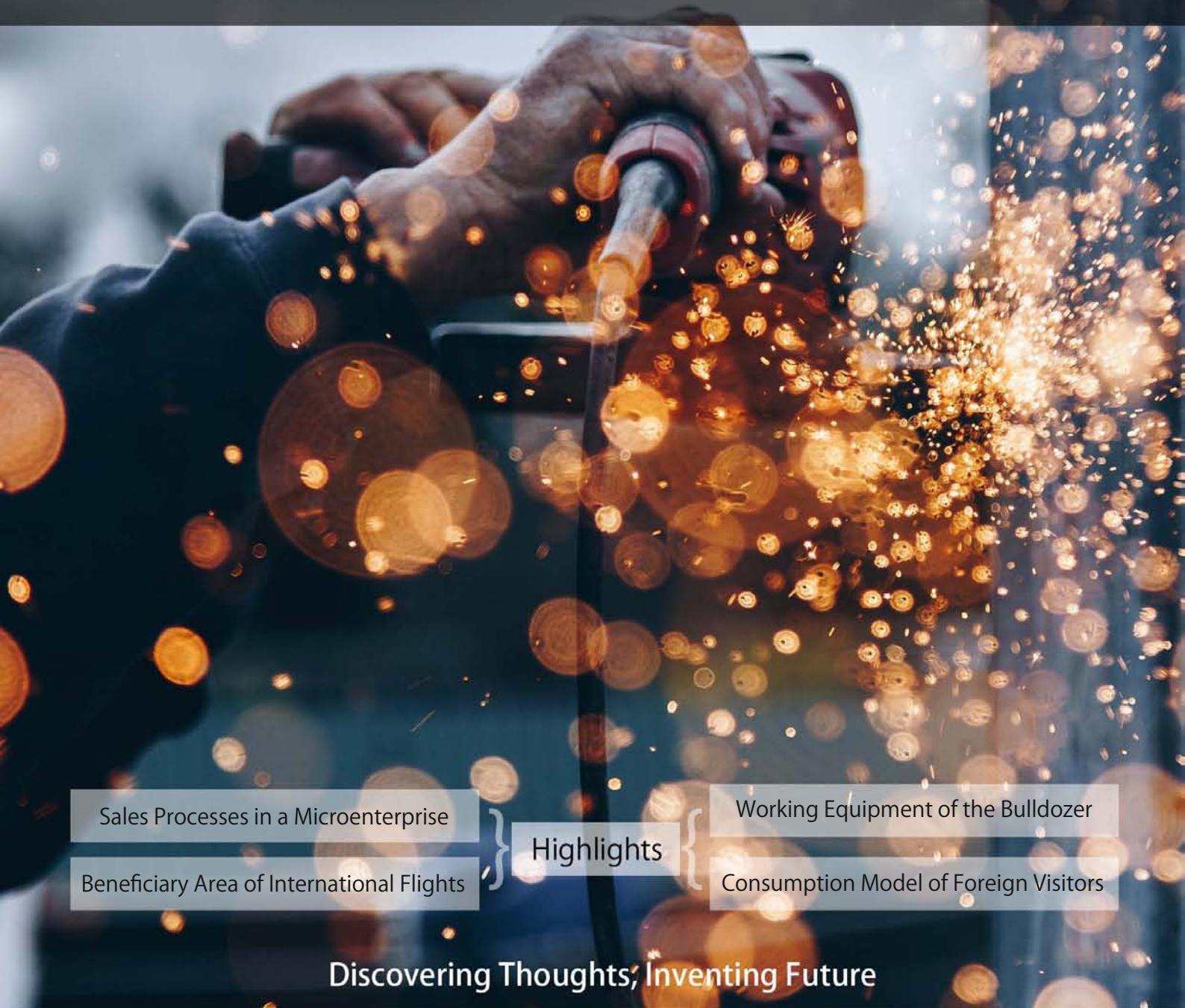


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Beneficiary Area of International Flights

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Working Equipment of the Bulldozer

Consumption Model of Foreign Visitors

Discovering Thoughts, Inventing Future



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A Consumption Model of Foreign Visitors in Japan: Identifying the Beneficiary Area of International Flights

By Takaaki Okuda

Abstract- This paper presents a model for the consumption patterns of foreign visitors in Japan. My study more specifically uses our model to analyze data about the passenger flow of Chinese tourists to Japan. I verified the accuracy of the model, using the total number of foreign visitors in each prefecture as listed in Japanese statistics about travel accommodations. The model identifies the beneficiary area of a Chinese budget airline that services an international airport, exploring this question through the impact of the airline's service on tourist consumption in three metropolitan regions. My study evidences that 1) tourists arriving at Narita Airport or Haneda Airport on Chinese budget airlines primarily consume in the Tokyo metropolitan region and 2) tourists arriving at Kansai Airport or Chubu Airport on Chinese budget airlines primarily consume in the Osaka metropolitan region, the central region, and the Tokyo metropolitan region.

Keywords: tourist consumption, passenger flow tables of foreign visitors, international flights.

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A Consumption Model of Foreign Visitors in Japan: Identifying the Beneficiary Area of International Flights

Takaaki Okuda

Abstract- This paper presents a model for the consumption patterns of foreign visitors in Japan. My study more specifically uses our model to analyze data about the passenger flow of Chinese tourists to Japan. I verified the accuracy of the model, using the total number of foreign visitors in each prefecture as listed in Japanese statistics about travel accommodations. The model identifies the beneficiary area of a Chinese budget airline that services an international airport, exploring this question through the impact of the airline's service on tourist consumption in three metropolitan regions. My study evidences that 1) tourists arriving at Narita Airport or Haneda Airport on Chinese budget airlines primarily consume in the Tokyo metropolitan region and 2) tourists arriving at Kansai Airport or Chubu Airport on Chinese budget airlines primarily consume in the Osaka metropolitan region, the central region, and the Tokyo metropolitan region.

Keywords: *tourist consumption, passenger flow tables of foreign visitors, international flights.*

I. INTRODUCTION

Japan aims to have 40 million foreign visitors by 2020 and 60 million by 2030 [14]. Today, a majority of foreign visitors to Japan primarily travel to the Tokyo metropolitan region and the Osaka metropolitan region. However, Japan is actively working to encourage foreign visitors to travel to other regions the government hopes that increasing tourism to non-metropolitan regions will revitalize these regions' economies. Because international low-cost air travel encourages consumers living in neighboring Asian countries to visit Japan, Japan might optimize tourist consumption by encouraging low-cost airlines to increase services to particular regions, in addition to marketing different regions to tourists and determining the efforts that domestic regions may have to undertake to effectively accept foreign visitors.

As I have already suggested, an increase in the number of foreign visitors to a region such as that surrounding an international airport can potentially revitalize that region's economy. It is, therefore, helpful to leave the decision of whether to service international air routes to each individual airport, as well as to actively involve the communities using the airport, in such

decisions. If the number of foreign visitors is increased by the attraction of international air routes, the effect can be felt clearly in areas close to the airport but not in areas away from the airport. To attract international airlines, a region must encourage foreign visitors to travel to it. Therefore, it is important to identify the beneficiary area of any potential international airline route and to jointly implement it while sharing its strategy.

Much scholarly work has gone into how an increase in the number of foreign visitors to a region impacts that region's economy [1], [15], [12]. Because countries with secondary traffic (e.g., high-speed railways and highways) enable foreign visitors to travel to multiple regions, it is important to understand the details of the consumer behavior of tourists during these trips to get a better sense of the impacts that different kinds of transportation may have on regional economies. As I discuss later, studies in traffic planning introduce a tourist flow model that analyzes the passenger flow of tourists from a macroscopic perspective. In addition, the Ministry of Land, Infrastructure, Transport and Tourism has published an OD table that reports the passenger flow of foreign visitors. These data can be used to develop a tourist consumption model for foreign visitors that makes visible the consumer behavior of tourists during round trips to Japan.

This study presents a tourist consumption model that uses the Ministry's foreign visitors' passenger flow table. It seeks to develop a method by which to identify the impact of international airline services on tourist consumption in different areas. Section 2 situates this study in relation to existing research. Section 3 proposes a tourist consumption model using the OD table of foreign visitors. Section 4 describes the results of developing a tourist consumption model for tourists from China. Section 5 describes the results of examining the estimation accuracy of the model, using the statistics made available by "Accommodation Travel Statistics." Section 6 describes the results of specifying the beneficiary area by the operation of low-cost air routes from China. Last, Section 7 summarizes the results of this research and articulates future areas of study.

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II. RELATED RESEARCH

a) Behavioral survey of foreign visitors

Recent years have seen much scholarly work on the behavior of the growing numbers of foreign visitors to Japan. Two examples include the "Survey on foreign consumption trends in Japan," conducted by the Japan Tourism Agency [4], and the "Flow of Foreigners-Data" (FF-data) in Japan, conducted by the Ministry of Land, Infrastructure and Transport [5]. FF-data provides a passenger flow database of foreign visitors in Japan that makes clear the passenger flow of foreign visitors from a site of departure to a destination, including flow from entry airport to first destination and flow from final departure site to departure airport. For our purposes, it is important to note that FF-data does not make clear the region that will experience an increase in tourist consumption owing to an increase in the number of foreign visitors entering from a particular airport.

b) Tourist behavior models

Scholars in the field of transportation planning have developed several models to measure tourist behavior at microscopic and macroscopic levels. For example, Mizogami et al. (1991) propose a microscopic model that assumes a by-level nested logit model [7], and Morichi et al. (1992) present a microscopic model that considers a tourist's choice of destination as well as their choice between returning home and continuing travel [8]. Meanwhile, Sasaki et al. (1968) introduce a macroscopic traffic flow model that analyzes traffic flow in the event hall using an Absorbing Markov Model [11], and Nishii (1993) presents a macroscopic traffic flow model that analyzes domestic travel flow using absorption Markov models [9].

c) Positioning the study

An input-output table was used to report the travel flow of foreign visitors described in 2.1. The author

(2017) proposes a passenger IO model that analyzes the passenger flow of foreign visitors by performing the same calculation as the input-output analysis using the travel flow table of foreign visitors [10]. Conversely, in the input-output analysis, an extended input-output table with data on energy input and environmental output is added to analyze the impact of changes in final demand on energy input and environmental output [6]–[13]. This study extends the table reporting the travel flow of foreign visitors by adding travel consumption data. First, we develop a travel consumption model to analyze the consumer behavior of foreign visitors to Japan. Next, we employ our model to determine the relationship between the rate of tourist consumption in a particular region and the rate of foreign visitors arriving at a particular airport. Last, we try to identify the beneficiary area of different international airline invitations.

III. DEVELOPING A TOUR-TYPE TOURISM CONSUMPTION MODEL

a) Passenger IO table (extended table)

The following section presents a passenger IO model for analyzing passenger flow using the visiting foreigner flow table. The passenger IO table, Table 1, treats n area as domestic visiting place (departure place) and domestic visiting place (destination place) and m Airport as entry and departure airports. Furthermore, Table 1 situates passenger flow from origin j to destination i as x_{ij} ; passenger flow from entry airport l to destination i as y_{il} ; passenger flow from origin j to exit airport k as z_{kj} ; and the number of total visitors to destination i as X_i . The number of visitors to the domestic destination i is equal to the number of departures (X_i) from the domestic destination i .

Table 1: Passenger IO table (extended table)

	Domenstic Destination j	Entry Airport l	Visitors
Domestic Destination i	x_{ij}	y_{il}	X_i
Departure Airport k	z_{kj}		
Visitors	X_j		
Total Guests	H_j		
Tourist Consumption	E_j		

The passenger IO table also presents the total number of guests (H_j) and the tourist consumption (E_j) that correspond to the domestic destination of the flow of foreigners. The total number of guests is the total number of foreign guests by nationality and by

destination presented in "Accommodation Travel Statistics" [3]. Tourist consumption is calculated by multiplying the total number of guests by the travel consumption per guest by nationality and by destination in the "Survey on foreign consumption trends in Japan."

b) *Passenger IO Model*

Table 1 sums up the passenger flow x_{ij} at the origin j and the passenger flow y_{il} at the entry airport l , which corresponds to the number X_i of foreign visitors to the domestic destination i . Written as a formula, this reads as follows:

$$X_i = \sum_{j=1}^n x_{ij} + \sum_{l=1}^m y_{il} \quad (1)$$

Furthermore, assuming that the ratio of the passenger flow X_{ij} to the destination i among the number X_j from the domestic destination j is a_{ij} , we obtain the following:

$$a_{ij} = \frac{x_{ij}}{X_j} \quad (2)$$

The number of immigrants to the airport l is Y_l . Therefore, we arrive at the following:

$$Y_l = \sum_{i=1}^n y_{il} \quad (3)$$

Among these, when the ratio of the passenger flow y_{il} to the destination i is b_{il} , we get the following:

$$b_{il} = \frac{y_{il}}{Y_l} \quad (4)$$

From equations (1), (2), and (4), we obtain the following:

$$X_i = \sum_{j=1}^n a_{ij} X_j + \sum_{l=1}^m b_{il} Y_l \quad (5)$$

We can express this in a matrix, as follows:

$$X = AX + BY \quad (6)$$

$$X = \begin{pmatrix} X_1 \\ \vdots \\ X_n \end{pmatrix}, \quad Y = \begin{pmatrix} Y_1 \\ \vdots \\ Y_m \end{pmatrix}, \quad A = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{pmatrix}, \quad B = \begin{pmatrix} b_{11} & \cdots & b_{1m} \\ \vdots & \ddots & \vdots \\ b_{n1} & \cdots & b_{nm} \end{pmatrix}$$

If equation (6) is solved for X , then the following holds true:

$$X = (I - A)^{-1} BY \quad (7)$$

c) *Tourist consumption model*

Let c_j be the tourist consumption per visitor in the domestic destination j . In other words, the following is the case:

$$c_j = \frac{E_j}{X_j} \quad (8)$$

At this time, the tourist consumption vector E can be obtained by the following equation.

$$E = CX \quad (9)$$

here,

$$E = \begin{pmatrix} E_1 \\ \vdots \\ E_n \end{pmatrix}, \quad C = \begin{pmatrix} c_1 & & O \\ & \ddots & \\ O & & c_n \end{pmatrix}$$

Substituting equation (7) into equation (9), we get the following:

$$E = C(I - A)^{-1} BY \quad (10)$$

By obtaining foreign visitor vector Y from the flow of foreigner data using equation (3) and substituting it into equation (10), we can determine the tourist consumption vector E at the domestic destination.

