# International Journal of Advanced Engineering, Management and Science

Journal CrossRef DOI: 10.22161/ijaems

(IJAEMS) An Open Access Peer-Reviewed International Journal



## Vol-6, Issue-6 | Dec, 2020

Issue DOI: 10.22161/ijaems.612



https://www.ijaems.com/ | editor@ijaems.com

# International Journal of Advanced Engineering, Management and Science (IJAEMS)

## (ISSN: 2454-1311)

DOI: 10.22161/ijaems

Vol-6, Issue-12

Dec, 2020

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#### Publisher

Infogain Publication Email: <u>ijaems.editor@gmail.com</u>; <u>editor@ijaems.com</u> Web: <u>www.ijaems.com</u>

# FOREWORD

I am pleased to put into the hands of readers Volume-6; Issue-12: Dec, 2020 of "International Journal of Advanced Engineering, Management and Science (IJAEMS) (ISSN: 2354-1311)", an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

**Dr. Dinh Tran Ngoc Huy** Editor-in-Chief Date: Jan, 2021

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# Load shedding in power system considering the generator control and AHP algorithm

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Received: 09 Oct 2020; Received in revised form: 11 Nov 2020; Accepted: 20 Nov 2020; Available online: 07 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— This paper proposes the load shedding method with considering the ranking load importance factors. The amount of shedding power is calculated based on the Primary and Secondary adjustments to restore the system's frequency back to allowed range. The ranking and distribution shedding power on each load bus will be prosed based on the AHP algorithm. Loads with the smaller importance factor will have priority to be shed with the larger amount of shedding power and vice versa. The experimental and simulated results will be estimated on IEEE 37- bus system, the results show that the proposed method can help the frequency restores back to nominal range and reduce damages compared to the UFLS method.

Keywords—Load shedding, Primary control, Secondary control, AHP algorithm, Frequency control.

#### I. INTRODUCTION

The control of load shedding in electrical system must ensure the efficiency of both technical and economical. This helps the electrical system stables and minimizes damages in economic loss when load shedding is required.

The Under Frequency Load Shedding UFLS [1-5] and Under Voltage Load Shedding [6] method, are methods commonly used in restoring the electrical system frequency. In these methods, when the frequency or voltage fluctuates outside of the preset working limit, the frequency/voltage relays will signal to shed each respective load level, thus preventing prevent frequency/voltage attenuation and its effects. The under frequency relays are set to shed a fixed amount of load capacity in 3-5 steps when the frequency drops below the set threshold to restore the electrical system frequency. In order to increase the efficiency of load shedding, some methods of load shedding rely on frequency droop (df/dt) [7-8], or use both frequency and voltage to shed the load [9]. These methods mainly restore the frequency to permissible values and prevent blackout. To optimize the amount of load shedding, some intelligent load shedding methods are applied such as: Artificial Neural Networks (ANNs), Fuzzy Logic, Neuro fuzzy, Particle Swarm

Optimization (PSO), Genetic Algorithm (GA) [10-15]. These studies mainly focus on solving the optimization of load shedding power under the established operating mode of the power system. However, due to the complexity of the electrical system, these cases have disadvantages in the burden of computation, the speed of processing the algorithm program is relatively slow or he passive load after the frequency is below the allowed threshold, so it will take a lot of time and cause delays in the decision to shed loads leading to instability of the electricity system. In particular, in the current electricity market, ensuring the quality of electricity and reducing the economic losses of load shedding need attention.

In the load shedding problem, the selection of load hierarchy based on the shedding priority is essential for power balance adjustment and restore frequency to bring economic efficiency. Therefore, it is necessary to clearly define which loads should be listed in the list of shed load and their priority. Determination of load shedding list must satisfy many aspects which require detailed analysis consequence of load shedding. However, the calculation and analysis of these economic consequences are very complicated and in most power companies in the world today still base on the evaluation of power system experts in the world on this problem. Even so, it is difficult for experts to give priority to shedding these loads when considering the entire electrical system, especially when a load needs to be considered in many different aspects. However, to make it easier for experts to access, when giving their opinions, they often rely on technology characteristics and operational reality to provide verbal comments. Experts easily compare each pair and use common language such as load number 1 is more important than load number 2, or criterion 1 is more important than criterion 2. To solve this problem, the Analytic Hierarchy Process (AHP) algorithm is used to rank loads in order of shedding priority based on consultation with experts on verbal representation.

In this paper, the minimum amount of load shedding capacity is calculated considering the primary frequency control and the secondary frequency control of the generator. The distribution of load shedding capacity at the load buses is done based on AHP algorithm. The load with the lower the importance factor will have the priority to shed more capacity and vice versa.

#### II. FREQUENCY CONTROL IN POWER SYSTEM AND AHP ALGORITHM

#### 2.1. The power system frequency respond

The ability to vary power according to frequency or the frequency stability ability of a turbine is determined by the drop of the speed control characteristic [16, 17]. The drop of the adjustment characteristic is determined by the equation:

$$R = \frac{\Delta f}{\Delta P_G} \tag{1}$$

Where, R is the speed or droop adjustment factor;  $\Delta f$  is the frequency change;  $\Delta P_G$  is the change in generator power.

The relationship between power variation and frequency variation is determined by the equation:

$$\Delta P_{\rm G} = \frac{-P_{G_n}}{R} \cdot \frac{\Delta f}{f_n} \tag{2}$$

Where:  $P_{G_{i}}$  is the rated power of the generators.

The load in the electricity system is a diverse collection of different electrical equipment. For resistive loads, such as lighting and heating, the power is not frequency dependent. In the case of a motor load, such as a fan and pump, the power changes with frequency causing the motor speed to change. The power of the combined load can be expressed by the following equation [18]:

$$P_L = P_{ID} + P_D \tag{3}$$

Where,  $P_L$  is the combine load component,  $P_{ID}$  is a frequency-independent load component, e.g. heat load, lighting...  $P_D$  The component of the load depends on the change of frequency, e.g. motor, pump.

The response of the load to the frequency deviation is presented in the following equation:

$$\Delta P_L = \Delta P_{ID} + \Delta P_D \tag{4}$$

When the frequency is equal to the rated frequency  $f_n$ , the required power of the load is the same as the actual consumed power  $P_{L0}$ , when the frequency decreases from  $f_n$  to  $f_1$ , the actual power used decreases from  $P_{L0}$  to  $P_{L1}$ .

The relationship between the load power variations with frequency variation is determined by the equation:

$$\Delta P_D = -\frac{\Delta f}{f_n} \cdot P_L \cdot D \quad (5)$$

Where,  $P_L$  is the active power of the system's load,  $\Delta P_D$  is the change of load power according to frequency change, D is the percentage characteristic of the change of load according to the percentage change of frequency [12], D value from 1% to 2% and experimentally determined in the power system. For example, a value of D = 2% means that a 1% change in frequency will cause a 2% change in load.

2.2. Primary and secondary frequency control in power system

The process of frequency adjustment in the event of generator outage in the electrical system consists of stages: the primary frequency control, the secondary frequency control. If after adjusting the secondary frequency control, the frequency has not yet been restored to the permissible value, it is required to load shedding to restore the frequency to the permissible value.

The process of the primary and secondary frequency control was shown in Figure 1.



Fig. 1 The relationship between frequency deviation and output power deviation.

In the case of a generator equipped with a governor, the power characteristic is shown in the characteristic (A) of Fig 3. In stable and balanced operation mode, the point of intersection of the generator characteristic (A) with load characteristic (F) determine the frequency  $f_0$ . Assume that it is the standard frequency, equal to 50Hz or 60Hz.

In case the total generator power decreases from  $P_{Gn}$  to  $P_{Gn-1}$ , respectively, the new characteristic line (C), the new frequency  $f_1$  is the intersection point of the (C) characteristic with the load characteristic (F).

In this case,  $f_1 < f_0$ , the governor does not prevent the frequency attenuation. However, the governor has limited the large deviation of the frequency. Compared with the case where the generator does not have the governor (characteristic (D)), the intersection point with the new load characteristic  $P_L$  determines the frequency  $f_1$ ', at this time  $f_1' < f_1$ .

Thus, the governor has the effect of adjusting the frequency and is called the primary frequency regulator. The effect of primary frequency adjustment depends on the slope characteristics of the generator. In the ideal case, the adjustable characteristic of the vertical generator (H) characteristic, the frequency does not change. It is the above feature of the primary adjustment process that leads to the need for external interference (automatic control or by the operator) - that is the process of adjusting the secondary frequency.

The secondary frequency adjustment is shown by paralleling the (C) characteristic to the (E) characteristic of the generator, with a constant slope. The intersection point of the (E) characteristic and the (F) characteristic of the load determines the new frequency  $f_2$ . In case the frequency value of  $f_2$  is smaller than the allowed value of

 $f_{cp}$ , it is necessary to cut the load. The original load characteristic (F) changes to the new characteristic of the load (G). The intersection of the (E) characteristic and the new characteristic of the load (G) determines the allowed frequency value  $f_{cp}$ .

Thus, in the case of a power imbalance between the source and the load, the electrical system goes through stages: the primary frequency control, the secondary frequency control. After the implementation of the secondary frequency adjustment process and the electricity system frequency has not yet recovered to the permitted value, the load shedding is implemented to restore the frequency. This is seen as a last resort to avoid power system blackout and electrical system collapse.

2.3. Minimum load - shedding calculation

Calculating the minimum load shedding capacity  $P_{LS\ min}$  ensures restoration of electricity system frequency to the allowable value, and helps to reduce the least economic damage to consumers. The calculation includes the primary control and secondary control of the generator in accordance with the actual operation.

In a power system with n generators, when a generator outage, the adjustment of the primary frequency of the remaining (n-1) generator is made with the adjustment of the power according to the following equation:

$$\sum_{i=1}^{n-1} \Delta P_{\text{Primary control}} = \sum_{i=1}^{n-1} \frac{-P_{G_{n,i}}}{R_i} \cdot \frac{\Delta f_1}{f_0} \quad (6)$$

Where,  $\Delta P_{\text{Primary control}}$  is the primary control power of the i generator;  $\Delta f_1 = f_1 - f_0$  is the rated power of the i generator; is the frequency attenuation;  $f_n$  is the rated frequency of the power system.

When the generator outage, the difference between the generation power and the load power causes the frequency difference, in particular, to be decreased. The amount of power of the frequency-dependent load reduces the amount of  $\Delta P_D$  is shown in Equation (5).

