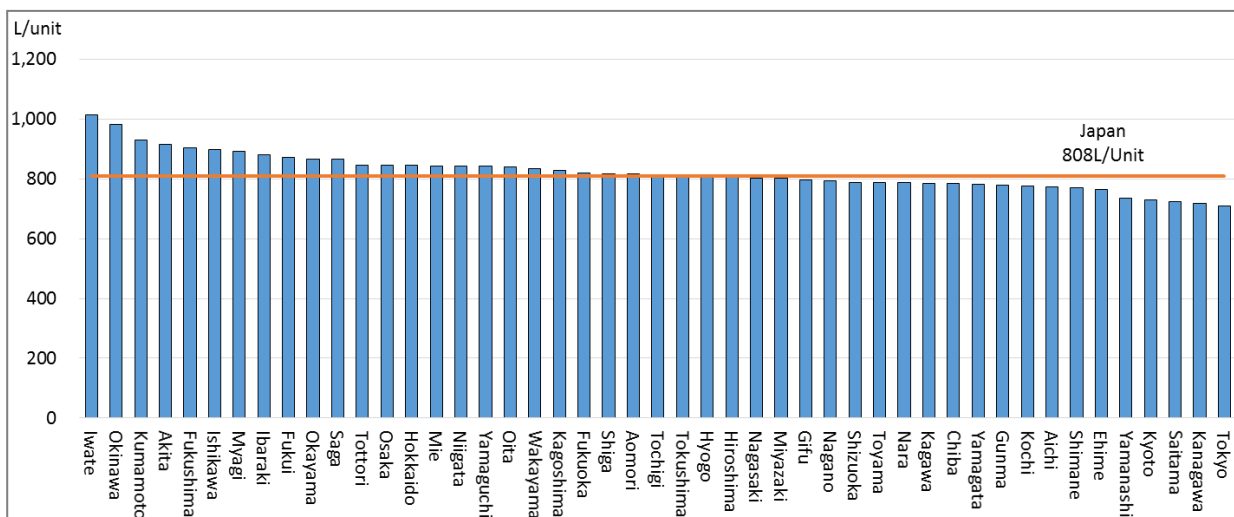

Figure2. The amount of gasoline consumption in each prefecture in 2015

3.4 Demand analysis

The demand for each gas station is analyzed by considering the difference between distribution of private passenger vehicles and distribution of gas stations in each region. The data of location is conducted from the "Fuel Fill Station (point) data", which is collected by the National Land Information Division, National Spatial Planning and Regional Policy Bureau, the Ministry of Land, Infrastructure, Transport and Tourism of Japan.

The study considers the distribution of gas stations and distribution of private passenger vehicles. For instance, Hachioji is selected because of its highest rate of gas station decline in Tokyo. This region is the area where the private vehicles are mostly distributed and gas stations are concentrated (Figure3).

On the other hand, in depopulated areas, for instance Shimanto city in Kochi Prefecture, is the area where the gas stations and the number of private vehicles is not densely

located (Figure4). There is less gas station in this region, and the private passenger vehicle users are distributed sparsely. Therefore, regional differences in urban areas and depopulated areas are confirmed.

Based on the distribution of gas stations and private passenger vehicles, the following two cases are assumed in use of gas station. The one case is to use specific gas station from the numbers of gas stations; the other case is to use nearest gas station. In these two cases, the demand could be analyzed based on the number of private passenger vehicles and its usage of each gas station.
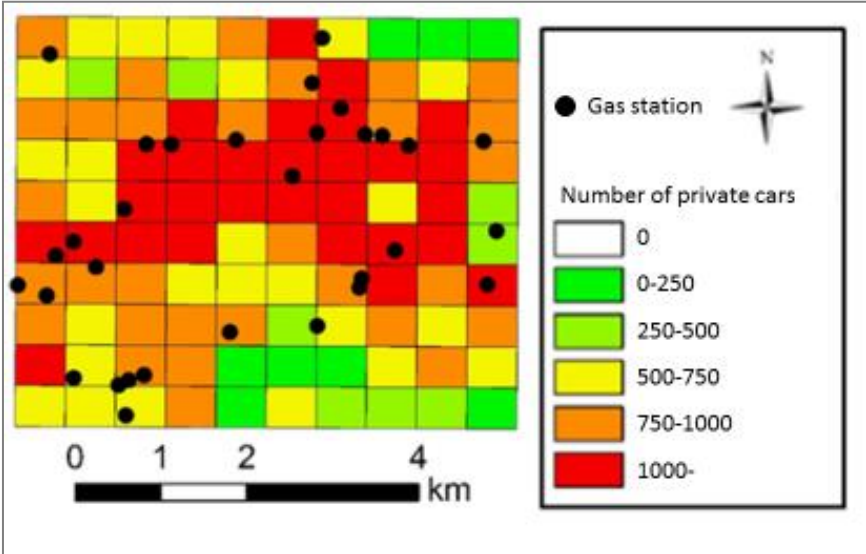