In what is similar to tourist consumption, the total number of nights can also be obtained by multiplying the number of visitors by the number of nights per visitor. Chapter 5 verifies the accuracy of the model, using the total number of guests by region as reported by "Accommodation Travel Statistics."

d) *Identifying the beneficiary area*

Let us consider a case in which the number of foreign visitors from an airport has increased because of the introduction of a new international airline service to that airport. The foreign visitor vector ΔY is considered, where the number of visitors from airport I is ΔY_I and visitors from other airports is 0. From equation (10), the tourist consumption vector ΔE in the domestic destination can be obtained by the following equation:

$$\Delta E = C(I - A)^{-1} B \Delta Y \quad (11)$$

Figure 1 shows how this model captures the tourist behavior and consumption of foreign visitors. The inverse matrix of equation (11) is given as follows:

$$(I - A)^{-1} = I + A + A^2 + \dots \quad (12)$$

Therefore, equation (11) is more specifically given as follows:

$$\Delta E = CB\Delta Y + CAB\Delta Y + CA^2B\Delta Y + \dots \quad (13)$$

The first term on the right-hand side of equation (13) represents the tourist consumption vector at the first destination because of the increase in the number of foreign visitors by the international airline service. The second term represents the tourist consumption vector at the second destination, and the third term represents the tourist consumption vector at the third destination. We can determine the tourist consumption vectors (ΔE) at all domestic destinations by summing up these more specific tourist consumption vectors. ΔE can also be determined without performing this iterative calculation by calculating the inverse matrix of equation (11).

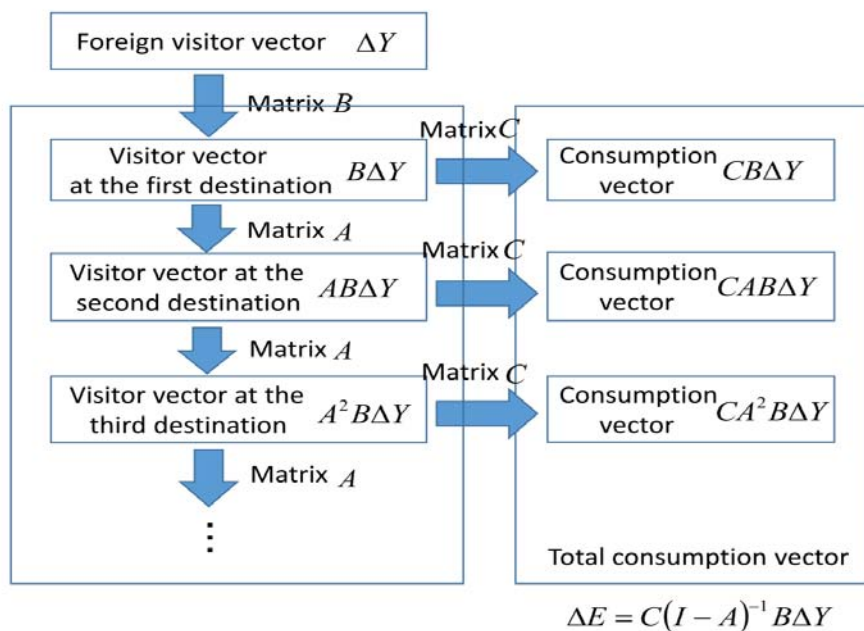


Fig. 1: Tourist behavior and consumption of foreign visitors to Japan

We can obtain the choice ratio of the first destination (matrix B) by using the data in FF-data. Because passenger flow data is aggregated by destination, we employ the choice ratio (matrix A) as the averaged value. However, as described in section (3), matrix A also corresponds to ΔE at the domestic destination by equation (10). FF-data shows the passenger flow among 47 prefectures and 29 airports by nationality. The tourist consumption model makes it possible to clarify the characteristics of visitors by nationality, due to comparing their entry airports and domestic destinations.

IV. DEVELOPING A MODEL FOR CHINESE VISITORS TO JAPAN

a) *Parameters of the passenger IO model*

As I detail in section 5, the number of Chinese visitors entering Japan has increased significantly in recent years. To analyze the consumer behavior of the growing numbers of Chinese tourists in each Japanese region, we developed a passenger IO model for Chinese visitors to Japan. The following section processes data from the Chinese flow table presented by FF-data, using the passenger IO model described in

section 3 to estimate the parameters of a passenger IO model for Chinese visitors to Japan. First, parameter b_{ij} was determined using equation (4). The parameter b_{ij} represents the rate at which Chinese tourists entering Japan from airport l choose destination i . Meanwhile, parameter a_{ij} was obtained using equation (2). The parameter a_{ij} represents the rate at which Chinese tourists departing from place j chose destination i . For instance, below I compare the parameters of visitors from Narita Airport and Chubu Airport and explore the differences in their behaviors.

Figure 2 shows the first destination of Chinese tourists entering from Narita Airport. Most passengers entering from Narita Airport depart first for Tokyo Prefecture, whereas others depart for other Tokyo metropolitan regions such as Chiba and Kanagawa Prefecture. Meanwhile, Figure 3 details the second destination of Chinese tourists entering from Narita Airport by surveying the destinations of Chinese tourists departing from Tokyo Prefecture. It is worth noting that Chinese tourists departing from Tokyo Prefecture chose the same destination more frequently than did tourists

departing from other areas and that this ratio remains high for tourists departing from other Tokyo metropolitan regions (Chiba, Kanagawa Prefecture, etc.); the Tokai region (Shizuoka, Aichi Prefecture); and the Kinki region (Kyoto, Osaka Prefecture).

Figure 4 shows the first destination of Chinese tourists entering from Chubu Airport. Figure 4 shows that tourists entering from Chubu Airport primarily chose Aichi Prefecture as their next destination, followed by Osaka and Tokyo Prefectures. Figure 5 reports the second destination of Chinese tourists, i.e., for which Chinese tourists depart from Aichi Prefecture. Chinese tourists departing from one destination in Aichi Prefecture rarely choose next destination in Aichi Prefecture. The rate of passengers departing from Aichi Prefecture and proceeding to the Tokyo metropolitan region (e.g., Tokyo, Kanagawa Prefecture, etc.) and the Osaka metropolitan region (e.g., Osaka, Kyoto Prefecture, etc.) is high. The deeper point is that many Chinese tourists arriving in Japan at Chubu Airport travel to other metropolitan regions without traveling around Aichi Prefecture.

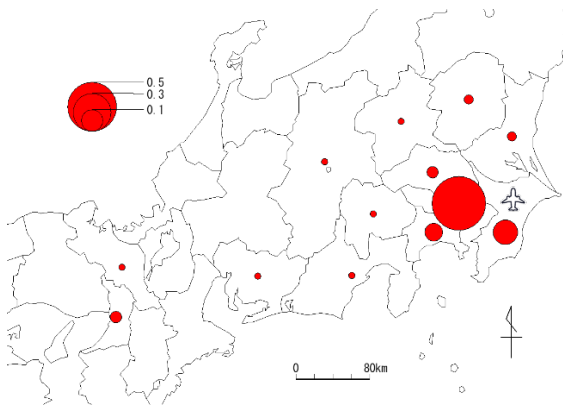


Fig. 2: The first destination of Chinese visitors entering from Narita Airport

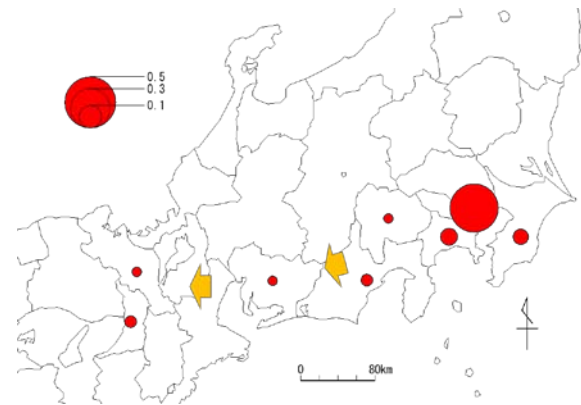


Fig. 3: Destination of Chinese visitors departing from Tokyo Prefecture

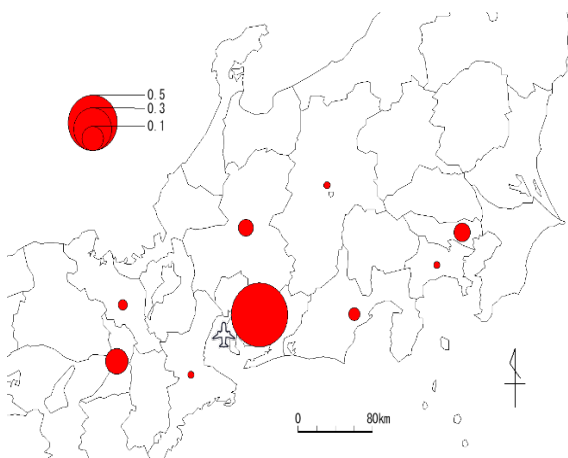


Fig. 4: The first destination of Chinese visitors from Chubu Airport

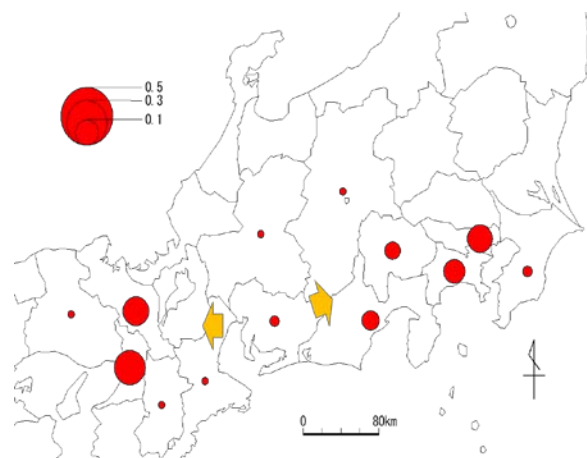


Fig. 5: Destinations of Chinese visitors departing from Aichi Prefecture

b) *Parameters of tourist consumption model*

This study uses the total number of Chinese guests listed in 2014 statistics regarding travel in Japan as the total number of guests per region. In addition, we calculated the rate of tourist consumption per region by multiplying the total number of nights that Chinese guests remained in any particular region by the rate of travel consumption per night of Chinese guests as listed on the Consumption Survey on Foreign Visitors to Japan in 2014. The parameter c_i was calculated from equation (8).

Figure 6 shows tourist consumption per visitor. Tourist consumption is high per visitor in southern Tokyo

metropolitan regions (e.g., Tokyo, Chiba Prefecture), prefectures near Mt. Fuji (e.g., Shizuoka, Yamanashi Prefecture), and southern areas of the Osaka metropolitan region (e.g., Osaka, Wakayama Prefecture); Toyama, Kanagawa Prefecture; and Aichi Prefecture. These regions may have high tourist consumption rates per visitor because they have relatively high rates of tourist consumption per night. Meanwhile, tourist consumption per visitor is low in Kyoto Prefecture. This is because the ratio of guests to visitors is low in Kyoto Prefecture and many Chinese visitors to Japan travel to other areas without spending much time in Kyoto Prefecture.

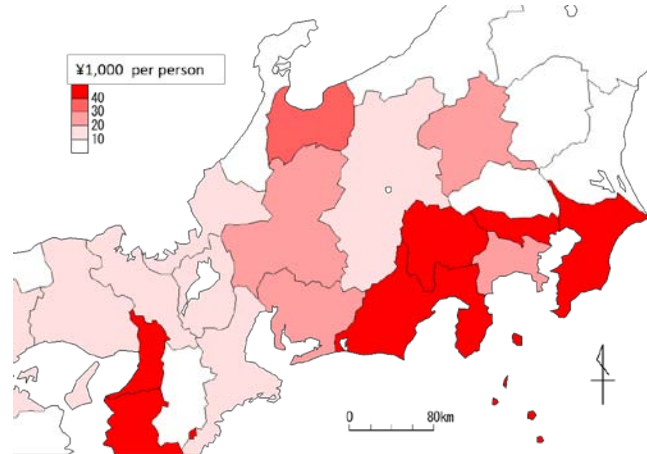


Fig. 6: Tourism consumption per visitor

V. TESTING THE ACCURACY OF THE MODEL

a) *Testing method*

Figure 7 reports changes in the number of Chinese visitors by airport since 2014. In 2015, the number of Chinese visitors in Japan doubled at Kansai, Chubu, Haneda, Naha, Fukuoka, and Chitose airports. Notably, the number of foreign visitors from Kansai Airport exceeded the number of foreign visitors from

Narita Airport, and there were more foreign visitors of Chinese nationality from Kansai Airport than any other airport. In 2016, the number of Chinese visitors to Japan increased again at all airports and doubled at Haneda Airport. While the number of Chinese visitors to Japan increased during these periods, the deeper point for our purposes is that these statistics make evident that the Chinese model that we develop in section 4 may predict the total number of guests in each prefecture.