Power balance status is presented in the following equation:

$$P_L - \Delta P_D = \sum_{i=1}^{n-1} P_{G_i} + \sum_{i=1}^{n-1} \Delta P_{\text{Primary control}}$$
(7)

$$P_{L} - \sum_{i=1}^{n-1} P_{G_{i}} = \Delta P_{D} + \sum_{i=1}^{n-1} \frac{-P_{G_{n,i}}}{R_{i}} \cdot \frac{\Delta f_{1}}{f_{0}}$$
(8)

$$P_{L} - \sum_{i=1}^{n-1} P_{G_{i}} = -\left(\frac{\Delta f}{f_{0}}\right) \cdot P_{L} \cdot D + \sum_{i=1}^{n-1} \frac{-P_{G_{n,i}}}{R_{i}} \cdot \frac{\Delta f_{1}}{f_{0}}$$
(9)

$$P_L - \sum_{i=1}^{n-1} P_{G_i} = -\left(\frac{\Delta f_1}{f_0}\right) \left(P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_{n,i}}}{R_i}\right)$$
(10)

Set 
$$\Delta P_L = P_L - \sum_{i=1}^{n-1} P_{G_i}$$
 and  $\beta = P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_{n,i}}}{R_i}$ 

From (10) infer: 
$$\Delta P_L = \frac{-\Delta f_1}{f_n} \cdot \beta$$
 (11)

In the case of the considering secondary control power, the new power balance equation with the new frequency value  $f_2$ , the equation (7) becomes:

$$P_L - \Delta P_D = \sum_{i=1}^{n-1} P_{G_i} + \sum_{i=1}^{n-1} \Delta P_{\text{Primary control}} + \Delta P_{\text{Secondary control max}}$$
(12)

Where,  $\Delta P_{\text{Secondary control max}}$  is the maximum amount of secondary control power supplied to the power system.

$$\Delta P_{\text{Secondary control max}} = P_{Gm,j} - \Delta P_{\text{Primary control, j}} \quad (13)$$

After performing the secondary control process but the system frequency has not yet been restored to the allowable value, then load shedding is required to restore the frequency, the minimum amount of load shedding power  $P_{LS \min}$  is calculated by the following equation:

$$P_{L} - \Delta P_{D} - P_{LS\min} = \sum_{i=1}^{n-1} P_{G_{i}} + \sum_{i=1}^{n-1} \Delta P_{Primary control} + \Delta P_{Secondary control \max}$$
(14)

$$\Delta P_{LS\min} = P_L - \Delta P_D - \sum_{i=1}^{n-1} P_{G_i} - \sum_{i=1}^{n-1} \Delta P_{\text{Primary control}} - \Delta P_{\text{Secondary control max}}$$
(15)

$$\Delta P_{LS\min} = P_L - \sum_{i=1}^{n-1} P_{G_i} + \frac{\Delta f_{cp}}{f_0} \cdot P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_{n,i}}}{R_i} \cdot \frac{\Delta f_{cp}}{f_0} - \Delta P_{\text{Secondary control max}}$$
(16)

Equation (15) is abbreviated according to the following equation:

$$\Delta P_{LS\min} = \Delta P_L + \frac{\Delta f_{cp}}{f_0} \cdot \beta - \Delta P_{\text{Secondary control max}} \quad (17)$$

#### 2.4. Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP) [19] is one of Multi Criteria decision making method that was originally developed by Prof. Thomas L. Saaty. In short, it is a method to derive ratio scales from paired comparisons. This method presents assessment method and criteria, and works collectively to arrive at a final decision. AHP is particularly well suited for case studies involving quantitative and analytical, making decisions when there are multiple standards-dependent alternatives with multiple interactions.

The steps of the AHP algorithm can be expressed as follows:

Step 1: Set up a decision hierarchy model.



Fig. 2 AHP model of the arrangement of units

Step 2: Build judgment matrix LC and LN that show the important factor between load centers (LC) and load nodes (LN) each other of the power system. The value of elements in the judgment matrix reflects the user's knowledge about the relative importance between every pair of factors.

$$LC = \begin{bmatrix} w_{D1}/w_{D1} w_{D1}/w_{D2} \dots w_{D1}/w_{Dn} \\ w_{D2}/w_{D1} w_{D2}/w_{D2} \dots w_{D2}/w_{Dn} \\ \vdots & \vdots \\ w_{Dn}/w_{D1} w_{Dn}/w_{D2} \dots w_{Dn}/w_{Dn} \end{bmatrix};$$

$$LN = \begin{bmatrix} w_{K1}/w_{K1} w_{K1}/w_{K2} \dots w_{K1}/w_{Kn} \\ w_{K2}/w_{K1} w_{K2}/w_{K2} \dots w_{K2}/w_{Dn} \\ \vdots & \vdots \\ w_{Kn}/w_{K1} w_{Kn}/w_{K2} \dots w_{Kn}/w_{Kn} \end{bmatrix}$$
(18)

where,  $wD_i/wD_j$  is the relative importance of the i<sup>th</sup> load node compared with the j<sup>th</sup> load node;  $wk_i /wk_j$  is the relative importance of the i<sup>th</sup> load center compared with the j<sup>th</sup> load center. The value of  $wk_i /wk_j$ ,  $wD_i/wD_j$  can be obtained according to the experience of electrical engineers or system operators by using some "1 – 9" ratio scale methods. According to the principle of AHP, the weighting factors of the loads can be determined through the ranking computation of a judgment matrix, which reflects the judgment and comparison of a series of pair of factors. Therefore, the unified weighting factor of the load nodes of the power system can be obtained from the following equation:

$$W_{ij} = W_{Kj} \times W_{Di} \qquad Di \in K_j \tag{19}$$

where,  $Di \in Kj$  means load node  $D_i$  is located in load center  $K_j$ .

Step 3: Calculate the load importance factor of center regions together and the load importance factors of each load unit in the same load area on the basis of constructing judgment matrix. According to the principle of AHP algorithm, the load importance factors can be calculated through the calculation of the maximum eigenvalue and the eigenvector of the judgment matrix.

To calculate the eigenvalue of matrix largest judgment, can use the root methods.

- Multiply all the components in each row of the judgment matrix.

$$M_i = \prod_i X_{ij}, i = 1, ..., n; j = 1, ..., n$$
 (20)

Here, n is the dimension of the judgment matrix A,  $X_{ij}$  is the element of the matrix A.

- Calculate the n<sup>th</sup> root of M<sub>i</sub>

$$W_i^* = \sqrt[n]{M_i}$$
,  $i = 1, ..., n$  (21)

Vector W \*: 
$$W^* = \left[W_1^*, W_2^*, ..., W_n^*\right]^T$$
 (22)

- Standardize vector W \*

$$W_i = \frac{W_i^*}{\sum_{j=1}^n W_j^*}, i = 1, ..., n$$
 (23)

In this way, there are eigenvectors of matrix A,

$$W = \begin{bmatrix} W_1 , W_2 , ..., W_n \end{bmatrix}^T$$
(24)

Step 4: Hierarchy ranking and check the consistency of the results. Sort in descending order of the load importance factor of each load unit to implement a load shedding strategy according to priority level.

#### 2.5. The proposed method

When there is a generator failure in the electrical system, the frequency will be reduced. Systems that control the Primary and the Secondary adjustments will be implemented to restore the frequency. In case the frequency is still not restored to permissible range, load shedding must be processed to restore frequency to permissible value. The AHP algorithm is applied to calculate the load importance factor of and rank these loads. The distributed shedding power at each load buses is based on this factor. Loads with the smaller importance factor will have priority to be shed with the larger amount of shedding power and vice versa. Flowchart of the load shedding process based on AHP algorithm is shown in Figure 3.



Fig.3 The flow chart of load shedding base on the AHP algorithm

#### III. CASE STUDIES

The proposed method is tested on the IEEE 37-bus 9generators electrical system [20]. The single line diagram of the system is shown in Figure 5. The generator at Bus-31 is considered the Slack Bus.

From the single diagram of the electrical system, build a model of the hierarchy between the load centers and the loads in the load center. The results of building the model hierarchy are presented in Figure 4.

Next, construct judgment matrices that show the importance of the load centers to each other and the importance of the loads in the load center. Construction results are presented from Table 1 to Table 5.

Table 1. The judgment matrix of load center LC<sub>i</sub>

PI	LC <sub>1</sub>	LC <sub>2</sub>	LC <sub>3</sub>	LC <sub>4</sub>
LC <sub>1</sub>	1/1	1/3	1/1	1/1
LC <sub>2</sub>	3/1	1/1	1/1	3/1
LC <sub>3</sub>	1/1	1/1	1/1	1/2
LC <sub>4</sub>	1/1	1/3	2/1	1/1



Fig. 4 AHP model for load centers and load units in IEEE 37 bus 9 generator

Table 2.	The judgment	matrix of loa	$d L_j at LC_j$
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	L <sub>2</sub>	L3	L <sub>4</sub>	L5	L6	L7	L8	L9
L <sub>2</sub>	1/1	1/1	1/1	1/3	1/2	1/3	1/2	1/2
L <sub>3</sub>	1/1	1/1	3/1	1/1	2/1	1/1	2/1	1/1
L <sub>4</sub>	1/1	1/3	1/1	1/2	1/1	1/2	1/1	2/1
L5	3/1	1/1	2/1	1/1	1/3	1/3	1/1	1/3
L <sub>6</sub>	2/1	1/2	1/1	3/1	1/1	1/1	3/1	1/3
L7	3/1	1/1	2/1	3/1	1/1	1/1	1/2	1/1
L8	2/1	1/2	1/1	1/1	1/3	2/1	1/1	1/2
L9	2/1	1/1	1/2	3/1	3/1	1/1	2/1	1/1

Table 3. The judgment matrix of load  $L_j$  at  $LC_2$ 

	L10	L <sub>11</sub>	L <sub>12</sub>	L13	L <sub>14</sub>
L10	1/1	1/1	1/1	1/3	1/2
L11	1/1	1/1	3/1	1/1	1/1
L <sub>12</sub>	1/1	1/3	1/1	1/2	2/1
L13	3/1	1/1	2/1	1/1	1/3
L14	2/1	1/1	1/2	3/1	1/1

*Table 4. The judgment matrix of load*  $L_j$  *at*  $LC_3$ 

	L <sub>15</sub>	L <sub>16</sub>	L19	L <sub>22</sub>	L <sub>23</sub>
L15	1/1	1/2	1/1	1/1	1/2
L16	2/1	1/1	3/1	1/3	1/1
L19	1/1	1/3	1/1	1/2	2/1
L <sub>22</sub>	1/1	3/1	2/1	1/1	1/3
L23	2/1	1/1	1/2	3/1	1/1

	L25	L30	L32	L34	L35	L36	L37
L <sub>25</sub>	1/1	1/1	1/1	1/3	1/2	1/3	1/2
L30	1/1	1/1	3/1	1/1	1/1	1/1	1/1
L32	1/1	1/3	1/1	1/2	2/1	1/2	2/1
L34	3/1	1/1	2/1	1/1	1/3	1/3	1/1
L35	2/1	1/1	1/2	3/1	1/1	1/1	3/1
L36	3/1	1/1	2/1	3/1	1/1	1/1	1/2
L37	2/1	1/1	1/2	1/1	1/3	2/1	1/1

Table 5. The judgment matrix of load  $L_j$  at  $LC_4$ 

From the values of judgment matrix, apply AHP algorithm presented in 2.4 section to calculate the importance factor of the load. Parameter values of the load and the results of calculation of the importance factor of the load are presented in Table 6:

Table 6.	The values of the loads and the importance factor
	of the load are calculated by AHP

Load cente r	WlCi Wkj	Load Bus t	Cost C <sub>mi</sub> (\$/ kW)	W <sub>Lj</sub> (load unit)	The impor t tanct factor W <sub>ij</sub>	P <sub>LSi</sub> (M W)
LC1	0.18	L <sub>2</sub>	220	0.07	0.0126	1.68
LC1	0.18	L <sub>3</sub>	200	0.16	0.0293	0.72
LC1	0.18	$L_4$	280	0.10	0.0172	1.23
LC1	0.18	$L_5$	200	0.10	0.0178	1.19
LC1	0.18	L <sub>6</sub>	250	0.14	0.0246	0.86
LC1	0.18	L <sub>7</sub>	300	0.16	0.0283	0.75
LC1	0.18	$L_8$	280	0.10	0.0187	1.13
LC1	0.18	L9	280	0.17	0.0308	0.69
LC2	0.41	L <sub>10</sub>	245	0.07	0.0556	0.38
LC2	0.41	L <sub>11</sub>	280	0.14	0.0991	0.21
LC2	0.41	L <sub>12</sub>	220	0.24	0.0638	0.33
LC2	0.41	L <sub>13</sub>	280	0.16	0.0913	0.23
LC2	0.41	L <sub>14</sub>	220	0.22	0.0991	0.21
LC3	0.20	L <sub>15</sub>	280	0.15	0.0295	0.72
LC3	0.20	L <sub>16</sub>	220	0.23	0.0447	0.47
LC3	0.20	L19	245	0.16	0.0312	0.68
LC3	0.20	L <sub>22</sub>	220	0.23	0.0447	0.47
LC3	0.20	L <sub>23</sub>	280	0.24	0.0484	0.44

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https://dx.doi.org/10.22161/ijaems.612.1	

LC4	0.21	L <sub>25</sub>	280	0.08	0.0176	1.2
LC4	0.21	L <sub>30</sub>	220	0.16	0.0344	0.62
LC4	0.21	L <sub>32</sub>	250	0.12	0.0252	0.84
LC4	0.21	L <sub>34</sub>	300	0.13	0.0278	0.76
LC4	0.21	L <sub>35</sub>	245	0.19	0.0403	0.53
LC4	0.21	L <sub>36</sub>	280	0.19	0.0403	0.53
LC4	0.21	L <sub>37</sub>	300	0.13	0.0278	0.76

To test the effectiveness of the proposed method, the situations of deactivation or disconnection of the electricity system of these generators are calculated, simulated and tested parameters such as: frequency, the amount of primary control power, the amount of secondary control power, and minimal load shedding power. In cases of calculation and simulation, the power for controlling primary and secondary frequencies is implemented. All test cases were simulated on PowerWorld GSO 19 software.