Figure3. Distribution of gas stations and the number of private cars in Hachioji City
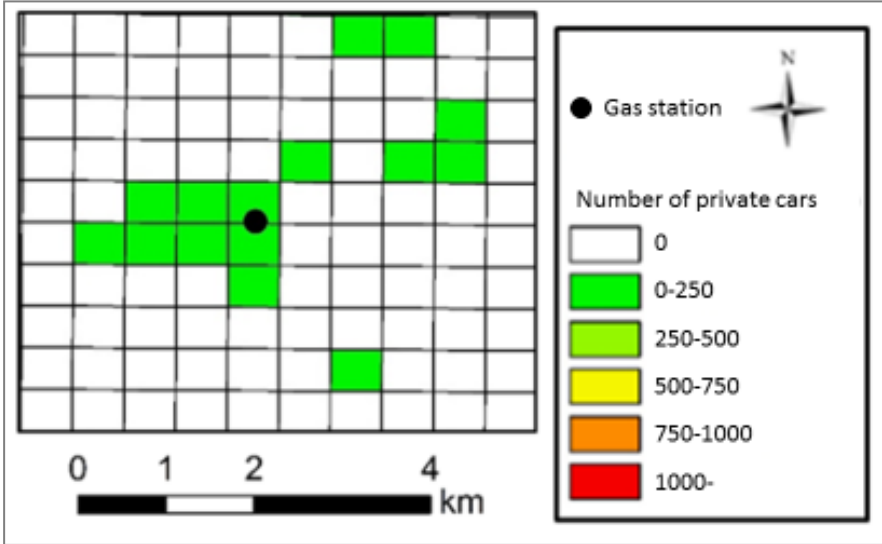

Figure4. Distribution of gas stations and the number of private cars in Shimanto City

3.4.1 Case of using the specific gas station instead of using other gas stations

Some gas stations are located nearby, however, the specific gas station is used mostly by the private car users in the region. In this case, the total number of private vehicles in the areas are allocated to each gas station. This case is assumed in suburban areas.

For further explanation, select the region approximately 5km × 5km range which has divided by 10 × 10 grids vertically and horizontally based on 500m grid. For example, Tokyo has the highest rate of decrease in number of gas stations. The city within the Tokyo metropolitan which is Hachioji City has been analyzed. The city has a relatively high number of private passenger vehicles in the suburbs. The private vehicles are mostly distributed, and the gas stations is concentrated in the region (Figure4). The number of gas stations in this region is 31, $\Sigma d_i = 87{,}397.$ $g_j = 709.7,$ and $\Sigma d_i g_j = 62{,}026$ (Table2). If the demand in the region is evenly distributed to each gas station, $d_i = 2{,}819$ and $d_i g_j = 2{,}001.$

Table 2. Result of demand analysis in Hachioji city

Notation	Value
Σi	31 stations
Σd_i	87,397 units
g_j	707.9 L/unit · year
$\Sigma d_i g_j$	62,026 kL

3.4.2 Case of using the nearest gas station

Some gas stations are not located nearby, in this case. Users tend to find a relatively close gas station. This happens in depopulated region. The users are assumed to use the closest gas station in the straight-line distance, conducting the analysis to create a Voronoi diagram based on the distribution of gas stations. The number of private passenger vehicles in the Voronoi region is considered as the demand for each gas station.