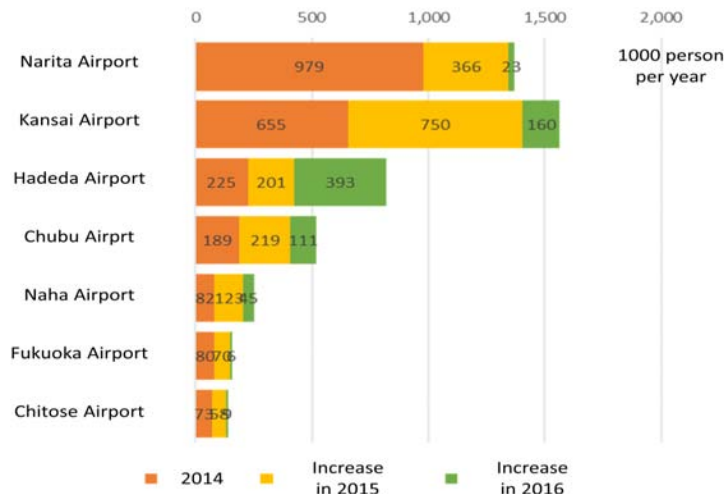


Fig. 7: Number of Chinese visitors to Japan by airport and year

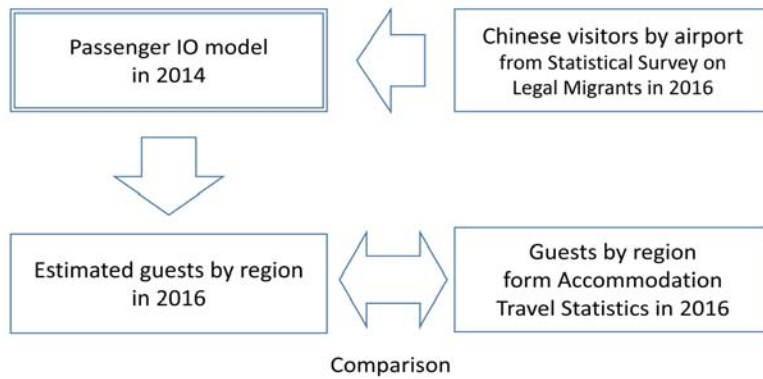


Fig. 8: Method for testing

Figure 8 depicts the procedure for testing the accuracy of the Chinese model developed in section 4. In particular, our model uses 2014 data from FF-data and “Accommodation Travel Statistics” to determine the parameters. Here we inputted the number of the Chinese visitors by airport from the 2016 Statistical Survey on Legal Migrants in the Chinese model [2] and calculated the total number of guests in 2016 by prefecture. Then, we compared this value with the total number of guests by prefecture in the 2016 Accommodation Travel Statistics and confirmed the degree of accuracy of the Chinese model.

b) Test result

Figure 9 compares the actual values for the total number of guests in 2016 with the estimated values obtained from the Chinese model. This figure shows that there are large numbers of guests in the Tokyo metropolitan region (Tokyo, Chiba, and Kanagawa); the

Osaka metropolitan region (Osaka and Kyoto); and the central region (Aichi and Shizuoka). There is a high correlation between the actual value of the total number of guests and the estimated value obtained from the Chinese model. As the number of Chinese visitors to Japan has increased rapidly since 2014, each region has implemented an initiative to increase the number of Chinese overnight guests. Therefore, it is thought that the pattern of Chinese passenger flow is also changing. Slight variations exist between the actual values and the estimated values in Figure 9 because the results of these efforts are not reflected. However, the correlation coefficient between them shows a high value of 0.994 (0.986 excluding Tokyo and Osaka). This suggests that if the number of Chinese visitors to Japan could be appropriately determined, relatively good results could be obtained (unless the travel behavior changes significantly).

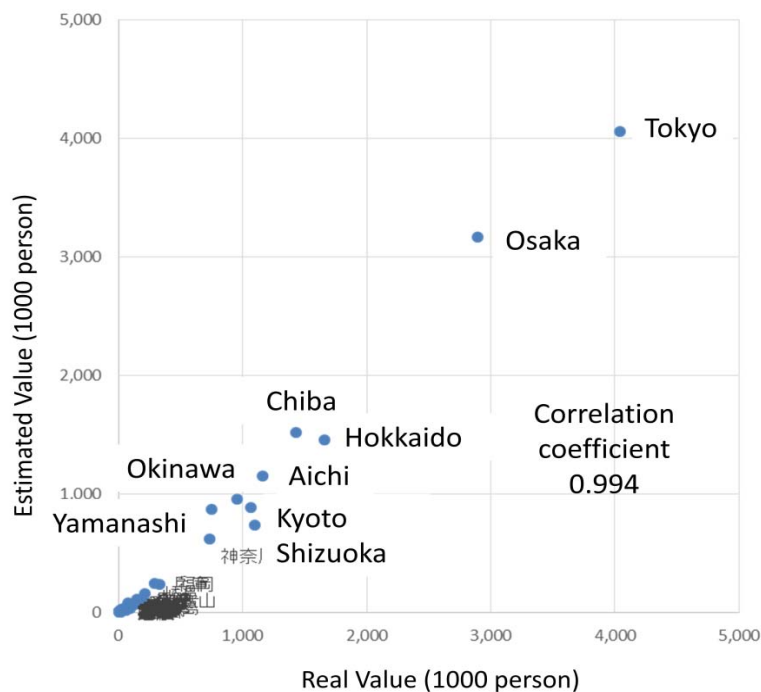


Fig. 9: Comparison between actual and estimated values (total number of guests in 2016)

VI. IDENTIFYING THE BENEFICIARY AREA

a) Changes in tourism consumption

Using the Chinese model developed in section 4, we calculated how much the tourist consumption of Chinese visitors might change if service by a Chinese LCC route was increased. We then sought to identify the beneficiary area of such increased service. In particular, using equation (11), we analyzed how much tourist consumption might increase in each prefecture relative to increases in the number of Chinese visitors from a particular airport as a result of increased service by a Chinese LCC route to that airport. For this study, we assumed that the number of Chinese LCC routes would increase by one flight, with 100 passengers per flight (number of seats: 160 to 170 seats × occupancy rate 60%). Therefore, adding one Chinese LCC route to a particular airport would theoretically increase the annual number of Chinese visitors to that airport by 36,500. Considering the number of users, we selected the three main international airports and Haneda Airport as the target airports for our study.

Figures 10 and 11 show the beneficiary areas of new LCC routes from China in service at Narita Airport and Haneda Airport, respectively. When Chinese LCC routes service Narita Airport, tourist consumption in Chiba Prefecture, where Narita Airport is located, is somewhat large. The results for Narita Airport and Haneda Airport are similar. The largest increase in

tourist consumption is in Tokyo Prefecture, followed by increases in other metropolitan areas such as Kanagawa and Chiba Prefecture. In addition, rates of tourist consumption are also increasing in the Tokai region (e.g., Shizuoka, Aichi Prefecture) and the Osaka metropolitan region (e.g., Osaka, Kyoto Prefecture).

Meanwhile, Figures 12 and 13 show the beneficiary areas of new LCC routes from China in service at Kansai Airport and Chubu Airport, respectively. For Kansai Airport, tourist consumption increases the most in Osaka Prefecture, which is followed by an increase in other Osaka metropolitan regions (e.g., Kyoto, Hyogo Prefecture). Flights servicing Kansai Airport also correlate with a significant increase in tourist consumption in Tokyo Prefecture, as well as increases in consumption in other areas of the Tokyo metropolitan region (e.g., Kanagawa, Chiba Prefecture) and the Tokai region (e.g., Aichi, Shizuoka Prefecture). In addition, flights that service Chubu Airport most strongly correlate with twin increases in tourist consumption in Aichi and Tokyo while also demonstrating a link with smaller increases in consumption in Osaka and Kyoto Prefectures. As section 4 details, such a tendency may be the result of Chinese visitors starting their tour in Aichi Prefecture before departing for the metropolitan regions around Tokyo and Osaka.

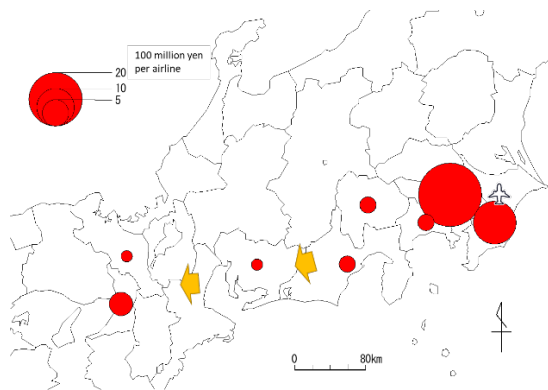


Fig. 10: Beneficiary area by service to Narita Airport

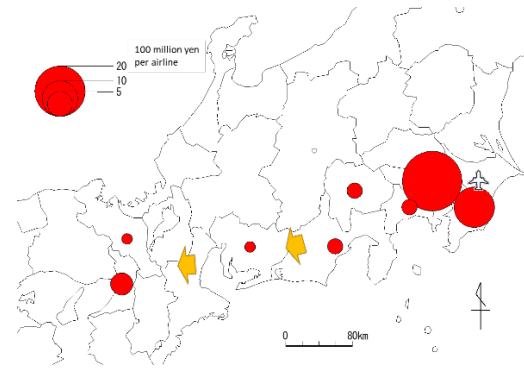


Fig. 11: Beneficiary area by service to Haneda Airport

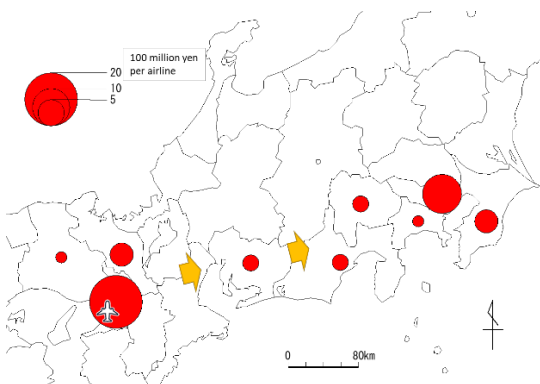


Fig. 12: Beneficiary area by service to Kansai Airport

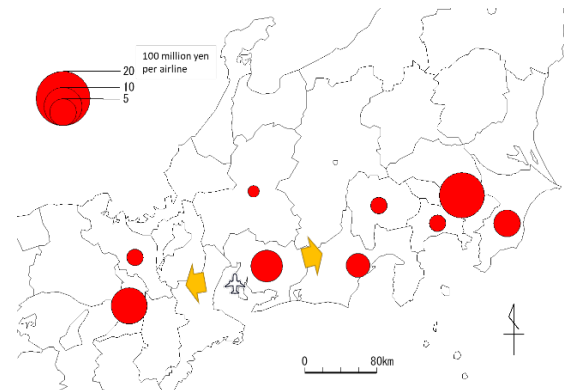


Fig. 13: Beneficiary area by service to Chubu Airport

b) Comparison of tourist consumption

Figure 14 sums up the changes in tourist consumption by region for each airport to compare the results of the four airports. The increase in tourist consumption clarifies that service to Narita Airport correlates with the largest increase in tourist consumption in Japan. Haneda Airport is the runner up, its flights demonstrating the second largest impact on tourist consumption. Services to Narita Airport and Haneda Airport mainly increase tourist consumption in the Tokyo metropolitan region. Meanwhile, the data also makes clear that service to the Tokyo metropolitan region increases tourist consumption far more than does service to Kansai Airport or Chubu Airport,

whereas service to Kansai Airport greatly increases tourist consumption in the Osaka and Tokyo metropolitan regions. Moreover, although service to Chubu Airport increases tourist consumption in the Chubu region, it more intensely increases tourist consumption in the Tokyo metropolitan region. The increase in tourist consumption in the Osaka metropolitan region is of about the same order as the increase in tourist consumption in the central region, the reason being that, as section 4 details, many Chinese tourists departing from Kansai Airport and Chubu Airport travel to Kinki and Chubu, as well as Tokyo. It is conceivable that a large amount of tourist consumption is being conducted in Tokyo.

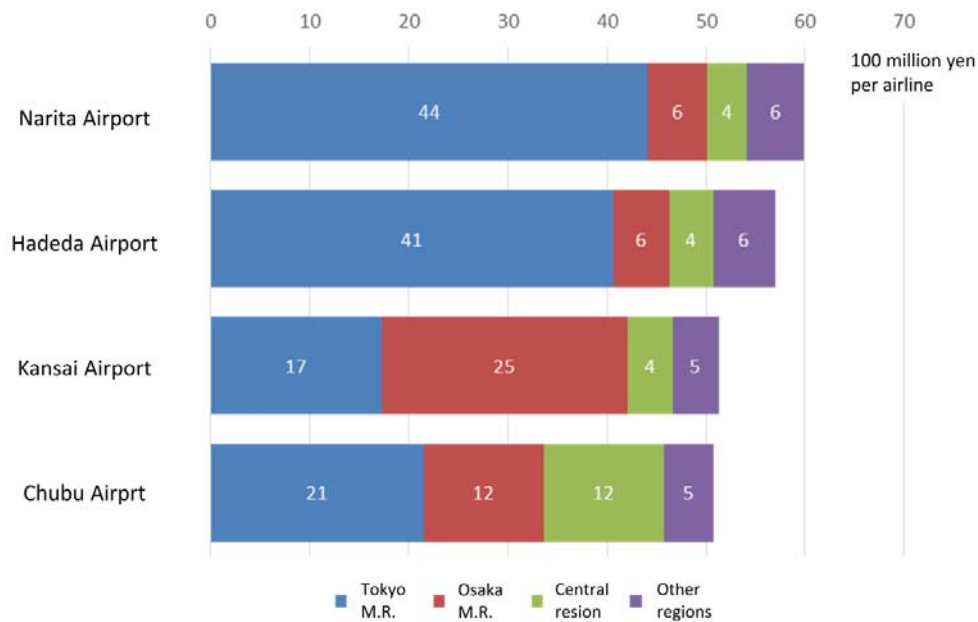


Fig. 14: Beneficiary area of international air routes

c) Suggestions for airport policy

Because many Chinese visitors to the Tokyo metropolitan region travel only in the Tokyo metropolitan region, increasing service to Narita Airport and Haneda Airport will increase tourist consumption in the Tokyo metropolitan region. On the other hand, many Chinese visitors entering Japan from Kansai Airport travel from the Osaka metropolitan region to the Tokyo metropolitan region, thereby increasing tourist consumption in both Osaka and Tokyo. Likewise, many Chinese visitors entering from Chubu Airport travel from the central region to the Tokyo metropolitan region and the Osaka metropolitan region, thereby increasing tourist consumption in the Tokyo and Osaka metropolitan regions. As noted above, an increase in tourist consumption by foreign visitors can revitalize a region. Once we have identified the regions that may benefit from increased tourist consumption, we can encourage this effect by incentivizing foreign visitors to arrive in Japan at the airport that this study links to an increase in

tourist consumption in that region. For our purposes, it is important to remember that many regions in Japan, i.e., not only the Tokyo metropolitan region, require Chinese tourist consumption. Therefore, it is important that airports other than those that primarily increase consumption in the Tokyo metropolitan region accept Chinese visitors. The deeper point here is that encouraging more Chinese consumers to enter Japan from Kansai Airport and Chubu Airport will nurture tourist consumption in regions beyond the Tokyo metropolitan area. While LCC service from China to Kansai Airport and Chubu Airport has increased since 2014, it remains important to encourage it in the future to attract more foreign consumers to areas outside of Tokyo.