In the case study, the generator JO345 # 1 (bus 28) is disconnected from the grid. Applying the equation (11) calculate the stable frequency value when the generator JO345 # 1 (bus 28) outage is 59.6Hz.

Therefore, it is necessary to implement the process of primary frequency control and secondary frequency control to restore frequency. The adjustment of primary frequency is done automatically. The reaction of the turbine governor is performed immediately after the generator JO345 # 1 (bus 28) is disconnected. The primary control power values of each generator turbine are shown in Table 7.



Fig. 5: The IEEE 37 bus 9 generators test system.

 Table 7. Value of parameters and primary control power
 of the generators

No	Gen	PG (MW)	PG (pu)	R	$\Delta P_{\rm Pri}$	$\frac{P_{G,n}}{R}$
1	WEBER 69	31.5	0.315	0.05	0.03 5	7
2	JO345# 1	0	0	0.05	0	0
3	JO345# 2	135	1.35	0.05	0.15	30
4	SLACK 345	187.28	1.8728	0.05	0.22	44
5	LAUF6 9	135	1.35	0.05	0.15	30
6	BOB69	46	0.46	0.05	0.05 2	10.4
7	ROGER 69	72	0.72	0.05	0.08	16
8	BLT138	126	1.26	0.05	0.14	28
9	BLT69	99	0.99	0.05	0.11	22
	Total	831.78	8.3178		0.93 7	187. 4

Because the recovery frequency is less than the allowed value, the secondary frequency control process is performed after the primary control. In the IEEE 37 bus 9-generator electrical system diagram, the SLACK 345 (SLACK Bus) is selected as the secondary frequency control generator. In this case, application equation (13) calculates the amount of the secondary control power of 10.72MW. The frequency of the system after the implementation of the secondary control is shown in Figure 6.

Thus, after performing the secondary frequency control process, the recovery frequency is 59.66Hz and has not returned to the allowed value. Therefore, the ultimate solution cuts or reduces the load to restore the frequency to the allowable value. Applying Equation (17) calculates the minimum amount of power load shedding to restore the frequency to the allowable value.



Fig. 6: The frequency of the system after the implementation of the primary and secondary control

$$\Delta P_{LS \min} = \Delta P_L + \frac{\Delta f_{cp}}{f_0} \cdot \beta - \Delta P_{\text{Secondary control max}}$$

$$\Delta P_L = P_L - \sum_{i=1}^{n-1} P_{G_i} = 9.5394 - 8.31780 = 1.2216$$

$$\beta = P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_i}}{R_i} = 9.5394 \times 0.02 + 187.4 = 187.59$$

$$\Delta P_{LS \min} = 1.2216 + \frac{(-0.3)}{60} \times 187.59 - 0.1072 = 0.1764 \, pu$$

So, the minimum load shedding capacity of  $P_{\text{Load shedding min}}$  is 17.64MW.

To test the effectiveness of the proposed method, this minimum load-shedding capacity is distributed for load nodes according to the importance factor of the load. The distribution table of load shedding capacity at the load bus is presented in Table 6.

Comparing the proposed load shedding method with the load shedding method using the under frequency load shedding relay (UFLS) when performing with the same amount of shedding capacity is 17.64MW. The result of frequency simulation and the economic losses associated with load shedding are presented in Figure 7 and Table 8.

Table 8. Comparing economic losses of load sheddingbased on AHP algorithm and UFLS

Load shedding Methods	AHP	UFLS
Load shedding (MW)	17.64	17.64
$\begin{array}{ll} E conomic & damage \\ \sum P_{LSi}C_{mi}\left(x10^3\right)\left(\$\right) \end{array}$	4391.5	4610.85

It can be seen that the frequency values at steady state of both load shedding methods based on AHP and UFLS are

restored to allowable value. The reason is due to load shedding with the same capacity. However, the frequency response quality of the UFLS method is not equal to the AHP method.



Fig. 7: The frequency of the system when applying the traditional and the proposed load shedding method

The reason is the UFLS method must wait for the frequency to drop below the set threshold to impact load shedding. Although they are shedding the same amount of power, the AHP method has about 5% less damage value. The reason is that AHP method ranks the load and supports load shedding based on the importance factor. This has helped to reduce the value of the damage caused by load shedding. Thus, the method of calculating the minimum load shedding capacity has controlled frequency to restore back to the allowed value of 59.7Hz and shows the effectiveness of the proposed method.

#### IV. CONCLUSION

The calculation of the amount of load shedding capacity considering the primary frequency control and the secondary frequency control helps to minimize the amount of load shedding capacity. This helps the frequency to recover to the value within the permissible range.

A load shedding method considers to the primary and secondary control elements of the power plant to calculate the minimum amount of load shedding power and restore the frequency back to the allowable value.

The effectiveness of the proposed method has been demonstrated on the 9 generator 37-bus system under different test cases. The performance of this is found to be better than that of a conventional UFLS scheme. The test results show that the proposed method results in reduced the cost of customer service interruption.

#### ACKNOWLEDGEMENTS

This work belongs to the project in 2020 funded by Ho Chi Minh City University of Technology and Education, Vietnam.

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# The Existence of Management Policies and Practices for the information of Regional Regulations on Development progress in Bone Bolango Regency

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Received: 07 Oct 2020; Received in revised form: 10 Nov 2020; Accepted: 21 Nov 2020; Available online: 07 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— This paper aims to analyze and describe: the existence of policies and management practices in the formation of regional regulations on development progress in the district of Tulang Bolango. The research method used is a qualitative method. Data analysis used in qualitative research is an interactive model analysis which consists of three components of analysis, namely: 1) Data Reduction; 2) Presentation of Data; 3) Verification of Data and Conclusion Images.

The results of the article show that: 1) Existence of Management Policies and Practices for the Formation of Regional Regulations on Development Progress in Bone Bolango District needs to emphasize the importance of collaboration with Regional Apparatus Organizations as material for consideration in formulating Regional Regulations. Apart from that, the Regional Government must always capture the aspirations of the community regarding the formulation of regional regulation policies; 2) In the formation of regional regulations in the Regional Representative Council of Bone Bolango Regency, it must consider the aspect of the right man on the right place, in the sense that Bapemperda members must be filled with human resources who understand the process of forming Regional Regulations.

Keywords— Management Policies and Practices; Bapemperda; Regional People's Representative Assembly.

#### I. INTRODUCTION

#### 1.1 Reaserch Background

The establishment of Regional Regulations or abbreviated (Perda) is basically intended to improve public services in order to accelerate the realization of community welfare through regional development. Therefore, the establishment of Regional Regulations should pay attention to various factors such as the economic capability of the region, regional potential, area, population density, consideration of socio-political, socio-cultural aspects, as well as other considerations and conditions that allow the region to organize and realize the purpose of regional formation. The process of drafting Regional Regulations in Bone Bolango Regency that is the focus of the study in this article should require competent people and to explore the field of legislation. Because the Regulation is a legal reference framework in the implementation of regional autonomy. The substance of the Regulation should be able to accommodate the needs of the community in the sense that the existence of the Regulation should affect the progress of the regional development. Therefore, the importance of evaluating the Regulation affects the development and quality of service to the community. The regulation that is signaled to be problematic and inhibit development in important areas is known, because the negative impact of the regional government that is problematic or ineffective implementation can have implications for the declining economic turnaround in the region so as to impede the development and welfare of the community. On the contrary, the character of the Regional Government that encourages the influx of regional investment will bring good luck or at least be expected to help increase Regional Native Income (PAD). Whereas the key to success in the implementation of regional autonomy based on Law No. 23 of 2014 on Local Government is not only determined by the high PAD. However, there are other factors that contribute to determining such as: the level of regional democratization, regional independence, and Community.

The benchmark for seeing whether or not there is a guarantee of security and legal certainty lies in the extent of the substance of the Regulation, and the effectiveness of its manufacture and application. Adapaun which is a technical requirement of performance measurement includes the factors that form the basis for the establishment of local regulations including inputs, processes, outputs, and impacts. Measurements of this performance to compare between one region and another.

Departing from the construction of the above thinking, the author assumes that: 1) Against the many policies of the Regional Government that are not effective implementation in the field will certainly have implications for the decrease in investment interest in the region ranging from micro scale (MSMEs) to macro; 2) There is a correlation between local regulatory policy and legal certainty. If the guarantee of legal certainty is high or good, it is certain that business actors can invest their capital in the area. Moreover, in the area of Bone Bolango Regency has prospective bargaining potential and such as agriculture, mining, and tourism, as well as trade. Conversely, if the guarantee of security certainty and legal certainty is low investors will be reluctant to even fear investing their capital.

The next problem related to the extent to which high security guarantees and legal certainty have been accommodated in the process of making the Regional Regulation so as to stimulate the emergence of the business climate and economic movement towards the progress of development in the region. After conducting a more indepth observation the author found that the existence of regional regulations that are less effective implementation, one of which is caused by the process and administrative mechanisms are not complete. Ideally a Regional Regulation should be made in an integrated and systematic plan to avoid cancellation or request to be canceled which if it happens can affect the running of the wheels of government and development in Bone Bolango Regency. Regional Regulations that are not optimal caused also by the understanding of the Organization of Regional Devices or abbreviated (OPD) on the mechanism and technical preparation of regional formation programs or abbreviated Propemperda. the lack of understanding of opd is due to the absence of Regent Regulation on the procedures for the preparation of Local Government Propemperda. The absence of Regent Regulation on the procedures for drafting Propemperda is also an obstacle to determining which issues are more important to be made a priority to be realized first and then made the regulation, so that the proposed draft regional regulations become ineffective and have implications for the stalled development in Bone Bolango Regency.

#### 1.2 Reasearch Objectives

Some of these fundamental problems will be the subject of the study in this article, but the author only limits on aspects of the study of habits and practices of management in the formulation of Local Regulations. In a different perspective of the study, the authors hope that there are other authors who are willing to solve some of the above problems in order to obtain the results of a more comprehensive analysis.