For example, Shimanto city in Kochi Prefecture is selected as the region where gas stations are located sparsely in depopulated areas. This case study targets the gas station which is called "Omiya Sangyo, Inc." operated by residents. The target region in Voronoi is shown in Figure 6 highlighted in red. In this area, $d_i = 613$ $g_j = 776.0,$ and $d_i g_j = 476$ (Table3).
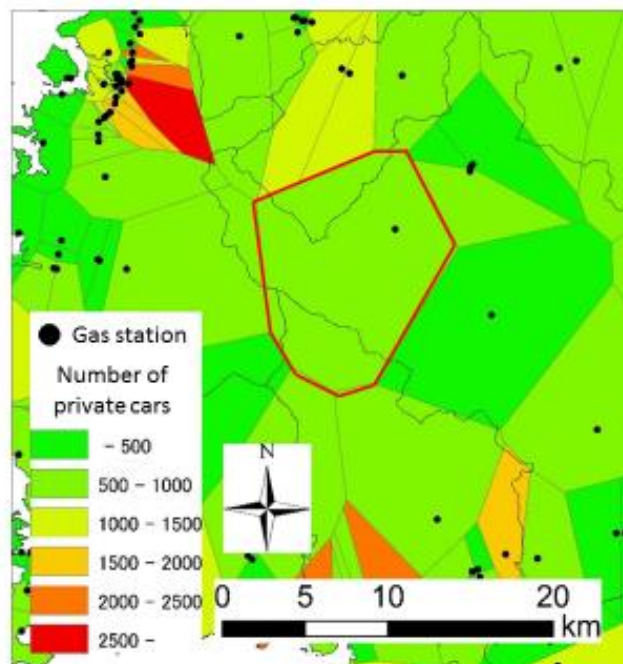

Figure6. Voronoi region in Shimanto City

Table 3. Result of demand analysis in Shimanto city

Notation	Value
Σi	1 station
Σd_i	613 units
g_j	776.0 L/unit · year
$\Sigma d_i g_j$	476 kL

4. ANALYSIS OF PROFITABILITY

Business balance analysis is generally conducted by business entity as a unit. Therefore, even in the case to analyze the operational management of the gas station, the business balance of entire business entity which operates the gas station also should be analyzed. However, since there is the case in which the business entity expands the other business and operates number of gas stations, it is very complicated to analyze the business balance of the entire business entity. Therefore, in this research, focusing on the profitability of each gas station, the business balance of each gas station has been analyzed.

As the analysis method of business balance, the prerequisites for income and expenditure items of the case in which business entity operates the gas station are given. Items of income are assumed to increase by the demand for gas stations. In addition, items of expenditure are assumed that they do not depend on the scale and operational form of the gas station. Further, analysis of gas station business balance is conducted.

4.1 Outline of business balance analysis

Profits in financial statements which are gross profit, operating income, ordinary income, pretax income, and net income. In this research, focusing on the profitability of each gas station, analyzing the business balance of each gas station based on operating income, which represents the profit obtained only by core business activities of business entity.

Generally, operating income can be calculated from gross profit and selling minus general and administrative expenses. In this research, considering gross profit is the sum of net sales and cost of sales in order not to take gasoline price fluctuation into consideration, the profitability of each gas station is analyzed based on total gross profit and business administration expenses in a single year.

It is assumed that the total gross profit is the sum of the gross profit from fuel oil sales and the gross profit obtained from other service and sales except fuel oil sales. Also, it is assumed that the business administration expense is the sum of labor costs, advertisement promotion and promotional expenses, rent on real estate and depreciation expenses.

4.2 Organize prerequisites

In the business balance analysis, the uniform assumption for each item of incomes and expenditure is made over the country because of the data acquisition. Each item is set up based on "Report on oil distribution business management status survey" conducted by National Petroleum Association, which surveyed on purchase and sales situation, financial situation etc. to petroleum product dealers and compiled the data on the business situation of gas stations, and "Monthly Gasoline Stand" journal published by Monthly Gasoline Stand Corporation, Inc., which posts trends and information in the petroleum marketing industry.