VII. CONCLUSION

a) Results

This study developed a tourist consumption model to analyze the tourist consumption behaviors of foreign visitors to Japan. Our data reports the

passenger flow of foreign visitors to Japan's 47 prefectures and 29 airports by nationality. Our analytical tourist consumption model uses this data. Moreover, we utilized data regarding Chinese visitors and estimated its parameters. We verified the accuracy of our model using the number of guests in the Accommodation Travel Statistics report in Japan. We evidence that if the number of foreign visitors by airport could be given appropriately, tourist consumption in each prefecture could be estimated with relatively good accuracy (barring significant changes in travel behavior). Furthermore, we employed the Chinese model to identify beneficiary areas of LCC services to different airports from China. The analysis revealed that tourist consumption mainly increased in the Tokyo metropolitan region when service began to be provided at the Tokyo metropolitan airports of Narita Airport and Haneda Airport. Meanwhile, increased service to Kansai Airport and Chubu Airport increased tourist consumption in the Osaka metropolitan region, the Chubu region, and the Tokyo metropolitan region. Moreover, our results indicate that increasing service to airports in the Tokyo metropolitan region increases tourist consumption in the region more than increasing service to other airports does. It is also interesting to note that increasing service to Kansai Airport and Chubu Airport may increase tourist consumption in the Tokyo metropolitan region as well as in other regions.

b) *Future issues*

Moving forward, it will be important to verify our model's assumptions, e.g., its assumption that matrix A averages destination choice. We must also evaluate the impact the model has on our results. To this end, we must use the questionnaire data that was used to prepare the data from FF-data. To dispel even a shred of doubt, we must also criticize the method by which we verified our model. We may also consider the other kinds of analysis that our model might perform. For example, while this study's use of the model assumes that matrices A and B are constants, these parameters are functions of destination characteristics and traffic access conditions. Estimating such functions makes it possible to analyze the effects of changes in destination characteristics, changes in traffic access conditions on passenger traffic, and changes in consumer behavior of foreign visitors. Setting aside these thoughts for a moment, it is important to note that further data preparation is required to use this model for other forms of policy evaluation. Currently, the data in FF-data is organized by prefecture. Gathering data organized by smaller regions and regarding the specific costs of items that tourists purchase would enable a more detailed analysis of our object of study by providing us with more specific destinations and patterns of consumption.

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Urban Planning in Jordan a View towards Decentralization

By Elaf Dawodieh & Nabeel Al-Kurdi

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Keywords: *centralization, decentralization, urban economy, regional planning.*

GJRE-J Classification: FOR Code: 870105



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Urban Planning in Jordan a View towards Decentralization

Elaf Dawodieh^α & Nabeel Al-Kurdi^σ

Abstract- The purpose of this research is to present the problem of centralization in Jordan, which transformed Amman into a capital state, where 4 million out of 10,103,311 concentrated in the capital, Amman. Urban planning policies in Jordan are orienting to the capital, Amman, which has turned into a magnet point and this is related to numerous reasons, which are economical, educational and health conditions, in addition to the absence of regional planning, which is concerned with the balanced distribution of services between urban areas. The results showed the effective urban polices for decentralization urban planning by creating a schematic model and redefining a global strategy for urban planning in Jordan to achieve decentralization by providing a smart growth economic development and giving each city a chance to assume a powerful part in attracting investmen.

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I. INTRODUCTION

One of the most prominent problems that are facing the countries of the world, including Jordan, is the centralization of INVESTMENTS, job opportunities, and services in the capital, which led to the concentration of the population according to the centralization of activities. This study emphasizes the impact of the absence of the role of urban planning on centralization in the capital Amman, which made an unmistakable distinction between urban areas, and has prompted the centralization of investments, job opportunities and services in the capital. CENTRALIZATION URBAN PLANNING CAN CAUSE PROBLEMS THAT CANNOT BE EASILY RESOLVED AFTER APPLIED. This requires reinforcing urban planning policies on orientation at the decentralization to achieve effective spatial distribution of services and job opportunities through the creation of a planning structure to make an adjusted development of urban areas and to achieve a sustainable urban economy of urban communities to reduce the centralization in Amman. In the planning stage to save time, effort and cost. A wide range of polices is available for decentralization planning.

To decide what approach is most appropriate to select the best method for decentralization urban planning. The current literature on decentralization have to be reviewed. Researchers have developed many polices to help reduce the centralization in the capital.

Urban planning Promotes inclusive, and sustainable economic growth, which is playing an important role to achieve a balanced growth between cities to reach a successful distribution of activities, services and job opportunities to reduce centralization in the capital. Urban planning embodies economic development projects to provide job opportunities for the population¹.

There are several planning methods for decentralization planning, including high-quality urban life, Dimensions of Decentralized Planning, and (SQL) Urban Quality of Life principles as a tool to improve the urban economy.

II. MATERIAL AND METHODOLOGY

The urban planning policies that aim a smart growth, economic development, and effective urban quality of life are still moving towards the capital Amman and are attempting to expand existing activities, whether economic, education, or health, which will increase the problem of centralization. In this work, we are trying to study the role of the urban planning and urban economy as a tool to resettle the population in their cities and solve the problem of centralization in the capital by using the analytical, descriptive methodology that confirms the problem.

III. CENTRALIZATION IN THE CAPITAL AMMAN

The concept of centralization in the cities came to express the centralization and accumulation of economic, political, educational, health, wellbeing, and social power in particular urban zones because of the absence of planning policies, which led to the unbalanced development between urban areas. The focal word means the concentration of services in one area meaning all kinds of services². The urban planning policies that aim a smart growth, economic development are still moving towards the capital Amman and they are attempting to expand existing activities, whether economic, education, or health, which will increase the problem of centralization.

The volume of investments in the capital Amman for the years 2013 and 2014 was (1,607.6) million JD compared to the total investment volume in the same period, which, was estimated (2456.1) million

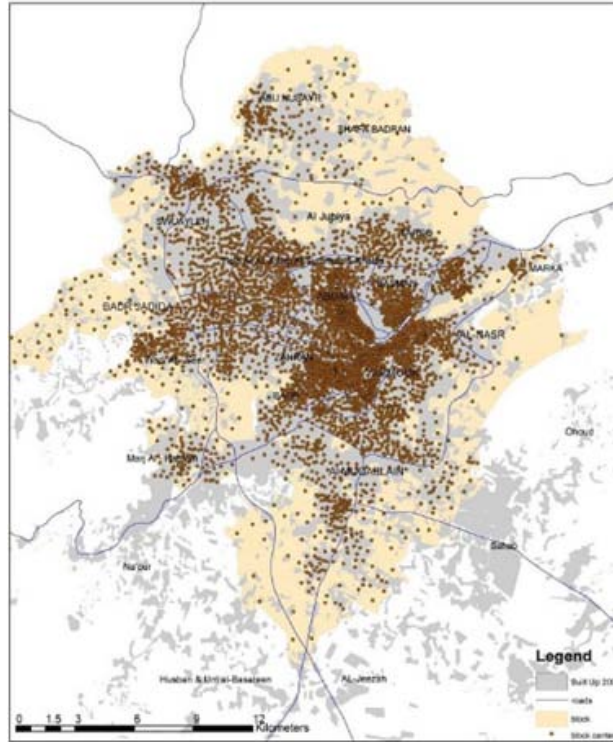
¹(Finnveden, Gunnarsson, 2016)

²(Marume, Jubenkanda, 2016)

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JD in all of Jordan, which contributed to the creation of (3829) job opportunities³. Almost, half of Jordan's hospitals are located in Amman, which includes (51 out of 104 hospitals in all of the Kingdom's cities)⁴, and (17

out of 30 universities⁵. This confirms the centralization of economic, health, educational and job opportunities in Amman.



Source: Greater Amman Municipality GIS, 2017

Fig. 1: Centralization in the capital Amman

In Jordan, we have unbalanced geographic distribution of the population as a result of absence regional planning, which most of the population is

concentrated in the central regions, however it is the least in the area.



Source: High Population Council, 2014: Modifications by the researcher

Fig. 2: Unbalanced geographic distribution of the population in Jordan

³ (Capital Governorate Development Program 2016-2018, Ministry of Planning and International Cooperation)

⁴ (Ministry of Health, 2015)

⁵ (Ministry of Higher Education, 2015)

The Northern Territory area	32.6 %
The central region area	16.2 %
The South Region	51.2 %

Table 1: The centralization of the economic activities in Amman

The number of companies	Amman	The state	The rate of companies from the state
Institutions work in industry	10279	20214	51%
Institutions work in transport and communications	1232	1843	67%
Institutions work in trade	39407	89331	44%
Institutions work in contracting	1340	2170	62%
Institutions work in services	18083	33314	54%
Total	70341	146872	48%

Source: (The Ministry of Planning and International Cooperation, 2016)

The previous table shows the concentration of the economic sector in the capital Amman, which lead to creating more jobs in the capital and encouraged the

population in migrate, which resulted to the centralization in Amman.

Table 2: The centralization of health services in the capital Amman

Governorate	No. of Hospitals	No. of Beds	No. of Gov. Hospitals	Private Hospital	Ministry of Health hospitals
Amman	47	5325	6	37	4
Balqa	5	532	0	1	4
Zarqa	8	896	1	5	2
Madaba	3	153	0	1	2
Irbid	16	1527	2	6	8
Mafraq	4	229	0	1	3
Jarash	1	135	0	0	1
Ajlun	1	105	0	0	1
Karak	6	365	1	3	2
Tafiela	1	86	1	0	0
Ma'an	2	191	0	0	2
Aqaba	3	199	1	2	0
Total	97	9743	12	56	29

The previous table shows the extent of the centralization of services in the capital Amman. In 2003 (47) of (97 hospitals) were concentrated in the capital Amman (Ministry of Health, 2003). Currently, Planning policies continue in orient planning towards the capital Amman, which increasing the problem of centralization.

In 2017 the Ministry of Health indicates that the number of hospitals in Jordan was 106 hospitals: 52 of them were concentrated in the capital Amman (Ministry of Health, 2012). This confirms the problem of centralization in Amman and the absence of the urban polices in Jordan.

Table 3: The capital Amman rich more than half of economic projects in the field of construction

Governorate	Number of contractors	The number of projects	The value of the projects (million)
Amman	1596	6084	758.3
Others Governorate	1014	1096	230.3
The total of state	2610	7180	988.6
The rate of the capital from the state	61%	84.7%	76.7%

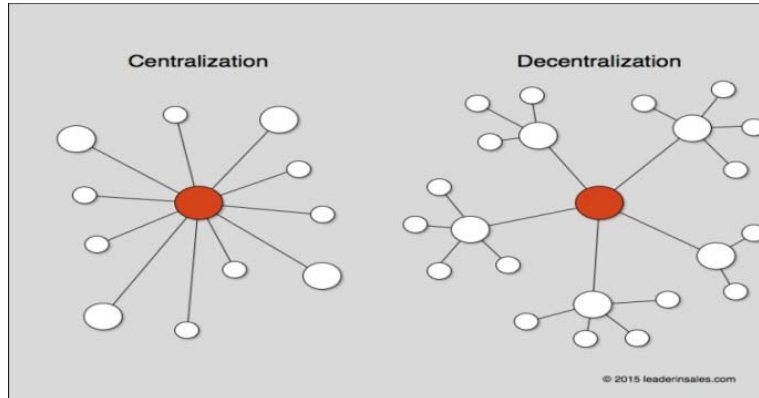
Source: (The Ministry of Planning and International Cooperation, 2016)

The previous table shows that the capital Amman rich more than half of economic projects in the field of construction, which contributed to provide job opportunities for the population in the capital, and increased the problem of centralization in Amman.

The absence of spatial planning leads to the concentration of services, such as hospitals, universities and economic activities in the capital Amman. We need to improve the urban economy to distribute jobs in balance way between cities.

Decentralization is the process by which the activities, especially those regarding planning and decision-making, are distributed or delegated away from a central, authoritative location or group.

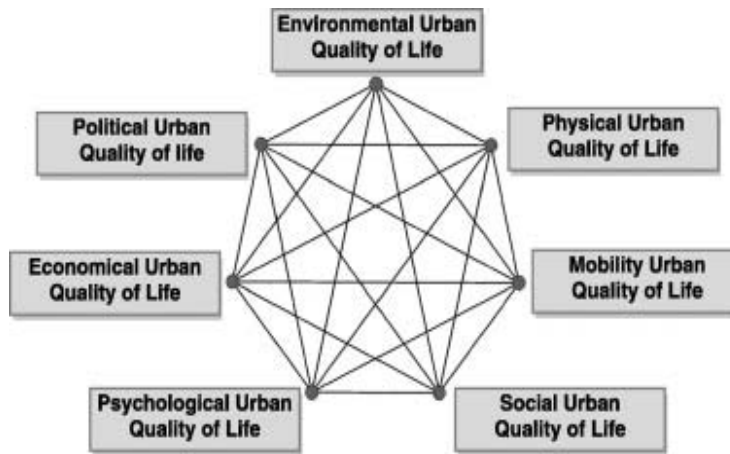
The concepts of decentralization are the distribution of services in different places or in other sense planning to give some services a higher authority than the level of their center⁶.