#### II. RESEARCH METHODS

The type of research in this article is phenomenology which is intended to give a clear picture of the policies and practices of local regulations on the progress of regional development in Bone Bolango Regency. Data analysis techniques are carried out using qualitative data analysis techniques, by conducting intensive analysis of the data that has been obtained in the field in the form of words. Data analysis techniques used by researchers are data reduction, then presenting data, and finally, drawing conclusions. (Miles and Huberman 1992)

#### III. RESULTS AND DISCUSSION

Bone Bolango Regency is an area located in Gorontalo Province. This district is the result of the expansion of Gorontalo Regency in 2003. At the time of the bloom Bone Bolango regency consisted of only four sub-districts, namely: Bone Pantai, Kabila, Suwawa, and Tapa. Until September 2011, Bone Bolango district experienced a lot of process of expanding sub-districts and villages / villages, so that the number of sub-districts and villages / villages became many, namely 17 sub-districts and 1 preparatory sub-district (Pinogu area), 152 villages, and 4 villages.

Members of the Bone Bolango Regency DPRD have interpellation rights, polling rights, and the right to express

opinions. Members of the Bone Bolango District Parliament also have the right to submit draft Regional Regulations, ask questions, submit proposals and opinions, defend themselves, immunity rights, protocol rights, vote and be elected, follow orientation and inland duties as well as financial and administrative rights. According to Law No. 22 of 2003 concerning the composition and position of mpr, DPR, DPD, and DPRD in carrying out their duties and authorities, dprd kabupaten has the right to ask state officials at the district level, local government officials, legal entities, or citizens to provide information.

In Law No. 23 of 2014 on Local Government, it is stated that the district government is the local government and the District People's Representative Council. Both are institutions that fill each other in running local government in order to achieve regional goals. The relationship between the two institutions is equal as a partner and checks and balances.

As for the duties and functions of Bapemperda as a function of the Legislature, namely: 1) Contains a list of the order and priorities of the draft regional regulations and their reasons for each fiscal year in the House of Regional Representatives; 2) Coordination for the preparation of between the of Propemperda House Regional Representatives and Local Government; 3) Harmonize, rounding, and strengthening the draft conception of local regulations submitted by members, commissions and/or joint commissions before the Propemperda is submitted to the leadership of the House of Regional Representatives; 4) Give consideration to the Propemperda submitted by members, commissions and/or joint commissions, outside the priority of propemperda in the current year or outside the draft regional regulations registered in the Propemperda; 5) Follow the development and evaluate the discussion of propemperda content material through coordination with the commission and / Special Committee; 6) Provide input to the leadership propemperda commissioned by the Board of Deliberations; and 7) Make a performance report and inventory at the end of the membership period of the House of Regional Representatives.

There are four factors that influence the effectiveness expressed by Steers Richard (1985:8) namely: 1) Organizational characteristics; 2) Environmental characteristics; 3) Characteristics of workers; and 4) Management policies and practices. However, in this article the author will only explore the aspects of management policies and practices because the indicators are directly related to the problem as the author has described in the introduction point above. Steers Richard (1985:10) says that management policies and practices, are strategies and mechanisms of work designed to conditioning everything in the organization so that effectiveness is achieved. Mananjeman policies and practices are tools for leaders to direct each activity to achieve the objectives of the organization. In implementing management policies and practices must pay attention to human beings, not only concerning strategies and mechanisms of work. These mechanisms include strategic objectives, the search and utilization of resources, the creation of an achievement environment, and the process of communication, leadership and decision making and adaptation to the changing organizational innovation environment.

Management policies and practices in an organization can be interpreted differently by each individual (member) in the organization, this is due to the different interpretations of each individual to an organizational policy that will affect its management practices. A member's interpretation of a policy can be maintained by providing a clear explanation of the members of the organization at the beginning of its policy introduction and management practices, this is to keep the expectations of permanent members at a realistic level. Realistic expectations help maintain a good perception of the member of a policy, will further influence the member's interpretation of a policy and management practice and will affect the behavior of such members such as the level of absence, performance, and orientation.

In line with the above, Lasatu, A. (2020) in his journal said that budget factors, time, society, and drafters, are also very influential in the preparation of Propemperda, as well as the establishment of regional regulations in Sigi Regency has not been effective and efficient because there is no regulation in the region that regulates in detail the mechanism of drafting Propemperda. Therefore, all respondents and stake holders recommend the establishment of local regulations as an instrument of planning Propemperda that is prepared in a planned, integrated, and systematic.

In addition, based on the results of interviews that the author did to members of the Regional Regulatory Establishment Agency said that "As a body that works in the formulation of local regulations, we find conditions where there are differences of opinion between each member of the Regional Representative Council Bapemperda Bone Bolango. This condition, motivated by several things, one of which is the difference of understanding in interpreting policies that are the aspirations of the community, meaning that there is a management function that does not work as it should." In line with the above, another Bapemperda Member who is the Chairman of Bapemperda of the Bone Bolango Regional People's Representative Council, revealed that " In every discussion at the Bapemperda level, we often encounter the issue of member participation level, meaning that sometimes there are members who do not participate in the discussion, or there are members who are not very focused on the agenda of discussion, this is meant as a release of the duties and responsibilities of members to their functions as members of the legislature , in my view this is due to management practices that do not run as they should, for example in the supervisory stage, is still very minimal, in the future I hope, these management functions can be implemented in every applicable policy."

According to the author, management policies and practices are one of the important functions of bapemperda's success in working, management functions, such as planning, organizing, implementing, until the stage of supervision should be inherent in the duties and functions of Bapemperda. In a democratic climate, a good management structure is able to align and balance each work plan to be implemented. This is in line with what Danusastro, S. (2016) said that democracy is part of the Indonesian state that is characterized among others by public participation in government as a form of people's sovereignty. In the process of drafting Regional Regulations, participatory Regional Legislation Program occupies a very important position because it can be a reference on the priority scale of drafting regional regulations for a period of 1 year in accordance with the mandate of Law No. 12 of 2011 on Regulation Area. Development of Legislation. Therefore, the Local Government in this case the City Government and the DPRD as the authority to develop the Regional Legislation Program must go through a participatory mechanism by involving the community and stakeholders such as nongovernmental organizations so that the Regional Legislation Program. resulting is the aspiration and participatory proposal of the Draft Regional Regulations and in practice the proposed Draft Regional Regulations are developed in a planned, integrated and systematic manner.

Furthermore, the author also conducted further interviews related to policy indicators and management practices in determining the effectiveness of Bapemperda's performance with one of bapemperda members, through the results of the interview stated that "Propemperda or regional legitimacy program is a reference or basis of Bapemperda's performance in formulating the Draft Regional Regulations every year running, by implementing a good management function, ranperda that will be plenary will be well realized , but there are obstacles and obstacles that we often jumai, the problem of obstacles are only trivial, for example the activeness of members in each siding discussion and plenary is often in the spotlight, for that I am among the people responsible with it expects in the future the management function can be implemented in all components of the work. Because formulating this regional policy should involve all elements and thoughts. So that every legal products born through the legislature or Bapemperda is able to give birth to responsive legal products."

The concept of policy characteristics and management practices according to the authors in this article provides understanding as a strategy and mechanism of work designed to improve the effectiveness of Bapemperda's performance towards the progress of development in Bone Bolango Regency. Management is a tool to achieve the desired goals. Good management will facilitate the realization of the objectives of the organization, so that the organization can be carried out properly then each organization must have effective and efficient management regulations. Management is basically a process in which an organization in carrying out an activity must have management principles by using all the resources owned by the organization in achieving its objectives in serving the public interest. This is in line with what Anam, S., \* Anwar, K. (2020) said that in reality the mechanism of control or supervision of the DPRD on public services in the District Pamekasan is sometimes hampered by intrinsic factors such as, internal institutional factors concerning the limited quantity of technical personnel in helping legislators perform, co-opted by the policy hierarchy as legal standing of legislators conducting surveillance, and the political climate factor of parliament that is split on the axis of coalition with the opposition. On the other hand, the control or supervision carried out by the fittings of the House of Regional Representatives commissions as partners of regional device organizations must be supported by strong legal aspects, supported by sufficient funding to carry out their duties and functions, supported by adequate facilities and supported by the council secretariat team.

Based on the results of the author's interview with the informant showed that the characteristics of management policies and practices in bapemperda DPRD Bone Bolango still need to be improved, meaning that there are improvements from the management aspect, so that the reference Propemperda can be fully set. This can be seen from the difference of each member in interpreting the policy, meaning that there are management lines that have not run as they should, ha this also affects the effectiveness of Bapemperda's performance itself. As well as the issue of commitment of each member in attendance, seen from the level of participation of members in the meeting or in each siding plenary. It also shows that management practices have not been running as they should, in terms of supervision needs to be tightened again in order to maximize each member's duties and functions and responsibilities.

Mahmudi (2010:37) asserts that management practices and policies in government are oriented to public needs so that the managerial approach carried out based on strategic functions namely strategy formulation and program creation is made in the framework of goal setting, vision and mission of the organization that is long-term. Because managers play a central role in the success of an organization through planning, coordinating and streamlining the activities aimed towards the target. Good policy is that it clearly takes us in the direction we want to go. Policy should be understood does not mean that the policy should be written.

As for according to Amstrong (2009:14) In essence management is about deciding what to do then implement it through people). This definition emphasizes that organization is the most important resource. From these policy factors and management practices, at least identified into six variables that contribute effectiveness, namely: 1) strategic goal preparation, 2) resource search and utilization, 3) creating an achievement environment, 4) communication processes, 5) leadership and decision making and 6) innovation and adaptation.

Based on the results of interviews and expert opinions above can be concluded by the author that management policies and practices set by the leadership in regulating and controlling the organization is very influential for the organization as well as for the achievement of goals. The principle of policy and management practice in the establishment of regional regulations is to regulate and implement a policy directed at the community in other words representing the need to be organized and channeled to the public interest, related to it, the principle is justice, in this case the government is able to provide guarantees of equal access for the community and create a flow of openness and transparency where every policy concerns the public interest and can be accounted for.

#### **IV. SUGGESTIONS**

Oriented to the results and discussion above, the author formulates the conclusion as follows:

1. The existence of Policies and Practices for the Establishment of Regional Regulations against The Progress of Development in Bone Bolango Regency needs to emphasize the importance of collaboration with Regional Device Organizations as a consideration in formulating Regional Regulations. In addition, local governments must always capture the aspirations of the community related to the formulation of local regulation policies.

2. In the establishment of local regulations in the House of Representatives bone bolango district should consider aspects of the right man on the right place, in the sense that bapemperda members must be filled by human resources who understand the process of forming Regional Regulations.

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# The Development of Edmodo-Based E-learning in Mathematics for Class V at Dr. Wahidin Sudirohusodo Primary School

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Abstract—This study aims to produce an Edmodo-based e-learning development product in mathematics class V at Dr. Wahidin Sudirohusodo Primary School and to know the feasibility and effectiveness of the developed Edmodo-based elearning media. This study uses a Research and Development (R&D) approach with ADDIE model where each stage is interconnected and in stages in producing development products. The research subjects in this study are the design, media, learning material experts, the teacher, and the students. The hypothesis proposed of this study is that the development media products on Edmodo-based e-learning are feasible and effective for use in the learning process of mathematics. The data is collected through questionnaire by research subject assessment instrument and posttest from learning outcome instrument. The feasibility of the media is obtained through the validation and testing by research subjects where the average percentage of the results of the assessment of design, media, and learning material experts is 89.3%, while the average percentage of the results of teacher and student assessments in the trial of individual and groups of students is 90.5% who fall into the "Very Appropriate" category. The product effectiveness test from the learning outcome test data on the research hypothesis test through one-party test obtained  $t_{count} > t_{table}$  (2.3798 > 1.66980), which means that students' mathematics learning outcomes with Edmodo-based e-learning were higher than students who studied conventional truth-tested. Thus development media products on Edmodo-based e-learning are feasible and effective for use in the learning process and can improve student learning outcomes compared to conventional learning.

Keywords— E-learning, Edmodo, Mathematics, Media.