4.2.1 Setting of the total gross profit

Total gross profit is assumed to be the sum of the gross profit from fuel oil sales and the gross profit obtained from other service and sales except fuel oil sales. It is assumed that the gross profit from fuel oil sales is obtained from gasoline (high-octane and regular) which is the main fuel of private passenger vehicles in Japan. The product of the fuel oil gross margin, the amount of gasoline refueling and gasoline sales ratio is calculated. The sum of high-octane and regular gasoline equals to the gross profit from fuel oil sales (Table4). It should be noted about gasoline sales ratio which is difficult to identify the private passenger vehicle users' choice of the high-octane or regular gasoline. Therefore, it is set by the composition ratio of monthly fuel sales volume in gas stations, referring to "Report on oil distribution business management status survey".

Table 4. Assumption of gross profit of gasoline

Item	Amount
High octane gasoline	¥ 10.0 · $d_i\, g_j$ · 0.113/year
Regular gasoline	¥ 9.7 · $d_i\, g_j$ · 0.887/year

Based on National Petroleum Association (2015)

In addition, it is assumed that the gross profit obtained from other service and sales except fuel oil sales such as the car wash, oil change, tires change, and automobile inspection. Each of the product of the gross profit margin, 5% of the demand for each gas station and the frequency of usage of gas station is calculated. The sum of them is the gross profit obtained from other service except fuel oil sales (Table5).

Table 5. Assumption of gross profit of other service

Item	Amount
Car wash	¥ 800 · d_i · 0.05 · 12/year
Oil change	¥ 1,500 · d_i · 0.05 · 2/year
Tires change	¥ 10,000 · d_i · 0.05 · 0.25/year
Automobile inspection	¥ 38,000 · d_i · 0.05 · 0.5/year

Based on Monthly Gasoline Stand Corporation, Inc. (2014)

4.2.2 Setting of business administration expenses

It is assumed that the business administration expense consists of labor cost and business administration costs except labor cost. The product of the average monthly labor cost per employee (¥285,700) and the average number of employees per gas station (classified by monthly fuel sales volume) is calculated as the labor cost of each gas station (Table6).

Table 6. Assumption of labor cost

Sales scale of gasoline	Average number of employees per one gas station	Amount
～49kL/month	4.5	¥15,430,000/year
50～99kL/month	5.5	¥18,860,000/year
100kL～/month	6.2	¥21,260,000/year

Based on National Petroleum Association (2015)

In addition, advertisement promotion and promotional expenses, rent on real estate and depreciation expenses is assumed to be constant regardless of the scale, because of the data acquisition (Table7).

Table 7. Assumption of operating cost

Item	Amount
Advertising and promotional expenses	¥1,389,000/year
Rent on real estate	¥2,593,000/year
Depreciation	¥4,204,000/year

Based on National Petroleum Association (2015)

4.2.3 The applicability of the analytical method

For example, if the demand is allocated to each gas station in a range, it is possible to consider how many gas stations could sustain in stable operations management. In addition, some measures towards the stable operations management of the gas station could be considered such as price changes in fuel oil and other services; the introduction of subsidies by the government and local governments; assistance from the residents, etc. It is estimated the effectiveness of each measure would help each entity in considering the measures to be taken.

In the next chapter, with the demand that is analyzed in Chapter3, the case study in each region is conducted.

5. RESERCH ON SUSTAINABILITY

The profitability in terms of the demand for gas station is analyzed by discussing with respect to the sustainability of the gas station. In this study, Hachioji City (Table2) and Shimanto City (Table3), where the demand analysis is conducted.

5.1 Case of using the specific gas station

In the case of Hachioji City, if the demand equally has been allocated to each gas station, the demand for each gas station is 2,819 units, and the business balance of each gas station is a deficit of ¥5,160,000 from the analysis. It is severe consideration how gas station is managed and it causes the deficit is also determined. For this reason, there are large number of gas stations in a region instead of meeting demand towards the stable operational management.

In addition, if the demand is concentrated on one gas station such as the profit is zero in the business balance, the demand is 3,418 units. The rest of the demand is evenly distributed to the other gas stations, each of gas station demand is 2,799 units.

By comparison of the two cases in demand allocation, if about 600 units demand for gas station are concentrated and increased, profit in the business balance becomes a surplus and stable. Therefore, if the demand of gas station is concentrated on specific gas stations and the demand per one gas station is reduced, profit becomes deficit and the operational management is determined to become more severe. Thus, profitability has deteriorated by competition with other gas stations and the manager considers withdrawal. This can be described that the number of gas stations has reduced in urban areas in recent years from the business balance analysis.