(Source: <http://leaderinsales.com/business/organizational-structure/centralization-decentralization/>)

Fig. 3: Centralization & decentralization

(SQL)Urban Quality of Life principles as a tool to improve urban economy



(source: Serag El Dina, Shalabya, Elsayed, . Elarianeb, 2013).

Fig. 4: Urban quality of life dimensions – Heptagon Shape

The Urban economy focuses on advancing the urban strategies and policies that reinforce the capacity of cities to realize their full potential as drivers economic development, of wealth and employment creation. Special attention is paid to the formulation and implementation of urban strategies and policies that promote and boost the participation of both men and women, enhance municipal finance and contribute to the creation of decent urban jobs and livelihoods that increase economic strengthening. These are most commonly portrayed as the creation of jobs, wealth, and

improvement of quality of life. Economic the development can also be described as a procedure that impacts development and restructuring of an economy to enhance the economic well being of a community.

⁶ (Rondinelle, and Nellis, 1986)

Table 5: Policy Options for Sustainable Economic Development

Policy Option 1	Facilitating a transition to a low-carbon economy by adopting legislation to catalyze investment in renewable energy for electric power generation in the industrial, commercial, residential and government sectors of the local economy.
Policy Option 2	Developing goals and programs for green economic growth in both traditional and emerging industry sectors.
Policy Option 3	Creating sustainable economic development, growth mechanisms, including subsidies, enterprise zones, land use, land purchases, public-private partnerships and business facilitation
Policy Option 4	Systematically, creating new business opportunities for local new economy startups by introducing them to the city's existing base of corporations and industries requiring such products or services.
Policy Option 5	Zoning for mixed-use development: Adjusting zoning codes to allow mixed-use development helps create walk able, mixed-use places.
Policy Option 6	Preservation of open and agricultural space: Preserving natural areas in the city and surrounding region provides important recreational, ecological, and economic benefits that enhance quality of life. Review the city's zoning ordinances and make necessary adjustments to preserve agricultural land, open space, and other environmentally sensitive areas.
Policy Option7	Partnership building. Because smart growth, economic development encompasses many issues, municipal governments often look for partners from the public, private, and nonprofit sectors to help achieve community goals.

A proposed model for the cities of the parties to solve centralization and reduce the migration of the population and their resettlement in their cities

Prosperous, Vibrant and Sustainable Economy

1. Attracting new businesses retains, and grow existing businesses through diversity, quality development and reasonable tax support.
 - Attracting investment: Providing tax exemptions for investment in cities of the parties such as Ma'an, Tafilah, and Karak, which suffer from high migration rates towards the capital Amman to create jobs for the population and settle the population in their cities. In addition, work to amend and review the laws to achieve the idea of decentralization so that the tax law, for example, the option of citizens to pay taxes directly to the government or contribute to the construction of services in areas experiencing migrations and lack of services such as universities, hospitals, and public places, which provides job opportunities for the population to develop the economy of the cities of the parties, and helps to settle the population and reduce migration to the capital.

2. Providing the type of mobility options, including parking, that businesses require to thrive reinvesting and appropriately maintains its infrastructure assets.
 - The transport sector is a basic sector that cannot be neglected because it affects the lives of every citizen and has a great impact on the national economy. The decline in services in this sector has negatively affected the lives of every citizen in Jordan. It is necessary to work on restructuring the public transport sector in all governorates of the Kingdom. Also finding and intensifying the means of transport for the development areas in the governorates through:
 - 1-Operating regular transportation to reduce waiting hours for users and not waste their time and effort as they move from one place to another and taking into account the increase in the population, especially users of the public transport service.
 - 2-Transportation: developing A well-connected, safe, and reliable transportation network that integrates driving, walking, biking, and public transit has many economic development benefits. It connects workers to jobs; lets people who cannot drive getting to stores, services amenities, and

disperses users across several modes and routes, which can reduce traffic congestion.

3. Promoting job growth, offering adequate housing options and quality of life amenities.
 - Public-private partnerships: to create job opportunities to accomplish community goals and services to achieve decentralization Most of the investments of the private sector that generated jobs are concentrated in the capital Amman, which led to the migration of a high proportion of the population of the provinces of the parties for jobs opportunities. Engage with the private sector, to ensure that urban and territorial planning coordinates the spatial location and distribution of economic activities, building on economies of scale and agglomeration, proximity and connectivity, thus contributing to increased productivity, competitiveness and job opportunities

IV. ACCESS TO RECREATIONAL AND EDUCATIONAL OPPORTUNITIES

1. Improving the educational environment in the cities of the parties.
 - Settlement and attract population: attract the population through education, to the cities of the parties through the construction of universities in those cities, and to grant scholarships to students in areas that suffer from population migration, Especially in the southern region in Jordan.
 - Improve the quality of education: having a high-quality public school district is an important component to building a skilled workforce. Many schools in Tafileh suffer from the dilapidation of buildings, lack of educational staff and services, resulting in the migration of a proportion of the population of the province towards the capital in search of better educational services. In addition to the weak relationship between universities and the product and industrial sectors. So it is necessary to Link higher education output to the labor market.
2. Attract investment in the cities of the parties (direct invest)
 - It is necessary to work on the development of planning policies in Jordan to achieve decentralized planning by attracting investments to the cities of the parties that suffer from high migration rates, especially Tafileh and Ma'an Governorate. This can be achieved through 1-Creating special zones equipped with infrastructure and services that are provided free of charge to investors provided that they provide 100 jobs to the residents of the region (directed investment).
 - The investor can obtain an interest-free loan to finance for 6-year and operate these investments. 2-

Undertaking the work of the industrial establishment on behalf of the investor by the state.

3. Improving the Urban quality of life environment to attract investment and population

Maintaining A balance between encouraging the growth of the local economy, while limiting impacts upon the quality of life

Providing a secure environment and creating job opportunities for the population with adequate income, low cost of living, and compatibility between the place of residence and the workplace through planning and reflection through the establishment of an effectively transport network that takes into account the human first, not the car. This will attract investors and residents to live in cities of the parties to achieve the idea of decentralization in Jordan through:

- Well-paid jobs
- Quality education / lifelong learning
- Medical facilities
- Quality and affordable housing
- Low pollution and environmental damage
- Public amenities
- Low crime
- Low cost of living / low taxation
- Aesthetic build and natural environment
- Preservation of open and agricultural space: Preserving natural areas in the city and surrounding region provides important recreational, ecological, and economic benefits that enhance the quality of life.

V. CONCLUSIONS

- Achieving a hierarchy of decentralized regional planning priorities that achieve decentralization by studying the spatial distribution of services to distribute to the regions in a balanced manner through regional planning and work to develop these plans and review it every four years to know the urban growth of the regions and the required distribution of services by demographic growth of regions to reduce the centrality of services in specific cities.
- Maintaining the balance in projects that ensure that all regions of the Kingdom are equal in development projects that contribute to the progress and development of each region process will ease concentration in major cities.
- Infrastructure: directing, planning for infrastructure to increase access to the city because the best access city gives a huge economic advantage to the city.
- Increase access to open space, parks, and recreation: Open space and public gathering spaces, including playgrounds and parks, can raise

property values in residential areas and could attract new residents and workers.

- Attracting new businesses could help increase job opportunities, local employment options and build the city's tax base
- It is important that the nature of each region is commensurate with each project, whether it is an economical, agricultural, or health project. In other words, each region will be characterized by projects that are suitable for its conditions and nature, such as tourist areas) (high educational areas) (agricultural areas) (industrial zones).

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Digital Twin of the Working Equipment of the Bulldozer

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Abstract- A brief overview of the types and properties of working equipment of a crawler bulldozer is presented. Methods for determining the forces of resistance to digging the ground with a bulldozer blade are analyzed. Disadvantages of existing methods in determining the values of the forces of resistance to digging, difficulties in calculating their values, which in practice represent an oscillatory process, are noted. A digital model of the working equipment of a bulldozer is proposed, based on the theory of layer-by-layer soil development, which allows calculating the minimum and maximum values of the digging resistance forces depending on the parameters of the soil and the blade when the drawing prism is increased.

Keywords: *bulldozer, working equipment of a bulldozer, dumps, digging of soil, theory of layer-by-layer development of soil, digital twin of the working equipment of a bulldozer.*

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Digital Twin of the Working Equipment of the Bulldozer

Цифровой Двойник Рабочего Оборудования Бульдозера

Leskovets Igor V.

Abstract- A brief overview of the types and properties of working equipment of a crawler bulldozer is presented. Methods for determining the forces of resistance to digging the ground with a bulldozer blade are analyzed. Disadvantages of existing methods in determining the values of the forces of resistance to digging, difficulties in calculating their values, which in practice represent an oscillatory process, are noted. A digital model of the working equipment of a bulldozer is proposed, based on the theory of layer-by-layer soil development, which allows calculating the minimum and maximum values of the digging resistance forces depending on the parameters of the soil and the blade when the drawing prism is increased.

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Аннотация- Представлен краткий обзор типов и свойств рабочего оборудования гусеничного бульдозера. Проанализированы методики определения сил сопротивления копанью грунта отвалом бульдозера. Отмечены недостатки существующих методик в определении величин сил сопротивления копанью, сложности в вычислении их значений, представляющих на практике колебательный процесс. Предложена цифровая модель рабочего оборудования бульдозера, основанная на теории послойной разработки грунта, позволяющая установить минимальные и максимальные значения сил сопротивления копанью в зависимости от параметров грунта и отвала при наборе призмы волочения.

Ключевые слова: бульдозер, рабочее оборудование бульдозера, отвал, копанье грунта, теория послойной разработки грунта, цифровой двойник рабочего оборудования бульдозера.

1. Введение

Бульдозеры нашли широкое применение в области дорожного строительства, добычи рудных и нерудных материалов. Благодаря простоте конструкции бульдозеры являются наиболее широко используются и практически незаменимы в области строительства и содержания дорог. Гусеничные бульдозеры

обладают наилучшей проходимостью и тяговыми характеристиками, по сравнению с колесными. Основным рабочим оборудованием бульдозера является отвал. Отвалы бульдозеров могут иметь разную конструкцию и разную форму[1]. Разработка грунта любым типом отвала бульдозера включает в себя одновременно процесс резания грунта и набора призмы волочения, что в совокупности является копанием. Бульдозеры эксплуатируются в различных климатических и грунтовых условиях. Влияние на технические показатели бульдозеров оказывают температура окружающей среды, влажность грунта, квалификация оператора и условия, существующие на рабочей площадке. Один и тот же бульдозер в разных условиях может показывать разную производительность. Основной задачей эксплуатирующих организаций является стремление к повышению производительности бульдозера и снижению эксплуатационных расходов.

На стадии проектирования рабочего оборудования бульдозеров невозможно учесть все условия возникающие на рабочей площадке. Наиболее совершенное рабочее оборудование бульдозера имеет 3 или даже 4 степени свободы[2]. Это обеспечивается подъемом опусканием рабочего оборудования, поворотом отвала в плане, изменением угла резания, выдвиганием отвала в сторону. Увеличение количества степеней свободы повышает возможности оператора в области управления отвалом, улучшает свойства бульдозера в части обеспечения высокой производительности в различных условиях.

Для получения оперативной информации о конструкции машины или о процессе ее работы все чаще используют цифровые двойники [3]. Если говорить о бульдозере, то информационные технологии и цифровые двойники можно использовать при проектировании, выборе параметров машины ее механизмов и систем[4], а также при эксплуатации для организации наиболее эффективного процесса работы. Работа любого цифрового двойника основана на использовании математических моделей и исходных данных. Математическая модель процесса копания

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рабочим оборудованием бульдозера предлагаемая в статье позволяет получить значения сил возникающих в процессе копания их амплитуду и частоту.[5]. Полученные результаты можно использовать при проектировании оптимального рабочего оборудования, для выбора оптимальных параметров отвала бульдозера, а также в процессе эксплуатации машины для выбора наилучшего положения отвала.обеспечивающего минимизацию сил сопротивления копанию.

II. Методика Определения сил Сопротивления Копанию.

Моделированием процесса копания занимались многие ученые. Они предложили различные зависимости для определения силы сопротивления копанию в разных условиях.

Для предварительного определения сил сопротивления копанию[6] часто используется зависимость

$$\sum W = W_1 + W_2 + W_3 \quad (1)$$

где

W_1 – сила сопротивления резанию грунта;

W_2 – сила сопротивления перемещению призмы волочения;

W_3 – сила сопротивления подъему грунта вверх по отвалу.

Сила сопротивления резанию W_1 определяются по зависимости

$$W_1 = k \cdot b \cdot h \quad (2)$$

где k – удельное сопротивление копанию;

b – ширина стружки;

h – высота стружки.

Сила сопротивления перемещению призмы волочения определяется по формуле

$$W_2 = V \cdot \rho \cdot \mu_1 \cdot g \quad (3)$$

Где

V – объем призмы волочения;

ρ – плотность грунта;

μ_1 – коэффициент трения грунта по грунту;

g – гравитационное ускорение;

Сила сопротивления подъема грунта верх по отвалу определяется по зависимости

$$W_3 = V \cdot \rho \cdot \mu_2 \cdot \cos^2 \delta \quad (4)$$

Где

μ_2 – коэффициент трения грунта по металлу;

δ – угол резания.

Этот способ определения сил сопротивления копанию не позволяет в полной мере исследовать силы, возникающие на рабочем оборудовании бульдозера. Различные методики определения сил сопротивления копанию, предложенные Зелениным А. Н., Ветровым Ю. А., Домбровским Н. Г. и др. учеными предназначены для вычисления сил, возникающих на рабочем оборудовании бульдозера в конце процесса копания при полной призме волочения. Важным недостатком данных методик является невозможность вычисления колебаний сил, возникающих и процессе копания и обусловленных периодическим отделением стружки от массива грунта.