#### I. INTRODUCTION

In this modern era, which is often referred to as the era of the industrial revolution 4.0, of course, technology is increasingly needed to assist human activities in their daily lives. Even the world of education has not escaped this touch of technology. In the world of education today, the use of technology in the learning process is one of the important things in supporting the quality of learning itself.

The rapid development and advancement of technology encourages changes in world globalization. (Murray, 2012) explained every change is called learning because learning arises from the need to survive in social, economic and cultural terms which are also triggered by the environment. Even the presence of this globalization cannot be avoided by the world of education. The development of globalization has triggered a tendency to shift in the world of education from conventional face-to-face meetings to a more open and flexible education (Budiman, 2017). This makes education today must always adapt to the times in facing the fast flow of information and knowledge through information and communication technology.

Conventional face-to-face learning still occurs at Dr. Wahidin Sudirohusodo Primary School. Based on the results of observations and interviews with several teachers and students, it was found that face-to-face conventional learning like that tends to be boring and does not provide motivation in the learning process that occurs. Even though some teachers have used learning media in schools such as physical props and textbooks, the learning that occurs is still mostly teacher-centered and does not involve the active participation of students. Student-centered learning is learning that involves students both individually and in groups in solving a problem and being active learners in seeking and finding knowledge, not just accepting it (Harmon & Hirumi, 1996). The learning process should use learner-centered principles that can develop creativity, a fun and challenging atmosphere, and also provide a diverse learning experience through the application of various learning strategies and methods (Warso, 2017). This shows that learning currently makes students the center in the learning process that must be active while the teacher functions as a facilitator in the learning.

Mathematics is one of the subjects that is avoided by many children even though learning mathematics is very important and useful because the knowledge in mathematics has been widely used in various other fields of science. (Bangun, 2016) stated "in mastering and creating future technology requires a strong mastery of mathematics". So we need a mathematics learning that emphasizes innovative learning media to improve student learning outcomes (Nugroho & Purwati, 2015).

Through advances in technology and information today, student-centered learning can be done with e-learning. Elearning is a type of teaching and learning where teaching materials are delivered to students using the internet, intranet or other computer network media (Hartley, 2001). This e-learning offers flexibility and flexibility where the collaborative learning that is presented can be accessed widely, anytime, and anywhere (Fuady, 2016).

There are many types of online learning (e-learning) that can be used today such as the Learning Management System (LMS). Edmodo is one type of LMS that is easy to use with an interactive and practical display. Students also get new learning experiences through Edmodo, can be more expressive, the learning atmosphere (chat) is very relaxed, and learning materials can be accessed anywhere and anytime if students forget the material he has learned (Pratama & Ismiyati, 2019).

This development research is focused on developing elearning using Edmodo as a learning platform that is conducted online to provide meaningful and studentcentered learning experiences. The use of Edmodo is expected to help teachers and students especially in mathematics to get better learning outcomes and take advantage of more technology in the learning process to prepare future generations of Indonesia who are ready to compete in the era of the industrial revolution 4.0.

#### THEORETICAL FRAMEWORK

#### 2.1 Learning

II.

Learning occurs due to the interaction between stimulus and response (Slavin, 2014). A person is considered to have learned if he can show changes / responses to a stimulus given to him. The stimulus is the input while the resulting response is the output. (Fiorella & Mayer, 2015) stated that "learning is a generative activity when learners actively generate their own learning outcomes by interpreting what is presented to them rather than by simply receiving it as presented". Learning is a change in one's behavior or abilities, which can be sustained, and not just considered a growth process (Gagne, 1970).

Thus, learning can be interpreted as an activity to acquire knowledge through a stimulus provided by the teacher where students actively respond to the information provided so that behavior changes are formed based on experiences that occur in achieving the desired learning outcomes

#### **2.2 Learning Outcomes**

Learning outcomes are abilities that students have after experiencing the learning process. Learning outcomes can indicate the extent to which students understand the material or information provided in the learning process. Learning outcomes are results in the form of scores or numbers achieved by students after being given a learning outcome test within a certain time (Dimyati & Mudjiono, 2006). Bloom (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) divides learning outcomes into three domains, namely cognitive domain, affective domain, and psychomotor domain. Learning outcomes can reveal holistically from the description of student achievement after going through learning (Sutrisno & Siswanto, 2016).

Therefore, learning outcomes can be interpreted as a learning experience that can be measured to describe the achievement of students after going through the learning process and includes aspects of cognitive (knowledge), affective (attitudes), and psychomotor (skills).

#### 2.3 Mathematics

Mathematics as a pattern of thinking, organizational patterns, and logical proof (Johnson & Rising, 1972). Courant (Courant & Robbins, 1996) in his book What is Mathematics ?: An Elementary Approach to Ideas and Methods which was revised by Stewart wrote "Mathematics as an expression of the human mind reflects the active will, the contemplative reason, and the desire for aesthetic perfection". It is further explained that mathematics departs from logic and intuition, analysis and construction, generalization and individualization.

James and James (James & James, 1976) say that mathematics is the science of logic regarding the form, arrangement, quantity, concepts that are related to one another in large numbers and divided into three fields, namely algebra, analysis, and geometry.

From some of the definitions above, it can be concluded that mathematics is the study of quantity, structure, space, change and other concepts that are related to one another and departs from deep logical thinking and then through reasoning produces generalized expressions of thought.

Mathematics learning in the 2013 curriculum uses a scientific approach which includes observing, asking, gathering information / trying, associating / processing information / reasoning, and communicating or better known as the 5M steps in the scientific approach (Rusman, 2015).

#### 2.4 E-learning

E-learning is a type of teaching and learning that allows teaching materials to be delivered to students using the internet, intranet or other computer network media (Hartley, 2001). E-learning is the use of internet technology to deliver a series of solutions that can increase knowledge and skills (Rosenberg, 2001). It can be concluded that e-learning is distance learning that utilizes one or more electronic technologies to support the learning process via the internet network.

The e-learning function for learning activities in the classroom (classroom instruction) is divided into three, namely (1) supplement; (2) complement; and (3) substitution. E-learning is said to be a supplement if students have the flexibility to choose whether to take advantage of the learning content contained in e-learning or not. e-learning as a complement aims to complement the learning material provided by the teacher. In this case, students access learning content in e-learning to increase their understanding of learning material. E-learning is said to function as a substitute if e-learning is used to substitute learning activities, for example by using learning activity models.

E-learning provides an interesting and meaningful learning experience for students because of its ability to integrate directly so that understanding of learning material will be more meaningful, easy to understand, easy to remember and easy to re-express.

#### 2.5 Edmodo

Edmodo is a social networking learning platform for teachers, students and parents developed in late 2008 by Nic Borg and Jeff O'Hara. (Pitoy, 2012) says Edmodo is a social media platform for teachers and students to share ideas, files, agendas, activities, and assignments. Edmodo aims to help teachers use social media in the learning process because Edmodo's appearance and features are similar to Facebook, but not as free as those on Facebook. This Edmodo feature is designed specifically for the world of education so that there will be interactions between teachers, students, and even parents.

Some of Edmodo functions include: (1) to facilitate communication between students and students or with teachers or teachers and students; (2) as a means of communication learning and discussion; and (3) as a place for exams / quizzes, and so on. Edmodo has features that are devoted to supporting the learning process. These features are classified based on users, namely teachers and students.

#### III. RESEARCH METHOD

#### 3.1 Research Design

This research uses a research and development approach (R&D) with the ADDIE development model which consists of five main stages, namely the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage.

The analysis stage includes analysis of needs, learning and characteristics of students' initial abilities, determining basic competencies and indicators of learning achievement.

The design stage includes designing the e-learning display and learning strategies as well as the collection of materials needed for product development according to predetermined basic competencies in the form of subject matter and other supporting aspects such as text, images, animation, audio, and video.

The development stage is the assembling of the media / combining all materials such as subject matter, pictures, animation, text, and learning videos.

The implementation stage is the application of Edmodobased e-learning which has been developed to determine the responses of teachers and students to e-learning that was developed in terms of appearance and feasibility.

At the evaluation stage, an assessment is carried out from the data that has been collected during the implementation stage. The evaluation obtained is in the form of formative and summative evaluations to determine the level of validation and its effectiveness on learning outcomes and learning quality. Formative evaluation is carried out to measure or assess learning products which include expert validation evaluations, individual, small group, and field trials. While summative evaluation is at the conclusion stage of a learning product. Summative evaluation is carried out to determine whether the product developed is effective or not in the learning process by conducting an effectiveness test.

#### 3.2 Research Subject

Learning development products require feedback in the context of formative evaluation. This feedback can be obtained from research subjects consisting of instructional design experts, material experts, media experts, teachers, and students of class V (five) at Dr. Wahidin Sudirohusodo Primary School.

#### **3.3 Research Instrument**

The data collection instrument in this development research is in the form of an assessment tool to assess the products being developed. The main instruments used to collect data in this study are as follows (1) questionnaire sheet; (2) interview; and (3) learning outcome test instrument.

The questionnaires used in this study were: (1) questionnaire sheet for material experts; (2) a questionnaire sheet for learning design experts; (3) questionnaire sheet for instructional media experts; and (4) questionnaire sheets for teachers and students.

Interview sheets are used as a means of collecting additional data from material experts, design experts, media experts, teachers, and students in the form of suggestions, criticisms, and input obtained when conducting trials.

Learning outcome tests are used to see the effectiveness of the use of Edmodo-based e-learning in learning compared to conventional learning. The form of learning outcomes test used is multiple choice with four choices (a, b, c, and d) where each correct answer is 1 and the wrong answer is 0 (zero).

The learning outcome test instrument that had been compiled was tried out on grade VI students to determine the quality of the instrument in the form of validity, reliability, level of difficulty, distinguishing power. From the results of the learning outcomes test instrument trial, 20 items were selected to be used in the product effectiveness test

#### 3.4 Data Analysis

Data analysis in this development research uses quantitative descriptive analysis, where all data that has been collected from the questionnaire are analyzed using descriptive statistical techniques which are quantitatively grouped by category to sharpen the assessment in drawing conclusions. The product development criteria will be converted into values using a Likert scale with the following formulas and criteria:

× –	$the \ number \ of \ scores \ obtained$	× 10004
<i>x</i> –	total ideal score of all items	x 100%
	Table 1: Assessment Criteria	

Grade	Criteria	Percentage (%)
А	Very Appropriate	81 - 100
В	Appropriate	61 - 80
С	Pretty Good	41 - 60
D	Less Appropriate	21 - 40
Е	Very Inappropriate	0 - 20

Source: (Sugiyono, 2015)

For quantitative data obtained from student learning outcomes in this study using a Posttest-Only Control Group Design experimental design, namely by comparing the posttest scores of students who used Edmodo-based e-learning developed with students who did not use Edmodo. The data analysis technique used is descriptive and inferential techniques.

Descriptive techniques are statistics used to analyze data by describing the data that has been collected without intending to draw general or generalized conclusions. Data presentation in the form of tables, diagrams, histograms, calculation of the mean, median, and standard deviation without significance testing.

Inferential techniques in this study using one-party t-test to test the hypothesis proposed in the study as follows:

$$t = \frac{\overline{x_1} - \overline{x_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where, t = value of t count;  $\bar{x}$  = sample mean; s = sample standard deviation; and n = number of samples.

#### IV. RESULTS AND DISCUSSION

The development of Edmodo-based e-learning media in mathematics learning with the topic of multiplying fractions is carried out in stages. The development process is carried out in accordance with the stages of the development process which includes the stages of analysis, design, development, implementation (testing), and evaluation.