With respect to sustainability, if the demand equally has been allocated to each gas

station in the region, the business balance of each gas station is a deficit. How much gas station users increase the additional costs for profitable is analyzed. The demand for each gas station in the even allocation is 2,819 units, and business balance is a deficit of ¥5,160,000. Therefore, if each gas station user increase the burden of ¥1,830 per in a year, the business balance becomes profitable. If this burden is covered by the fuel oil sales, it is possible to take profit if gross profit margin is ensured such as ¥2.6/L. However, pricing of fuel oil to ensure the additional gross profit could not be set for severe price competition between the gas stations in urban areas. It is considered that the gas stations withdrawal can be described.

5.2 Case of using the nearest gas station

In the case of Shimanto City, based on business balance of analysis, total gross profit is ¥5,680,000 (the gross profit from fuel oil sales is ¥4,630,000, and the gross profit from other service and sales except fuel oil sales ¥1,050,000), the business administration expenses are ¥23,610,000 (labor costs are ¥1,542,000, and business administration costs except labor cost are ¥8,190,000). When the prerequisites for each item as what it is, it becomes a deficit of about ¥17,930,000 in operating income (Table8). The demand such as the profit is zero in the business balance analysis is 2,550 units. However, 613 units of the demand that is analyzed are far below the profit line.

Table 8. Business balance in Omiya Sangyo, Inc.

Item	Actual value	Analysis value
Net sales	¥63,780,000	
Purchase price	¥56,120,000	
Total gross profit	¥7,260,000	¥5,680,000
Selling, general and administrative expenses	¥7,290,000	¥23,610,000
Operating income	-¥30,000	-¥17,930,000

Based on Shiraishi (2014)

Business balance from the analysis results in the deficit is determined to be severe. However, how much gas station users increase the additional costs for profitable is analyzed. The demand for the gas station is 613 units, and operating income is a deficit of ¥17,930,000. Therefore, if each gas station user increase the burden of ¥29,250 per in a year, the business balance becomes profitable.

If this burden is covered by the fuel oil sales, it is possible to take profit if gross profit margin is ensured such as ¥37.7/L. However, it is a challenge that increase of fuel oil price is acceptable for the users in this region. Also, it is difficult to cover with fuel sales alone.

Looking at the financial statements of "Omiya Sangyo, Inc." in the March 31 end of 2013, in fact the net sales are ¥63,780,000, purchase price is ¥56,120,000 and total gross profit is ¥7,260,000. Selling, general and administrative expenses including labor costs are ¥7,290,000, and operating income is a deficit of ¥30,000. It should be noted that the ratio of the net sales is shown in Table9. Fuel sales are 59.0%, sales of Omiya rice sales are 18.1%, food and household goods sales are 15.8%, and sales of agricultural material are 7.1%. In order to fulfill the needs of residents in this region, and to improve operations management, "Omiya Sangyo, Inc." including the residents has made efforts to sell other than fuel. Sales efforts and cost reduction by residents run are related in gas station survival.

Table 9. Ratio of net sales in Omiya Sangyo, Inc.

Item	Ratio
Sales of fuel used for vehicles	59.0%
Sales of foods and daily necessaries	15.8%
Sales of agricultural material	7.1%
Sales of Omiya rice	18.1%

Based on Shiraishi (2014)

Comparing the results of the analysis and the business balance in reality, although the gross profit from fuel oil sales is made to some extent estimates, there is a large discrepancy between the analysis results and reality. This is considered that the real business administration expenses are small or, the revenue from other service and sales is not set.

6. CONCLUSION

This research approach from both sides of demand and profitability, and discusses the sustainability of gas station. On the demand side, the difference between private vehicle ownership and usage in each region is taken into consideration. Making use of the data of number of the private passenger vehicles by the municipality in order to spatial analyze the distribution of the gas stations users in 500m grid unit. In addition, the gasoline consumption is regarded as that of gasoline refueling. Further, the distribution of the gas stations and the number of private passenger vehicles are analyzed for each demand. On the operation side, the analysis of the profitability is conducted. Setting up assumption for items of income and expenses, the business balance of each gas station could be measured based on the demand analysis.