На рис. 1 представлены графики зависимости сил сопротивления копанию во времени, полученные автором при проведении экспериментальных исследований

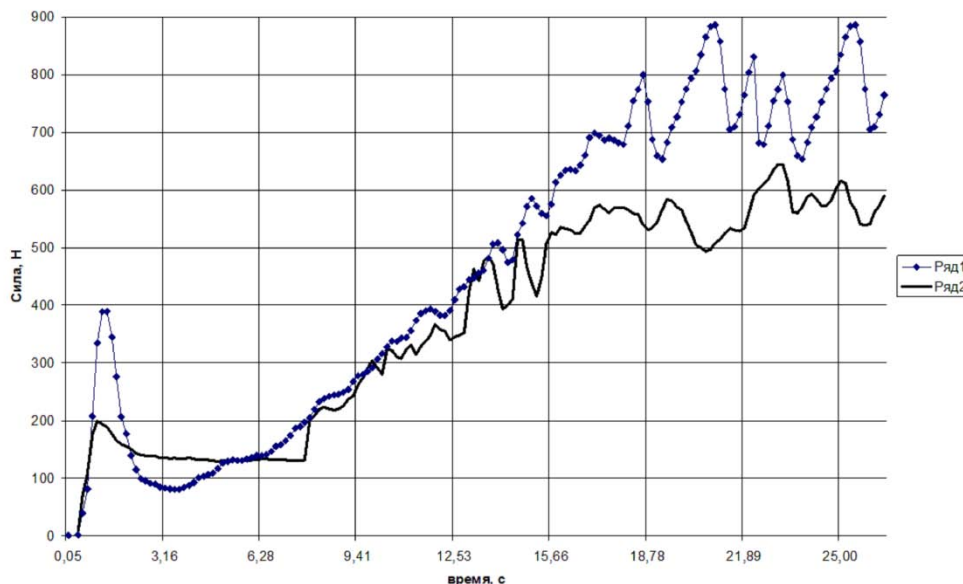


Рис. 1: Силы сопротивления копанию при использовании разных профилей отвала.

Из графиков видно, что колебания сил сопротивления копанью в конце набора призмы волочения могут достигать 20 %.

Для определения колебаний сил сопротивления копанью автором использована и усовершенствована методика Е. И. Берестова, посвященная исследованию процесса послойной разработки грунтов [5].

III. Методика Моделирования Процесса Копания Грунта

Для создания цифровой модели процесса копания [7] Берестовым Е. И. предлагается структура, представленная на рис. 2.

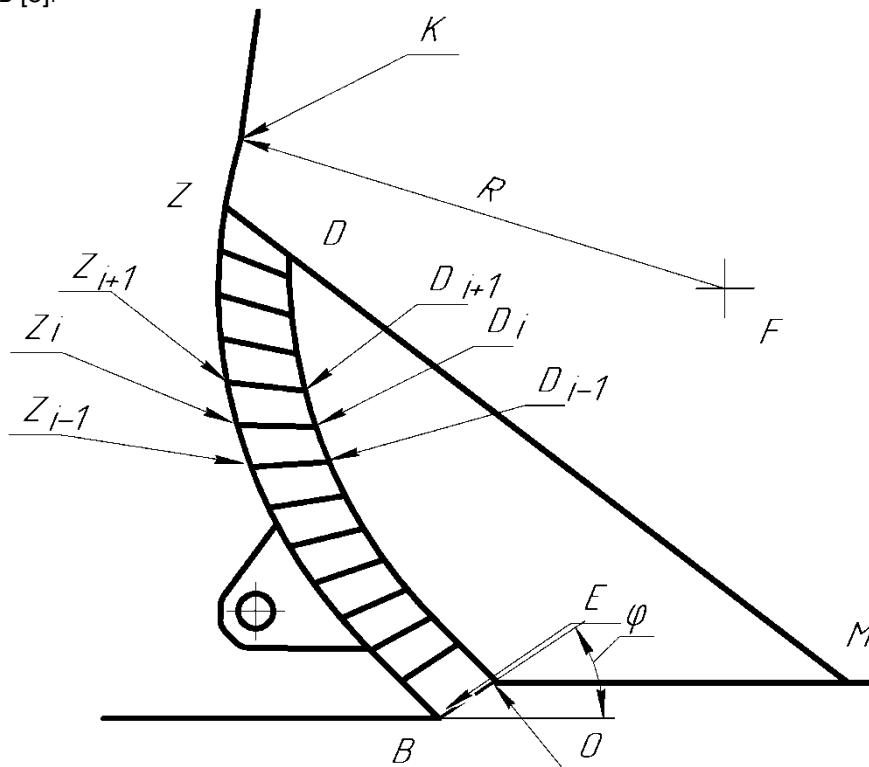


Рис. 2: Отвал с призмой волочения

Профиль отвала ограничен линией BZ. Поверхность грунта расположена на линии MO. Призма волочения ограничена профилем BZDM. Призму волочения предлагается разделить на условно подвижную часть BZDO и условно неподвижную ODM. Условно подвижная часть представляет собой набор сегментов $Z_{i-1}, Z_i, D_i, D_{i+1}$. Разбивка условно подвижной части на сегменты осуществляется радиусом R, являющимся центром криволинейной части отвала.

При отделении стружки от массива грунта на площадке BO возникает сила E, которая зависит

от параметров грунта, угла наклона φ и давления грунта, расположенного в призме волочения на поверхности OM.

Сила E может принимать максимальное значение, возникающее в момент отделения стружки от массива грунта и минимальное, которое возникает после завершения формирования площадки сдвига.

Максимальное значение силы $E_{\text{определяется}}$ о формуле

$$E_{\text{max}} = \frac{G \sin(\alpha + \omega) + R_{OT}^0 \sin(\omega + \rho) - C_{OB} \cos(\alpha + \omega + \varphi) + C_{ПП}^0 + N^0 \cos(\omega)}{\sin(\alpha + \omega + \varphi)} \quad (4)$$

Минимальное значение силы $E_{\text{определяется}}$ по формуле

$$E_{\text{min}} = \frac{G \cdot \sin\left(\frac{\pi}{2} - \alpha - \omega\right) + R_{OT}^0 \sin(\omega + \rho) + C_{ПП}^0 + N^0 \cos(\omega)}{\sin(\alpha + \omega + \varphi)} \quad (5)$$

где

α – угол резания,

ω – угол трения грунта по отвалу,

R_{OT}^0 – сила трения нулевого сегмента подвижного потока грунта в призме волочения,

ρ – угол внутреннего трения грунта,

C_{OB} – сцепление грунта на площадке сдвига,

φ – угол наклона площадки большого сдвига,

G – вес сегмента подвижного потока в призме волочения.

Сила трения нулевого сегмента подвижного потока грунта в призме волочения:

$$R_{OT}^0 = \frac{R_{ПП} \cdot \sin(\beta_{C_{ПП}}) + (C_{ПП} + N_{i+1}) \sin(\beta_{C_{ПП}})}{\sin(\beta_0 + \omega)} \quad (6)$$

где

$$R_{ПП} = \frac{G \cdot \sin(\rho) + C_{ПП}^X \cdot \sin(\rho) + C_{ПП}^Y \cdot \cos(\rho)}{\cos(\beta_{ПП} - \rho)} \quad (7)$$

Проекции силы $C_{ПП}$ на оси абсцисс и ординат

$$C_{ПП}^X = C_{ПП} \cos(\beta_{C_{ПП}}),$$

$$C_{ПП}^Y = C_{ПП} \sin(\beta_{C_{ПП}}),$$

Где

$C_{ПП}$ определяется

$$C_{ПП} = h_{ПП} \cdot C_r \cdot B,$$

где

$h_{ПП}$ – высота выделенного сегмента в подвижном потоке призмы волочения, рис.3.

C_r – удельное остаточное сцепление грунта,

B – ширина отвала.

$\beta_{C_{ПП}}$, β_0 – углы в соответствии с рис.3.

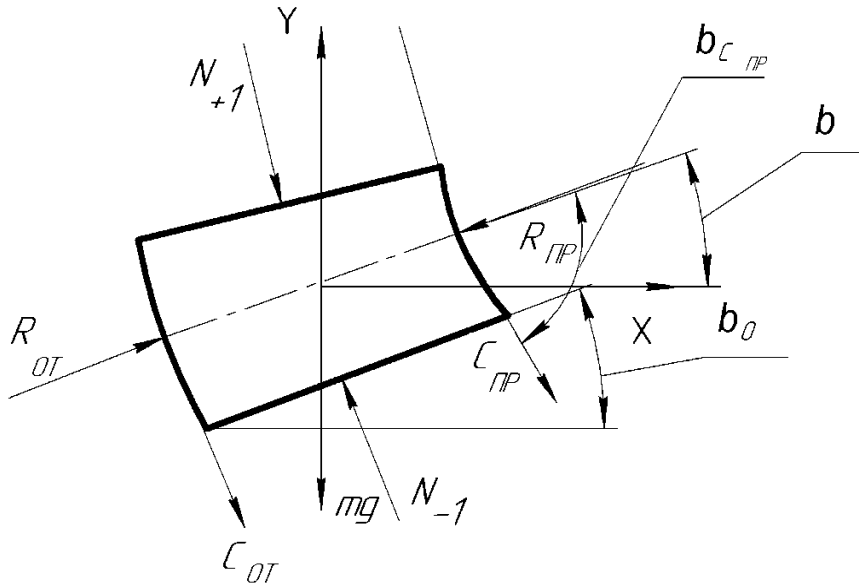


Рис. 3: Элемент подвижного потока

Нормальная сила, действующая от верхнего сегмента грунта, определяется по формуле:

$$N_{-1} = \frac{G \cdot \sin(\beta_{C_{ПП}} + \omega) + R_{ПП} \cdot \sin(\omega + \rho) + (C_{ПП} + N_{+1}^i) \cdot \cos(\omega)}{\cos(\beta_0 - \beta_0^{i-1} + \omega)} \quad (8)$$

где G - вес сегмента грунта, N_{+1}^i - нормальное усилие воздействия от предыдущего сегмента, β_0^{i-1} - угол в соответствии со схемой для предыдущего сегмента. Сила сцепления на площадке OB определяется, как $C_{OB} = l_{OB} \cdot B \cdot C$, здесь l_{OB} - длина площадки OB ,

C_3 - удельное сцепление грунта ненарушенной структуры.

Представленная выше методика позволяет определить силы E на площадке сдвига грунта в момент её формирования. Площадки сдвига возникают периодически, по мере продвижения режущей части отвала, рис. 4.

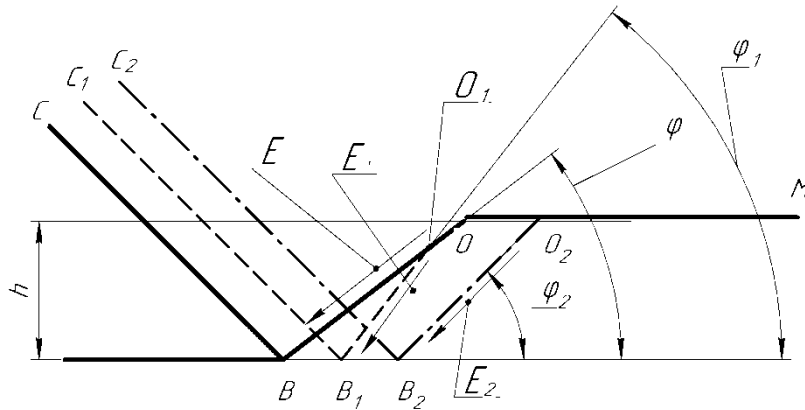


Рис. 4: Последовательность формирования площадок сдвига

Процесс формирования площадок сдвига имеет следующую последовательность:

в положении ножа CB имеется площадка сдвига BO , по мере продвижения ножа к точке B_1 напряжения в грунте растут, растет сила сопротивления передвижению, которая определяется по формуле

$$F_p = \Delta V \cdot C_0 \quad (9)$$

где ΔV - объем грунта перед отвалом на текущем шаге расчета;

C_0 - коэффициент жесткости грунта;

Величина предельных давлений со стороны отвала, которые может выдержать грунт в каждом конкретном случае, зависит от его параметров и определяется по формуле:

$$Q_{пред} = P \frac{\sin(\Delta_1)}{\sin(\Delta_1 - \delta_1)} \frac{\sin(\Delta + \delta)}{\sin(\Delta)} e^{((2\beta - \pi - \Delta - \delta - \Delta_1 + \rho) \operatorname{tg}(\rho))} \quad (10)$$

где ρ - угол внутреннего трения грунта,

$$\Delta_1 = \arcsin \frac{\sin(\delta_1)}{\sin(\rho)}$$

$$\Delta = \arcsin \frac{\sin(\delta)}{\sin(\rho)}$$

где

δ_1 - угол отклонения приведенного давления со стороны ножа,

δ - угол отклонения приведенного давления со стороны призмы волочения на участок OM ,

β - угол при вершине площадки сдвига.

P - давление, создаваемое призмой волочения на участок OM в зоне формирования площадки сдвига.

Если величина давления со стороны отвала превышает предельные, то формируется площадка сдвига B_1O_1 . На этой площадке сдвига возникает сила E_{max} происходит сдвиг грунта, давление в зоне движения ножа уменьшается, и возникает сила E_{min} . Если точка O_1 не расположена на поверхности OM , то сдвиг считают малым, затем нож продвигается дальше, до формирования нового сдвига. По мере продвижения ножа, периодически возникают малые

сдвиги, до выхода точки O_i на площадку OM , тогда сдвиг считают большим, что соответствует линии O_2B_2 , после чего картина повторяется.

Таким образом, на основании предложенной методики последовательно, с заданным шагом определяются силы, возникающие на ноже отвала бульдозера в процессе копания грунта, рис. 5.