The analysis stage which included needs analysis was carried out by distributing questionnaires as well as conducting interviews based on a list of questions that had been compiled in a questionnaire to 3 teachers and 28 students at Dr. Wahidin Sudirohusodo Primary School by first outlining the definition of research development carried out so that respondents have an idea of the questions to be asked.

The results of this analysis activity found that all students still used textbooks as the main source of learning and 42% of students were able to find other learning sources besides text books such as videos or other electronic information. The learning methods used by teachers so far are still mostly lecture methods with occasional use of teaching aids or learning media in class. As much as 57% of students stated that mathematics was difficult to learn, especially regarding fractions because students were not explained about concepts related to everyday life and had limited time to ask questions when they encountered difficulties in learning, while 79% of students had difficulty understanding the material through the teaching materials and methods applied.

Teachers and students already has a laptop and a cell phone that supports internet networks and most students (86% of students) stated that they are used to using the internet and electronic devices in their daily life. Students have never known and learned to use Edmodo while teachers have known Edmodo but have never applied it in the learning process. In addition, teachers (100%) and students (93%) agree that learning is developed using Edmodo.

Based on the results of this needs analysis, it can be concluded that the development of Edmodo-based elearning media is really needed by teachers and students in the mathematics learning process to facilitate studentcentered learning that is flexible, fun, and challenging in accordance with current technological developments.

Furthermore, an instructional analysis and the characteristics of the initial abilities was carried out according to the curriculum and syllabus currently being used in Dr. Wahidin Sudirohusodo Primary School which contains learning material to be used as a guide in determining basic competencies, the order of learning materials and also indicators of achievement of learning outcomes. The characteristics of the initial ability of grade V (five) students are students aged between 9-11 years and are already familiar with the use of technology and the internet where their initial abilities are familiar with fractions and master the addition and subtraction of fractions and decimals.

The result of the analysis of mathematics learning in the 2013 curriculum that is applied in schools is the determination of the basic competence of mathematics for class V (five) Odd Semester on the core competencies of knowledge, namely explaining and determining the multiplication and division of fractions and decimals. The

sub-material used is the multiplication of fractions with the learning sequence which is divided into 4 (four) meetings in the Learning Implementation Plan.

At the design stage, the concept design and initial appearance of the mathematics learning space in Edmodo are carried out through storyboarding. Then determine the learning strategy used in the learning process using Edmodo, namely STAD (Student Team Achievement Division). The selection of learning strategies used is adjusted to the characteristics of students and Edmodo's carrying capacity in implementing the mathematics learning process. Subject matter materials and supporting aspects are collected through textbooks that are being used as well as other sources in the form of text or images used in making learning media.

At the development stage, the media is assembled and made based on the previously made designs. The making of learning media in the form of learning videos which also includes learning instructions, material summaries, and assignments or exercises are carried out separately and gradually, then combined into Edmodo in the form of a learning folder in a previously made classroom. Furthermore, the evaluation questions were made in Edmodo application using the quiz feature based on the learning outcome test instrument that has been tested for validity and reliability.

The stages of testing or implementation of learning media that have been developed are carried out according to the stages of the trial implementation which includes testing and validation of media experts, material experts, and learning design experts, teachers, and students where the results of trials and validation on each research subject are used as the basis implementation of revision of learning media development so that the media developed in the end can be said to be suitable for use.

The evaluation stage is also the stage of media revision after getting the results of the trials carried out according to the suggestions and comments given by the research subjects. After being revised to fit the eligibility category of Edmodo-based e-learning media, then a trial of the implementation of learning in the experimental class was carried out on the fifth grade students at Dr. Wahidin Sudirohusodo Primary School to find out the effectiveness of the learning media that has been developed.

The average percentage of the results of the assessment of instructional design experts, instructional media experts, and learning material experts is as follows:

No	Validation	Percentage	Criteria
1	Design Experts	85,3%	Very Appropriate
2	Media Experts	93,3%	Very Appropriate
3	Material Experts	89,3%	Very Appropriate
	Average	89,3%	Very Appropriate

 Table 2: Average Percentage of Expert Validation Results

From the average percentage of the results of the three experts' assessment, 89.3% was included in the "Very Appropriate" category, which means that the development of Edmodo-based e-learning media in mathematics class V (Five) at Dr. Wahidin Sudirohusodo Primary School fulfills the need and is suitable for use by teachers and students.

The average percentage of the assessment aspects of the results of teacher and student assessments in individual and group student trials can be seen in the following table:

 Table 3: Average Percentage of Teacher and Student

 Assessment Results

No	Evaluator	Percentage	Criteria
1	Teachers	91,0%	Very Appropriate
2	Students (Individual Trial)	91,5%	Very Appropriate
3	Students (Group Trial)	89,0%	Very Appropriate
	Average	90,5%	Very Appropriate

From the average percentage of teacher and student assessments of 90.5% which fall into the "Very Appropriate" category, which means the development of Edmodo-based e-learning media in mathematics in class V (Five) at Dr. Wahidin Sudirohusodo Primary School deserves to be used and has benefits in the learning process between teachers and students.

Based on the results of the study after learning process using lectures methods, obtained the following data where the highest mark is 100 and the lowest mark is 20 with the mean of 69.53.

No	Interval	Frequenc y	Relative frequency
1	20 - 33	3	9.375
2	34 - 47	3	9.375
3	48 - 61	5	15.625
4	62 - 74	3	9.375
5	75 - 87	8	25
6	88 - 100	10	31.25
	Total	32	100%

Table 4: Frequency Distribution of Learning Outcomes of

The frequency distribution of learning outcomes shows that most of the students who got posttest result between mark of 75 and 100 is 18 pupils, while there are 14 students who got the posttest result between mark of 20 and 74.

The results of the study after learning process using Edmodo-based e-learning media, obtained the following data where the highest mark is 100 and the lowest mark is 55 with the mean of 81.25.

 Table 5: Frequency Distribution of Learning Outcomes of

 Experimental Class

No	Interval	Frequenc y	Relative frequency
1	55 - 62	4	12.5
2	63 - 70	6	18.75
3	71 - 78	1	3.125
4	79 - 86	8	25
5	87 - 94	5	15.625
6	95 - 100	8	25
	Total	32	100%

The frequency distribution of learning outcomes of experimental class shows that there are 22 students who got mark between 71 and 100. Then there are 10 students got mark between 55 and 70.

Based on the learning outcomes research data on the experimental group that show 84.375% of the students have passed the minimum learning completeness of 70 which is categorized as high and 15.625% got the mark below 70 which is categorized as average, it means that the results of learning on subjects who were given treatment in the experimental class is likely to be high.

The result of the one party t-test proves that students' mathematics learning outcomes with Edmodo-based elearning are higher than students learning conventionally. So it can be concluded that Edmodo-based e-learning media that has been developed in mathematics on the topic of multiplying fractions at Dr. Wahidin Sudirohusodo Primary School is more effective in improving learning outcomes.

#### V. CONCLUSION

Based on the results of the research that have been conducted, it can be drawn the conclusion that production of Edmodo-based e-learning media which begins with collecting information, analyzing student needs and characteristics, formulating learning materials, designing and developing products, validating and revising, until product testing shows that media products that have been developed in Edmodo-based e-learning is suitable for use in fifth grade mathematics at Dr. Wahidin Sudirohusodo Primary School where the average result of expert validation was 89.3% as well as the average teacher and student assessment of 90.5% which was included in the "Very Appropriate" category.

Edmodo-based e-learning media products are effective in the learning process and can improve student learning outcomes compared to conventional learning. This can be seen from the results of the learning outcomes where 84.375% of the students on the experimental class have passed the minimum learning completeness of 70 compared with 59.375% of the students on the control class. The results of the hypothesis test where  $t_{table} = 1.66980$  with a significance level of 5% while the value of  $t_{count} = 2.3798$ , then  $t_{count} > t_{table} = 2.3798 > 1.66980$ , which means that students' learning outcomes of mathematics using Edmodobased e-learning has a higher accuracy with an effectiveness of 84.375% compared to students who learn conventionally with an effectiveness of 59.375%.

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## Load shedding in power system using the AHP algorithm and Artificial Neural Network

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Received: 06 Nov 2020; Received in revised form: 25 Nov 2020; Accepted: 06 Dec 2020; Available online: 12 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

**Abstract**— This paper proposes the load shedding method based on considering the load importance factor, primary frequency adjustment, secondary frequency adjustment and neuron network. Consideration the process of primary frequency control, secondary frequency control helps to reduce the amount of load shedding power and restore the system's frequency to the permissible range. The amount of shedding power of each load bus is distributed based on the load importance factor. Neuron network is applied to distribute load shedding strategies in the power system at different load levels. The experimental and simulated results on the IEEE 37- bus system present the frequency can restore to allowed range and reduce the damage compared to the traditional load shedding method using under frequency relay- UFLS.

*Keywords*—*AHP*, *ANN*, *AHP* algorithm, frequency control, load shedding.

#### I. INTRODUCTION

Frequency is an importance technical parameter in evaluating the power quality of the power system and it has to be maintained within specified limits to ensure stable operation of the grid. Therefore, the maintaining the frequency in specified limits is always the goal of the electrical system's designer and operator. When there is a generator failure in electrical system, the frequency will droop. When the corrective method cannot restore the frequency back to steady state, the load shedding is quick and necessary method to restore the system's frequency. In load shedding, it is necessary to rapidly devise a reasonable load shedding strategy in order to help the frequency restore to permissible values quickly. Previous researches on load shedding mainly focus on the solving the optimization the shedding power [1-3]. In fact, the important issue is in the bulk grid, the factors of load shedding position and time to recover the parameters of the system quickly and within the allowable range. Because there are a lots information need to be processed to find out which load needs to be shed, so that, many algorithms have been studied and applied. In [4], an

(AANN) is presented to enhance the reliability of the grid. In [5], the proposed load shedding method based on the fuzzy logic to combine the frequency and speed of frequency change of the electrical system. In [6], by using Particle Swarm Optimization (PSO) to support Fuzzy system in order to plan the load shedding strategy. These studies mainly focus on optimize the load shedding power under established operating mode conditions of the electrical system. However, due to the complexity of the grid, in case of the emergency operation, these methods have problems with amount of data, calculating time and the processing speed of the algorithm is relatively slow or passive load shedding after waiting for the frequency below the threshold. As a result, it has caused delays in the decision to load shedding. In addition, these studies only focus on single problems; it is the application of intelligent algorithms to solve the load shedding problem without combining with other problems, for example, the load shedding problem considers the load importance factor to reduce economic losses in an overall solution to restore the power system frequency.

improved model of Artificial Adaptive Neutral Network

To overcome these above problems, this paper proposes the load shedding using neuron network is capable of quickly responding to the requirement of distributed load shedding control when there is a generator failure occurs causing frequency droop and load shedding must be processed in bulk system. In each case, the amount of shedding power is calculated taking into account the primary frequency control and secondary frequency control of the generator. These load shedding strategies have been pre-designed by using Analytic Hierarchy Process (AHP) algorithm, and rapidly help in making decisions to control load shedding process and reduce the economic loss.

The efficiency of the proposed method is tested on the IEEE 37- bus 9- generator power system. The results of the proposed method are compared with the underfrequency load shedding method (UFLS). The process of identifying and quickly distributing the load shedding strategy using the neuron network combined with the predesigned load shedding control based on the AHP algorithm has helped the frequency quickly restores to the nominal values and the restoring time of the frequency is faster than the traditional load shedding method.

#### II. FREQUENCY CONTROL IN POWER SYSTEM AND AHP ALGORITHM

## 2.1. Arrange the shedding priority of the load units based on the importance factor

The application of Analytic Hierarchy Process (AHP) algorithm [7] is proposed by T.L. Saaty with the idea of using expert knowledge to rank the objects in a system. This algorithm arranges the priority for load shedding of the load units through the following steps:

**Step 1:** Identify the Load Centre areas  $LC_i$  and the load units  $L_j$  in the power system diagram, this division of load centers is based on the criteria that the loads are close to each other or in the same load cluster.