In the case of using the specific gas station, assuming the urban areas, even if the demand equally has been allocated to each gas station, the operational management of each gas station is determined to be more severe. Further, profitability has deteriorated by competition with other gas stations. Thus, in the metropolitan area, it is considered that the gas stations withdrawal can be described.

In the case of using the nearest gas station, assuming in the depopulated areas, comparing the results of the analysis and the business balance in reality, the setting of the items of business and administrative expenses is insufficient because of the rough assumptions in the analysis. However, looking at each case, sales efforts and cost reduction by the residents run are related in the sustainability of gas station.

Although business administration expenses should be changed by the site area and facilities scale, in this research they are assumed to be constant for the data acquisition. Setting each item corresponding to the region and facility size, the analysis method of profitability is improved. The gas station in the depopulated areas has intended to serve as a livelihood of residents not to increase the revenue. In this research, there is some items of incomes and expenditure, which are not able to cover the business balance analysis.

The demand in this research is analyzed based on the number of private passenger vehicles. However, all the demand for gas stations are not considered. In the future, the demand for gas stations should be improved by considering the front traffic volume, etc.

REFERENCES

The Agency for Natural Resources and Energy, of the Ministry of Economy, Trade and Industry (2015) Changes in the number of volatile oil suppliers and the number of filling stations (registration -based), http://www.enecho.meti.go.jp/category/resources_and_fuel/distribution/hinnkakuhou/data/20150703_ss26fy.pdf.

Value Management Institute, Inc. (2011) Report of research and study about oil industry organization.

Sanuki, R., Suzuki, T., Yoshikawa, T. (2012) Availability analysis of facilities focusing on accessibility and capacity in an emergency: Case study on gas station in Aomori city. *Journal of the City Planning Institute of Japan,* 47(3), 859-864. (in Japanese)

Sanuki, R., Yoshikawa, T. (2012) Evaluation of accessibility to gas stations and effects of closedown: A case study in Iwate prefecture. *Journal of Architecture and Planning (Transactions of AIJ),* 77(673), 639-648. (in Japanese)

Sanuki, R., Suzuki, T., Yoshikawa, T. (2013) Analysis of changes in accessibility to gas stations due to their suspension and restoration: A case study in Iwate and Miyagi prefectures damaged by Great East Japan Earthquake. *Journal of Architecture and Planning (Transactions of AIJ),* 78(683), 149-157. (in Japanese)

Bonkohara, A., Kobayashi, T., Ohsawa, Y. (2014) Mathematical consideration of depopulated area of gas station. *Journal of the City Planning Institute of Japan,* 49(3), 603-608. (in Japanese)

Tanimoto, K., Tsuchiya, S. (2015) Assessment of sustainability of gas stations in depopulated areas. *Journal of Japan Society of Civil Engineers, Ser. D3 (Infrastructure Planning and Management)*, 71(5), I_261-I_268. (in Japanese)

Automobile Inspection & Registration Information Association (2015) Number of registered vehicles by the municipality in Japan.

Light Motor Vehicle Inspection Organization (2015) Number of registered light motor vehicles by the municipality in Japan.

Statistics Bureau Director-General for Policy Planning (Statistical Standards) and Statistical Research and Training Institute (2010) 2010 Population Census, http://e-stat.go.jp/SG2/eStatGIS/page/download.html.

Ministry of land, infrastructure, transport and tourism (2015) Annual Statistical Report on Motor Vehicle Transport, http://www.mlit.go.jp/k-toukei/search/pdf/22/22201400a00000.pdf.

National Land Information Division, National Spatial Planning and Regional Policy Bureau, the Ministry of Land, Infrastructure, Transport and Tourism of Japan (2010) National Land Numerical Information download service, Fuel Fill Station (point) data, http://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-P07.html.

Shiraishi, J., Arita, S., Ito, T. (2014) The study of the starting technique of the gas station management by a resident organization, *Bulletin of the Shimane Prefecture Mountainous Region Research Center*, 10(2), 97-114. (in Japanese)

National Petroleum Association (2015) Report on oil distribution business management status survey.

Monthly Gasoline Stand Corporation, Inc. (2014) Monthly Gasoline Stand, 56(7), 164-167. (in Japanese)