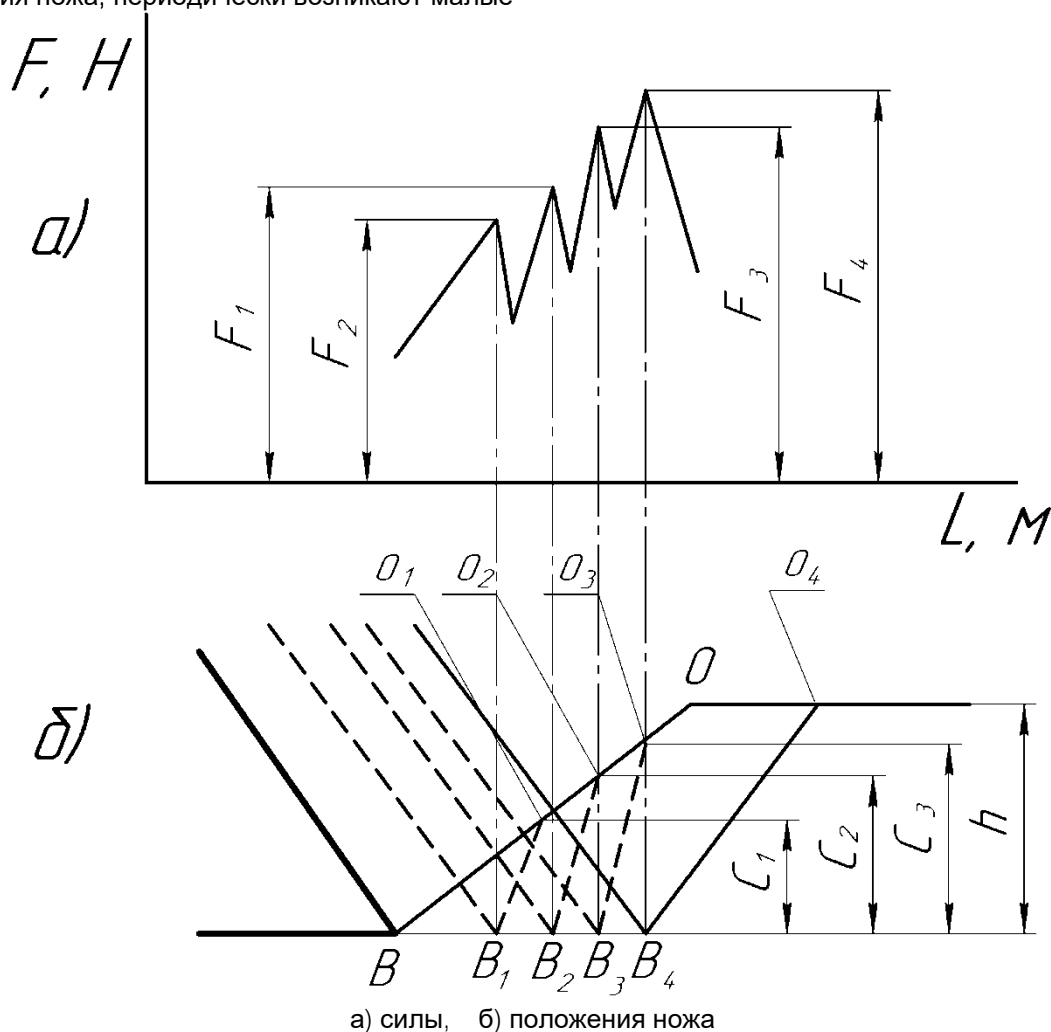


Рис. 5: Силы, возникающие на отвале ножа бульдозера в процессе копания

По мере продвижения отвала бульдозера, на нем формируется призма волочения. Величина её зависит от пройденного пути и увеличивается на каждом шаге. Объем, на который увеличивается призма волочения определяется по формуле

$$\Delta V_n = b \cdot \Delta l \quad (11)$$

где Δl - приращение пути, пройденного бульдозером, за текущий шаг расчета.

Зная новую величину объема призмы волочения можно построить её профиль, на основании параметров кривизны отвала и угла естественного откоса грунта. Параметры профиля

призмы волочения позволяют определить новое положение точки M на каждом шаге и новую массу грунта, оказывающую давление на площадку OM . Соответственно можно смоделировать картину увеличения сил сопротивления копанию по мере роста призмы волочения.

Цифровой двойник реализован в виде программного обеспечения, которое позволяет в режиме реального времени определить силы сопротивления копанию в зависимости от параметров грунта, геометрических параметров отвала и действий оператора.

Параметры грунта представлены в таблице 1.

Таблица 1: Параметры грунтов различных категорий

Параметры грунта	Категория грунта		
	I-II	III	III-IV
угол внутреннего трения грунта (град)	26-32	24-28	20-25
угол трения грунта по металлу (град)	26-32	22-26	22-26
угол наклона призмы волочения к горизонту (град)	35-55	35-55	35-55
удельное сцепление грунта ненарушенной структуры (кПа)	4-20	30-70	50-120
удельное сцепление грунта нарушенной структуры (в призме волочения) (кПа)	0-2	3-5	4-8
удельная жесткость Н/м	1000-2000	1500-3000	2000-3500
Удельное сопротивление резанию, Па	12	26	35
Плотность, т/м.куб	1,2	1,3	1,4

На рис. 6 представлены графики разработки грунтов 1, 2 и 3 категорий с результатов расчета сил, возникающих при параметрами, указанными в таблице 1.

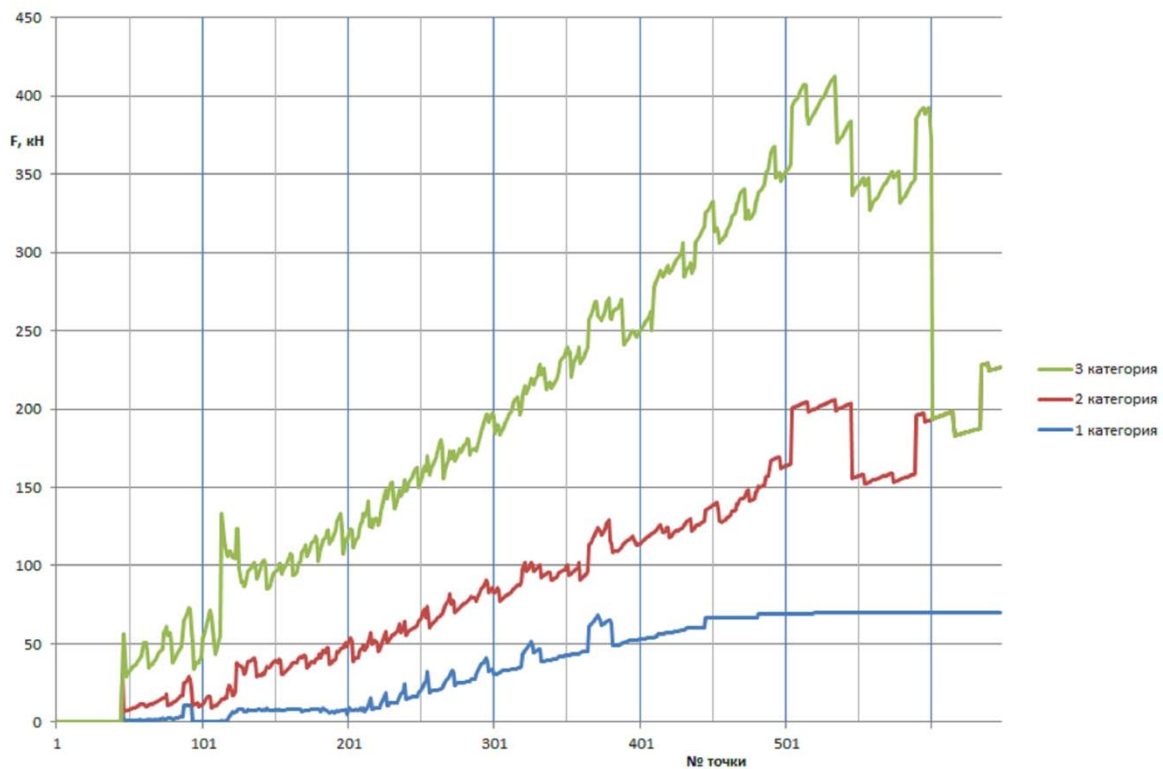


Рис. 6: Силы, возникающие при разработке грунтов 1, 2 и 3 категорий.

Из рис. 7 видно, что параметры грунта оказывают значительное влияние не только на величину силы сопротивления копанью, но и на периодичность их колебаний.

Значительное влияние на форму и периодичность колебаний сил сопротивления копанью оказывают параметры рабочего оборудования и высота призмы волочения. На стадии проектирования цифровой двойник можно использовать для выбора оптимальных параметров отвала. В настоящее время значения

этих параметров выбираются на основании результатов экспериментальных исследований проведенных ранее. Кроме формы и размеров ножа и отвала в процессе эксплуатации можно изменять положение угла его установки, что также приводит к изменению сил сопротивления копанью. Положение отвала оказывает влияние на величину призмы волочения, что в свою очередь может увеличить или уменьшить производительность бульдозера.

При автоматизации управления положением рабочим оборудованием бульдозера основной задачей цифрового двойника является выбор такого положения рабочего оборудования, при котором обеспечивается максимальная производительность, минимальные значения сил сопротивления, минимальное поддержание такой толщины стружки, которая будет восполнять грунта формирующие боковые валики. Такая задача является достаточно сложной при отсутствии данных о параметрах грунта. В условиях рабочей площадки, как правило, параметры грунта известны, хотя и в значительной степени зависят от температуры окружающей среды. В начале рабочей смены эти параметры могут быть измерены и введены в систему управления рабочим оборудованием бульдозера в качестве исходных значений для работы цифрового двойника. Важной задачей является разработка источников первичной информации и алгоритмов работы системы автоматизированного управления рабочим оборудованием бульдозера, позволяющих достичь поставленных целей.

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Design of a Web System for the Sales Processes in a Microenterprise in Peru

By Charlie Cieza-Palma & Kiko Alexi-Delgado

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Abstract- The present work is a design of a sales web site with which we will observe everything it contains and we can have a good control of all sales, because today is microenterprises still do it manually, and so much time is wasted and becomes very tedious, For this the web system was implemented with the SCRUM methodology which helps us in a more agile way and we will divide it into its 5 phases with which it has and by the Application was developed the phases already mentioned and was also used the program Balsamiq Mockups for the design of the prototypes that he is going to have the web system to store all the necessary information requested by the client as a final product.

Keywords: sales process, web system, scrum.

GJRE-J Classification: FOR Code: 870105



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Design of a Web System for the Sales Processes in a Microenterprise in Peru

Charlie Cieza-Palma^α & Kiko Alexi -Delgado^σ

Abstract- The present work is a design of a sales web site with which we will observe everything it contains and we can have a good control of all sales, because today is microenterprises still do it manually, and so much time is wasted and becomes very tedious, For this the web system was implemented with the SCRUM methodology which helps us in a more agile way and we will divide it into its 5 phases with which it has and by the Application was developed the phases already mentioned and was also used the program Balsamiq Mockups for the design of the prototypes that he is going to have the web system to store all the necessary information requested by the client as a final product.

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I. INTRODUCTION

The problematic is the control that is given to the sales process, is that in the modern season the commercial sector has suffered great alterations and is forced to the growth of communications and the entry of new technologies and it is essential that new companies achieve these changes so that they force other competitors to continue in their participation in the market[1]. We will touch some examples found in Perú is that most microenterprises do not have optimal control of their sales we will take the company Angelito located in the city of Chepén that is dedicated to the sale of clothing for children, men and women and as mentioned above do not have optimal control of sales and only handle it manually[2]. We have another example of the company Vasgar that is located in San Juan de Lurigancho that is dedicated to the sale of cleaning products, beverages and sweets, as mentioned above the company also handled manually where they controlled their profits and payments and wasted too much time and also had the problem of customer service [3].

As for the methodologies to develop this investigation there are different ,we begin by SCRUM that has a utility for the more agile development and using more than all the selection of Sprints[4], on the other hand we have to UML that more than everything is an agile planning for the progress of software and more than everything demands a complete documentation [5], RUP is known for the software process development

framework that extends in the unified process [6] , the MVC pattern is well known to developers because it interacts with databases and storage systems[7], I chose the SCRUM methodology because it helps us in a more agile way because and has an established duration that lasts between 2 to 4 weeks as a unique delivery date.

En el caso de aplicación abarcara en las microempresas que se encuentran en puente piedra el sistema web será desarrollado con algunas herramientas como creación de prototipos por el Balsamiq Mockups, se trabajará con el lenguaje PHP que explicaremos en el servidor web y va procesar código HTML u otra salida que los visitantes puedan ver [8], y por la metodología Scrum se va a trabajar con las 5 fases.

The objective of this work is to implement a web system with which we can have a control of all sales, products and customers, so that we may have an excellent information administration and improve customer service.

In this work is organized by stages, II stage we have the methodology that is going to be developed for research, III stage we have the study case which is related to the methodology, IV stage we will see the results, V etapa the conclusions of research work.

II. METHODOLOGY

This investigation will be carried out using the following methodology:

a) PHP

PHP or hypertext processor is a server-side scripting language designed for the web. PHP will be explained on the web server and will process html code or other output that visitors can see. PHP is an open source project that allows everyone to have access to the source code at no charge, it also has many integrated functions to perform many useful tasks related to the web. [8].

b) Balsamiq Mockups

After mentioning the methodology with which the project will be done, we will know the tool Balsamiq Mockups which will help us to create views of the interface that shows the system, such as buttons, links, tables, and so on. With which it will be possible to design a model of the ones we want to implement in the finished system. [9].

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c) SCRUM

Scrum proposes a personalized image to work on various projects that have a variety of conditions and having a usefulness as the selection of sprints and there is no method to follow. Being considerably scrum used for some essential components that can give an edge to other methods [10].

i. *Producto Backlog*

Here we begin with the list of requirements of functionality that offers us the client with which he wants it to be his final product.

ii. *Sprint Backlog*

We will see the list of requirements of the backlog product, how we will work with the team to achieve the objectives and that will become an increment in functionality.

iii. *Sprint Planning Meeting*

Tells us about the planning of the Sprint, are prioritized more than everything the inspection and the adaptation of the advances more than everything of the tasks of the product backlog.