**Step 2:** Set up a hierarchy model based on the Load Centre areas and load units identified in Step 1.

**Step 3:** Set up judgment matrix  $LC_i$  and  $L_j$  showing the importance factor of load centers and the importance factor among loads in the Load Centre together. The values of the components in the judgment matrix reflect the operational experience of the operating expert on the importance of the relationship between the pair of factors presented in equation (1), (2).

$$LC = \begin{bmatrix} w_{K1}/w_{K1} & w_{K1}/w_{K2} & \dots & w_{K1}/w_{Km} \\ w_{K2}/w_{K1} & w_{K2}/w_{K2} & \dots & w_{K2}/w_{Dm} \\ \vdots & \vdots & \vdots & \vdots \\ w_{Kn}/w_{K1} & w_{Kn}/w_{K2} & \dots & w_{Km}/w_{Km} \end{bmatrix}$$
(1)  
$$L_{j} = \begin{bmatrix} w_{D1}/w_{D1} & w_{D1}/w_{D2} & \dots & w_{D1}/w_{Dn} \\ w_{D2}/w_{D1} & w_{D2}/w_{D2} & \dots & w_{D2}/w_{Dn} \\ \vdots & \vdots & \vdots & \vdots \\ w_{Dn}/w_{D1} & w_{Dn}/w_{D2} & \dots & w_{Dn}/w_{Dn} \end{bmatrix}$$
(2)

Where: m is the number of the Load Centre; n is the number of loads in a Load Centre;  $W_{Di}/W_{Dj}$  describe the relative importance of the  $i_{th}$  load compared to the  $j_{th}$  load;  $W_{Ki}/W_{Kj}$  describe the relative importance of the  $i_{th}$  Load Centre compared to the  $j_{th}$  Load Centre. The value  $W_{Di}/W_{Dj}$ ;  $W_{ki}/W_{kj}$  can be obtained from the experience of experts or system operators through the use of the 9-scaling method.

If both loads A and B are equally important, then the scaling factor will be "1".

If load A is a bit more important than load B, then the scaling factor of A to B will be "2".

If load A is slightly more important than load B, then the scaling factor of A to B will be "3".

If load A is relatively more important than load B, then the scaling factor of A to B will be "4".

If load A is more important than load B, then the scaling factor of A to B will be "5".

If load A is relatively more important than load B, then the scaling factor of A to B will be "6".

If load A is much more important than load B, then the scaling factor of A to B will be "7".

If load A is extremely relatively important compared to load B, then the scaling factor of A to B will be "8".

If load A is extremely important compared to load B, then the scaling factor of A to B will be "9".

**Step 4:** Calculate the importance factor of the Load Centre areas together and the importance factor of the load units in the same load area on the basis of set up a judgment matrix. According to AHP principles, the importance factor of the load can be calculated through the calculation of the maximal eigenvalue and the corresponding eigenvector of the judgment matrix. The calculation steps using the root method are as follows:

- Multiply all elements of each row in the judgment matrix

 $M_{i} = \prod_{i} X_{ii}, \quad i=1, ..., n; j = 1, ..., n$  (3)

- Calculate the nth root of Mi

$$W_i^* = \sqrt[n]{M_1}, i=1, ..., n$$
 (4)

- Once done, obtain the following vector:

$$\mathbf{W}^* = \left[ \mathbf{W}_1^*, \mathbf{W}_2^*, \dots, \mathbf{W}_n^* \right]^T \tag{5}$$

- Normalize the vector W\*

$$W_{i} = \frac{W_{i}^{*}}{\sum_{i=1}^{n} W_{j}^{*}},$$
(6)

- The eigenvector of the judgment matrix A, that is:

$$\mathbf{W} = \begin{bmatrix} \mathbf{W}_1, \mathbf{W}_2, \dots, \mathbf{W}_n \end{bmatrix}^T \tag{7}$$

Step 5: Calculate the importance factor of the load units for the whole system.

The importance factor of the load  $W_{ij}$  for the whole system can be calculated from the equation (8).

$$W_{ij} = W_{LCi} \times W_{Lj} \qquad L_j \in LC_i$$
(8)

Where:  $L_j \in LC_i$  it means the  $L_j$  load is located in the LCi Load Center.

#### 2.2. Primary and secondary frequency control

The process of frequency adjustment in the event of generator outage in the electrical system consists of stages: the primary frequency control, the secondary frequency control. If after adjusting the secondary frequency control, the frequency has not yet been restored to the permissible value, it is required to load shedding to restore the frequency to the permissible value.

The process of the primary and secondary frequency control was shown in Figure 1.



Fig. 1: The relationship between frequency deviation and output power deviation.

## 2.3. The Artificial Neural Network training algorithms (ANN)

There are 4 recommended ANN training algorithms in the identification problem: Lenvenberg-Marquardt, Bayesian, Scaled Conjugate Gradient and Resillient Backpropagation. In this paper, the 4 above algorithms are used to train ANN network to compare with each other and choose the most optimal algorithm.

Lenvenberg - Marquardt (trainlm) training algorithm: Trainlm is an ANN network training function that updates the weights and threshold values according to the Levenberg-Marquardt optimization algorithm. Trainlm is the fastest backpropagation algorithm compared to other algorithms and is of great choice [8].

Bayesian (trainbr) training algorithm: Trainbr is an ANN training function that allows updating weight and threshold values. It minimizes the combination of squaring and weighting errors, and then determines the correct combination to create a good generality neural network. This process is known as Bayes rule [9].

Scaled Conjugate Gradient (trainscg) training algorithm: Trainscg is an ANN network training function, which updates the weights and threshold values according to the federation method [10].

The training algorithm Resillient backpropagation (trainrp): Trainrp is an ANN network training function that updates the weights and threshold values according to the backpropagation algorithm [11].

#### 2.4. The proposed method

When there is a generator outage in the power system, the SCADA system will collect data of the power system parameters. In the case that after the primary frequency control and secondary frequency control are performed but the frequency has not yet recovered to its allowable value, this data will be included in the data set to train the Artificial Neural Network (ANN). In this case, the minimum amount of shedding capacity is calculated. Then, the distribution of load shedding power at the load buses is done based on AHP algorithm. Here, the AHP algorithm supports in calculating the load importance coefficient. Loads with a small importance factor will be given priority to shedding large amounts of capacity and vice versa.

Flowchart of the proposed load shedding method is shown in Figure 2.



Fig. 2: Flowchart of the proposed load shedding method

#### III. CASE STUDIES

The proposed method is tested on the IEEE 37 bus 9generators electrical system [12]. The single line diagram of the system is shown in Figure 3. The generator at Bus-31 is considered the Slack Bus.

From the single diagram of the electrical system, build a model of the hierarchy between the load centers and the loads in the load center. The results of building the model hierarchy are presented in Figure 4.

Next, construct judgment matrices that show the importance of the load centers to each other and the importance of the loads in the load center. Construction results are presented from Table 1 to Table 5.



Fig. 3: The IEEE 37 bus 9 generators test system

## **3.1** Calculate the importance factor of the load based on the AHP algorithm

Table 1. The judgment matrix of load center  $LC_i$ 

PI	LC <sub>1</sub>	LC <sub>2</sub>	LC <sub>3</sub>	LC <sub>4</sub>
LC <sub>1</sub>	1/1	1/3	1/1	1/1
LC <sub>2</sub>	3/1	1/1	1/1	3/1
LC <sub>3</sub>	1/1	1/1	1/1	1/2
LC <sub>4</sub>	1/1	1/3	2/1	1/1



Fig. 4: AHP model for load centers and load units in IEEE 37 bus 9 generator

	$L_2$	L3	L <sub>4</sub>	L5	L <sub>6</sub>	L <sub>7</sub>	L <sub>8</sub>	L9
$L_2$	1/1	1/1	1/1	1/3	1/2	1/3	1/2	1/2
L3	1/1	1/1	3/1	1/1	2/1	1/1	2/1	1/1
L4	1/1	1/3	1/1	1/2	1/1	1/2	1/1	2/1
L5	3/1	1/1	2/1	1/1	1/3	1/3	1/1	1/3
L6	2/1	1/2	1/1	3/1	1/1	1/1	3/1	1/3
$L_7$	3/1	1/1	2/1	3/1	1/1	1/1	1/2	1/1
L8	2/1	1/2	1/1	1/1	1/3	2/1	1/1	1/2
L9	2/1	1/1	1/2	3/1	3/1	1/1	2/1	1/1

Table 2. The judgment matrix of load  $L_j$  at  $LC_1$ 

Table 3. The judgment matrix of load  $L_j$  at  $LC_2$ 

	L10	L11	L12	L13	L14
L <sub>10</sub>	1/1	1/1	1/1	1/3	1/2
L <sub>11</sub>	1/1	1/1	3/1	1/1	1/1
L <sub>12</sub>	1/1	1/3	1/1	1/2	2/1
L13	3/1	1/1	2/1	1/1	1/3
L14	2/1	1/1	1/2	3/1	1/1

Table 4. The judgment matrix of load  $L_j$  at  $LC_3$ 

	L15	L16	L19	L22	L23
L15	1/1	1/2	1/1	1/1	1/2
L <sub>16</sub>	2/1	1/1	3/1	1/3	1/1
L19	1/1	1/3	1/1	1/2	2/1
L22	1/1	3/1	2/1	1/1	1/3
L <sub>23</sub>	2/1	1/1	1/2	3/1	1/1

Table 5. The judgment matrix of load $L_j$ at L	$C_4$
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	L25	L30	L32	L34	L35	L36	L37
L25	1/1	1/1	1/1	1/3	1/2	1/3	1/2
L <sub>30</sub>	1/1	1/1	3/1	1/1	1/1	1/1	1/1
L32	1/1	1/3	1/1	1/2	2/1	1/2	2/1
L34	3/1	1/1	2/1	1/1	1/3	1/3	1/1
L35	2/1	1/1	1/2	3/1	1/1	1/1	3/1
L <sub>36</sub>	3/1	1/1	2/1	3/1	1/1	1/1	1/2
L37	2/1	1/1	1/2	1/1	1/3	2/1	1/1

Apply AHP algorithm presented in 2.1 section to calculate the importance factor of the load. Parameter values of the load and the results of calculation of the importance factor of the load are presented in Table 6.

#### 3.2 Minimum load-shedding calculation

Calculating the minimum load shedding capacity  $P_{LS\ min}$ ensures restoration of electricity system frequency to the allowable value, helps to reduce the least economic damage to electricity consumers. In a power system with n generators, when a generator outage, the adjustment of the primary frequency of the remaining (n-1) generator [13, 14] is made with the adjustment of the power according to the following equation:

$$\sum_{i=1}^{n-1} \Delta P_{\text{Primary control}} = \sum_{i=1}^{n-1} \frac{-P_{G_{n,i}}}{R_i} \cdot \frac{\Delta f_1}{f_0}$$
(9)

Where,  $\Delta P_{\text{Primary control}}$  is the primary control power of the i generator;  $P_{G_{n,i}}$  is the rated power of the i generator;  $\Delta f_1 = f_1 - f_0$  is the frequency attenuation;  $f_n$  is the rated frequency of the power system.