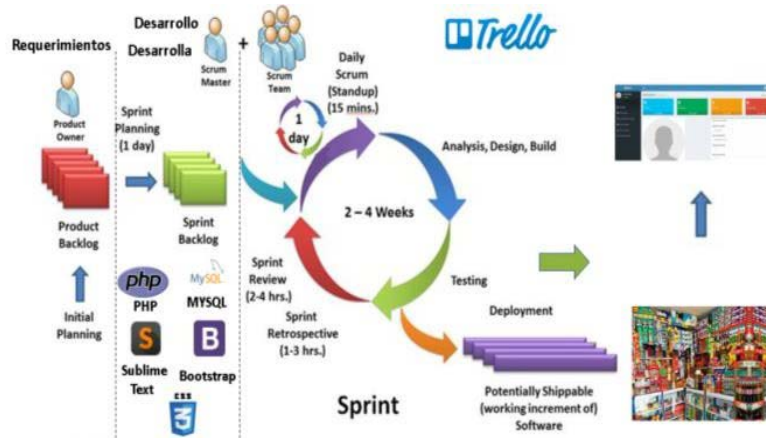
iv. *Ejecución de Sprint*

We will have a review of the increment (Sprint) as it will have a duration of 2 to 4 weeks as a unique delivery date.

v. *Inspección e Interacción*

It is the presentation of the sprint already finished with the requirements that have been indicated from the beginning by the client.

Fig. 3 will show the graph of the Scrum methodology where it covers all the phases already mentioned:



Fuente: William B. Heys

Fig. 3: Diagram of the Scrum Methodology Cycle

III. APPLICATION

a) *Application Architecture*

In this architecture we will talk about PHP where shown in the image will generate an html document,

then send the web system to the browser and where it will generate the more than all the request of the web system by the web server as shown in Fig. 4.

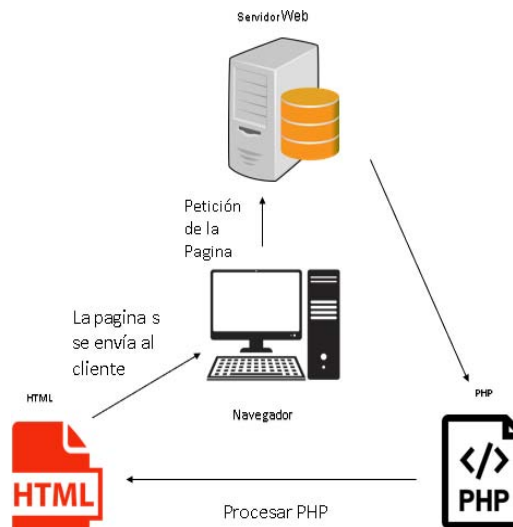


Fig. 4: Communication diagram of client and server

b) *Prototype Design*

The design of the web system was developed with the application Balsamiq Mockups, which will be implemented in microenterprises in Perú to have more than all a good control of their sales, products and customer and thus have a good administration of the data.

i. *Producto Backlog*

- As an administrator I need to register in order to enter the system.
- As a user I need the system to approve my data in order to enter the system.
- As a seller I need to register a customer to make the sale.
- As a seller I need to register the categories for each type of products.
- As a seller I need to register a product to make the sale.
- As a seller I need to register the customer's order to make the sale.
- As an administrator I need to produce a report to keep track of registered clients.

- As an administrator I need to produce a report to have a control of the registered products.
- As an administrator I need to produce a report to have a control of sales.

ii. *Sprint Backlog*

a. Increment 1: User Registration

In this increment the user records that can be administrator or salesperson will be presented (Fig. 6).

b. Increment 2: Record of the sale

In this increment we will see the registration of customers, categories, products, register orders and register the sale itself (Fig. 7, Fig. 8 and Fig. 9).

c. Increment 3: Report Management

In this increment we will have the verification of the sale and allows the administrator to generate reports on customers, products and the sale (Fig. 10).

iii. *Sprint Planning Meeting*

In this phase we will see the planning of the sprints and how long each has as shown in Fig. 5.

	Nombre	Duracion	Inicio	Terminado
	SISTEMA DE VENTA EN LA MICROEMPRESAS	45 days	08/09/19 08:00 AM	08/11/19 05:00 PM
	1.Registro Usuario	10 days	10/09/19 08:00 AM	23/09/19 05:00 PM
	Modulo de Usuarios	10 days	10/09/19 08:00 AM	23/09/19 05:00 PM
	2.Registro de la Venta	20 days	23/09/19 08:00 AM	18/10/19 05:00 PM
	Modulo de Clientes	5 days	23/09/19 08:00 AM	27/09/19 05:00 PM
	Modulo de categorias	5 days	28/09/19 08:00 AM	04/10/19 05:00 PM
	Modulo de Productos	5 days	04/10/19 08:00 AM	10/10/19 05:00 PM
	Modulo de la Venta	5 days	10/10/19 08:00 AM	16/10/19 05:00 PM
	3.Gestio de Reportes	15 days	16/10/19 08:00 AM	05/11/19 05:00 PM
	Reporte de Clientes	3 days	16/10/19 08:00 AM	18/10/19 05:00 PM
	Reporte de Productos	3 days	18/10/19 08:00 AM	22/10/19 05:00 PM
	Reporte de los pedidos	4 days	22/10/19 08:00 AM	25/10/19 05:00 PM
	Reporte de la Venta	5 days	25/10/19 08:00 AM	31/10/19 05:00 PM

Fig. 5: Sprints Planning

iv. *Execution of Sprint*

a. Sprint 1: Registro de Usuarios



Fig. 6: Login Administrador

b. Sprint 2: Registro de venta

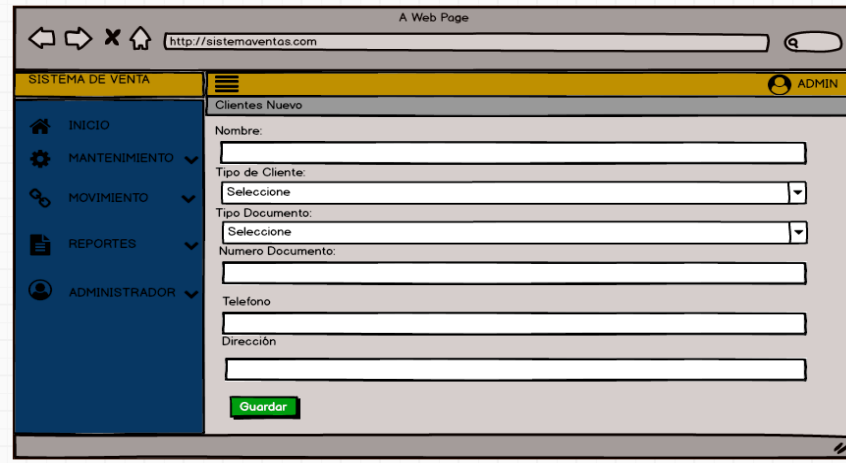


Fig. 7: Registrar Cliente

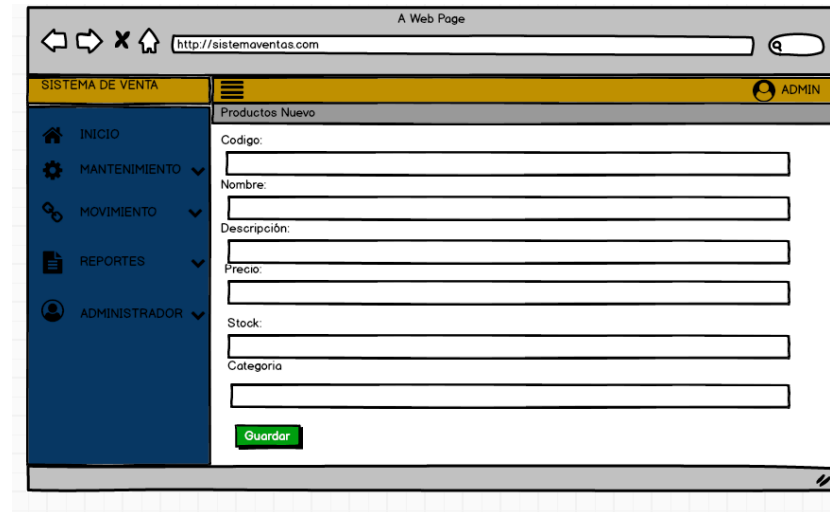


Fig. 8: Registrar Producto

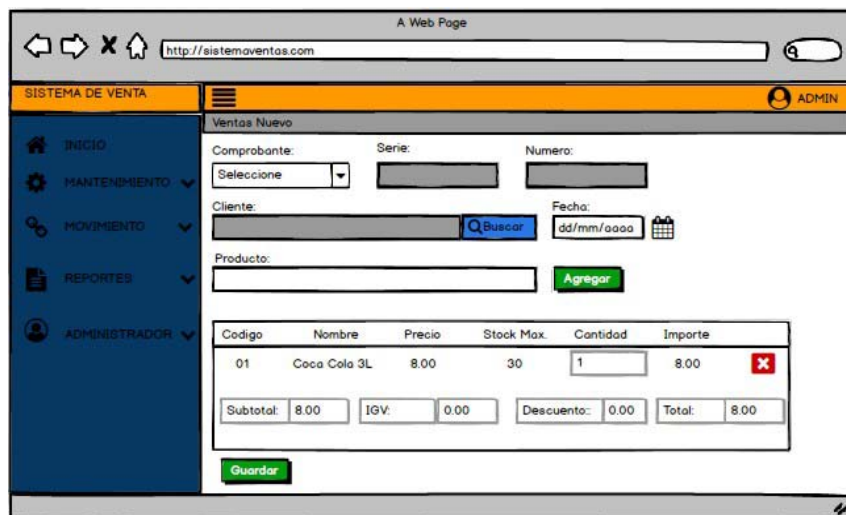


Fig. 9: Registrar Nueva Venta

c. Sprint 3: Reporte de Venta

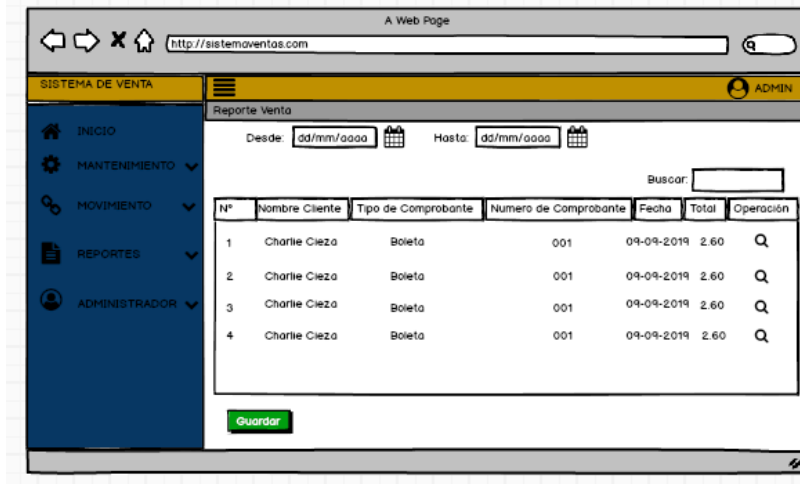


Fig.10: Reporte de la Venta

v. Inspection or Interaction

As last phase we have the sprints already finished with the requirements they gave us, where we'll see more than the entire system fully developed.

IV. RESULTS AND DISCUSSION

a) In the Application

The design of prototypes of the sales web system for the micro-companies in Puente Piedra was completed, ending with the requirements already requested and having a good control of sales and thus only having the design of the system to be implemented later.

i. Comparison

- Compared to a web-based platform for customers and designers for website prototypes [11], what we can observe is that we have developed the pappers with the software Balsamiq Mockups for the prototypes our work, another comparison is that this papper has created a process to create prototype and has communication from client to server and get customer feedback, in comparison with our work has also developed an architecture for communication of the client and server with PHP language.

b) In the Methodology

i. Ventaja

- One of the advantages with the Scrum methodology is that the development team meets every day approximately 15 minutes to complete some elements of the sprint backlog to be a review of the project which will be presented [12].

ii. Desventaja

- One of the disadvantages would be that if you focus on large projects with several members, the results would not be as good.

iii. Diferencias

- In the differences exist is that the scrum methodology is for more agile projects on the other hand if we use the UML methodology it is for more extensive projects and in addition they are too heavy as the implementation of the sales system of the monitoring based on mobile devices in Semi Tani Shop. [13].

V. CONCLUSIONES

In this way the implementation of the sales web system will help with the improvement of the sales process, so there will be no problems with calculations such as for preparing a ticket, or control of products.

The application was used with the program Balsamiq Mockup which helped with the design of the interfaces for the design of a website for a microenterprise.

La Metodología Scrum nos ayudo de una manera más ágil ya que cuentas con 5 fases, y que se ejecuta en ciclos temporales, ya que los Sprint tienen una duración entre 2 a 4 semanas como una fecha límite de entrega del proyecto.

In future investigations an artificial intelligence system could be added with a chatbot so that customers can ask for information about each specific product they are looking for in the store and the prices for each one.

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The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.



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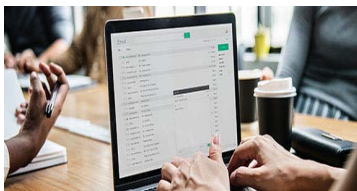
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Acknowledgments

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The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.



Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

- a) A title which should be relevant to the theme of the paper.
- b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
- c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
- d) An introduction, giving fundamental background objectives.
- e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
- f) Results which should be presented concisely by well-designed tables and figures.
- g) Suitable statistical data should also be given.
- h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

- i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
- j) There should be brief acknowledgments.
- k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



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It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.



Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

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Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

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TIPS FOR WRITING A GOOD QUALITY ENGINEERING RESEARCH PAPER

Techniques for writing a good quality engineering research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of research engineering then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

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6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.



21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.



- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.



Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.



Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.



Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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	A-B	C-D	E-F
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<i>Introduction</i>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<i>Result</i>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
<i>Discussion</i>	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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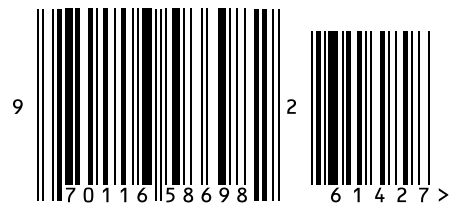


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