When the generator outage, the difference between the generation power and the load power causes the frequency difference, in particular, to be decreased. The amount of power of the frequency-dependent load reduces the amount of  $\Delta P_D$  [15]. The relationship between the load power variations with frequency variation is determined by the equation:

$$\Delta P_D = -\frac{\Delta f}{f_n} P_L D \tag{10}$$

Where,  $P_L$  is the active power of the system's load,  $\Delta P_D$  is the change of load power according to frequency change, D is the percentage characteristic of the change of load according to the percentage change of frequency [15], D value from 1% to 2% and experimentally determined in the power system. For example, a value of D = 2% means that a 1% change in frequency will cause a 2% change in load.

 Table 6. The values of the loads and the importance factor
 of the load are calculated by AHP

Load cente r	WLCi	Load Bus t	Cost C <sub>mi</sub> (\$/ kW)	W <sub>Lj</sub> (load unit)	The impor t tanct factor W <sub>ij</sub>	P <sub>LSi</sub> (MW)
LC1	0.18	L <sub>2</sub>	220	0.07	0.0126	1.59
LC1	0.18	L <sub>3</sub>	200	0.16	0.0293	0.68
LC1	0.18	L <sub>4</sub>	280	0.10	0.0172	1.16

International Journal of Advanced Engineering, Management and Science (IJAEMS)
https://dx.doi.org/10.22161/ijaems.612.4

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LC1	0.18	$L_5$	200	0.10	0.0178	1.12
LC1	0.18	L <sub>6</sub>	250	0.14	0.0246	0.81
LC1	0.18	L <sub>7</sub>	300	0.16	0.0283	0.71
LC1	0.18	L <sub>8</sub>	280	0.10	0.0187	1.07
LC1	0.18	L9	280	0.17	0.0308	0.65
LC2	0.41	L <sub>10</sub>	245	0.07	0.0556	0.36
LC2	0.41	L11	280	0.14	0.0991	0.2
LC2	0.41	L <sub>12</sub>	220	0.24	0.0638	0.31
LC2	0.41	L <sub>13</sub>	280	0.16	0.0913	0.22
LC2	0.41	L <sub>14</sub>	220	0.22	0.0991	0.2
LC3	0.20	L <sub>15</sub>	280	0.15	0.0295	0.68
LC3	0.20	L <sub>16</sub>	220	0.23	0.0447	0.45
LC3	0.20	L <sub>19</sub>	245	0.16	0.0312	0.64
LC3	0.20	L <sub>22</sub>	220	0.23	0.0447	0.45
LC3	0.20	L <sub>23</sub>	280	0.24	0.0484	0.41
LC4	0.21	L <sub>25</sub>	280	0.08	0.0176	1.13
LC4	0.21	L <sub>30</sub>	220	0.16	0.0344	0.58
LC4	0.21	L <sub>32</sub>	250	0.12	0.0252	0.79
LC4	0.21	L <sub>34</sub>	300	0.13	0.0278	0.72
LC4	0.21	L <sub>35</sub>	245	0.19	0.0403	0.5
LC4	0.21	L <sub>36</sub>	280	0.19	0.0403	0.5
LC4	0.21	L <sub>37</sub>	300	0.13	0.0278	0.72
	16.64					
1						

Power balance status is presented in the following equation:

 $P_L - \Delta P_D = \sum_{i=1}^{n-1} P_{G_i} + \sum_{i=1}^{n-1} \Delta P_{\text{Primary control}}$ (11)

$$P_{L} - \sum_{i=1}^{n-1} P_{G_{i}} = \Delta P_{D} + \sum_{i=1}^{n-1} \frac{-P_{G_{n,i}}}{R_{i}} \cdot \frac{\Delta f_{1}}{f_{0}}$$
(12)

$$P_{L} - \sum_{i=1}^{n-1} P_{G_{i}} = -\left(\frac{\Delta f}{f_{0}}\right) \cdot P_{L} \cdot D + \sum_{i=1}^{n-1} \frac{-P_{G_{n,i}}}{R_{i}} \cdot \frac{\Delta f_{1}}{f_{0}}$$
(13)

$$P_L - \sum_{i=1}^{n-1} P_{G_i} = -(\frac{\Delta f_1}{f_0})(P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_{n,i}}}{R_i})$$
(14)

Set  $\Delta P_L = P_L - \sum_{i=1}^{n-1} P_{G_i}$  and  $\beta = P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_{n,i}}}{R_i}$ 

From (14) infer: 
$$\Delta P_L = \frac{-\Delta f_1}{f_n} \cdot \beta$$
 (15)

In the case of the considering secondary control power, the new power balance equation with the new frequency value f2, the equation (11) becomes:

$$P_{L} - \Delta P_{D} = \sum_{i=1}^{n-1} P_{G_{i}} + \sum_{i=1}^{n-1} \Delta P_{\text{Primary control}} + \Delta P_{\text{Secondary control max}}$$
(16)

Where,  $\Delta P_{\text{Secondary control max}}$  is the maximum amount of secondary control power supplied to the power system.

$$\Delta P_{\text{Secondary control max}} = P_{Gm,j} - \Delta P_{\text{Primary control, j}}$$
(17)

After performing the secondary control process but the system frequency has not yet been restored to the allowable value, then load shedding is required to restore the frequency, the minimum amount of load shedding power P<sub>LSmin</sub> is calculated by the following equation:

$$P_{L} - \Delta P_{D} - P_{LS\min} = \sum_{i=1}^{n-1} P_{G_{i}} + \sum_{i=1}^{n-1} \Delta P_{Primary \text{ control}} + \Delta P_{Secondary \text{ control max}}$$
(18)

$$\Delta P_{LS\min} = P_L - \Delta P_D - \sum_{i=1}^{n-1} P_{G_i} - \sum_{i=1}^{n-1} \Delta P_{\text{Primary control}} - \Delta P_{\text{Secondary control max}}$$
(19)

$$\Delta P_{LS\min} = P_L - \sum_{i=1}^{n-1} P_{G_i} + \frac{\Delta f_{cp}}{f_0} \cdot P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_{n,i}}}{R_i} \cdot \frac{\Delta f_{cp}}{f_0} - \Delta P_{\text{Secondary control max}}$$
(20)

Equation (15) is abbreviated according to the following equation:

$$\Delta P_{LS\min} = \Delta P_L + \frac{\Delta f_{cp}}{f_0} \cdot \beta - \Delta P_{\text{Secondary control max}}$$
(21)

The case study, the generator BLT138 (Bus 53) is disconnected from the grid. In the IEEE 37 bus 9-generator electrical system diagram, the SLACK 345 (SLACK Bus) is selected as the secondary frequency control generator. The amount of the secondary control power is 10.72MW. The primary control power values of each generator turbine are shown in Table 7.

 Table 7. Value of parameters and primary control power
 of the generators

No	Gen	P <sub>G</sub> (MW)	PG (pu)	R	$\Delta P_{\rm Pri}$	$\frac{P_{G,n}}{R}$
1	WEBER6 9	31.5	0.315	0.05	0.03 5	7
2	JO345#1	135	1.35	0.05	0.15	30
3	JO345#2	135	1.35	0.05	0.15	30
4	SLACK34 5	187.28	1.872 8	0.05	0.22	44

5	LAUF69	135	1.35	0.05	0.15	30
6	BOB69	46	0.46	0.05	0.05 2	10.4
7	ROGER69	72	0.72	0.05	0.08	16
8	BLT138	0	0	0.05	0	0
9	BLT69	31.5	0.315	0.05	0.03 5	7
	Total	831.78	8.317 8		0.94 7	189. 4

In this case, after the primary and the secondary frequency control are performed, the frequency value has not been restored to the permissible value. Therefore, the load must be reduced to restore the frequency to the allowable value. Applying Equation (21) calculates the minimum amount of power load shedding to restore the frequency to the allowable value.

$$\Delta P_{LS\min} = \Delta P_L + \frac{\Delta f_{cp}}{f_0} \cdot \beta - \Delta P_{\text{Secondary control max}}$$
  
$$\Delta P_L = P_L - \sum_{i=1}^{n-1} P_{G_i} = 9.5394 - 8.31780 = 1.2216$$
  
$$\beta = P_L \cdot D + \sum_{i=1}^{n-1} \frac{P_{G_i}}{R_i} = 9.5394 \times 0.02 + 189.4 = 189.59$$
  
$$\Delta P_{LS\min} = 1.2216 + \frac{(-0.3)}{60} \times 189.59 - 0.1072 = 0.1664 \, pu$$

So, the minimum load shedding capacity of P  $_{\text{Load shedding min}}$  is 16.64MW. This power is distributed for load nodes according to the importance factor of the load. The distribution table of load shedding capacity at the load bus is presented in Table 6.

## 3.3 Building learning patterns and training neural networks

The construction of the data set is performed as follows: PowerWorld GSO 19 software is used for off-line simulation to collect data for neural network training to distribute the load shedding control strategy when the generator outage occurred. In each case, after performing the processes of primary frequency and secondary frequency control, the electrical system will perform load shedding when the frequency falls below the permitted threshold 59.7Hz. The amount of load shedding capacity is calculated and the distribution of load shedding capacity at the load buses is done based on AHP algorithm.

For the construction of the training data set will be collected by changing the load from 60% to 100% of the maximum load, and changing the location of the faulty generator. During the simulation, the cases that have to shedding the load are put into a data set to train the neural network. The results were a data set consisting of 122 samples. During neural network training, the data set is divided into 80% data for training and 20% data for testing. Data were standardized before training.

The neural network structure consists of 3 layers: input layer, hidden layer and output layer. The total number of input variables is 164 variables (including: 9  $\Delta P_G$ variables, 25  $\Delta P_{\text{Load}}$  variables and 56  $\Delta P_{\text{Branch}}$  variables, 37  $\Delta f_{\text{Bus}}$  variables, 37  $\Delta V_{\text{Bus}}$  variables). The amount of load shedding at the load buses (25 variables) are the output signals corresponding to the case of generator outage. ANN configuration is shown in Figure 5.

The ANN is trained with the use of Back Propagation Neural Network (BPNN) with 4 training algorithms: Lenvenberg-Marquardt (trainlm), Bayesian (trainbr), Scaled Conjugate Gradient (trainscg), Resillient Backpropagation (trainrp) to compare the effectiveness of training methods. The results of the training accuracy and the test accuracy of the training methods are presented in Table 8 and Figure 6.



Fig. 5: ANN configuration

Training algorithm	Lenvenberg-Marquardt	Bayesian (trainbr)	Scaled Conjugate	Resillient Backpropagation
for ANN	(trainlm)		Gradient	(trainrp)
			(trainscg)	
Training accuracy (%)	0	99.74	97.4	97.92
Test accuracy (%)	0	98.51	98.51	98.51
Training algorithm	Lenvenberg-Marquardt	Bayesian (trainbr)	Scaled Conjugate	Resillient Backpropagation
for ANN	(trainlm)		Gradient	(trainrp)
			(trainscg)	

Table 8. Training and test accuracy of Artificial Neural Network training methods



Fig. 6: The training and testing accuracy comparison of the ANN training algorithms

From the data results Figure 6 shows that in the case of identifying the load shedding strategy, the training method using the neural network with the Bayesian training algorithm has the highest accuracy. In addition, as the number of input variables increases, the accuracy increases and reaches the highest precision value when reaching 100 variables with a training accuracy of 99.74% and test accuracy of 98.51%.

Comparing the proposed load shedding method (ANN-AHP) with the load shedding method using the underfrequency load shedding relay (UFLS) when done with the same amount of shedding capacity is 16.64MW. Here, the method of load shedding using neural network combined with AHP algorithm has a load shedding time of 300ms after the generator failure occurs. The method of load shedding using the load shedding relay UFLS has the time of cut the load after the frequency drops below the threshold value. The result of frequency simulation and the economic losses associated with load shedding are presented in Figure 7 and Table 9.



Fig. 7: The frequency of the system when applying the traditional and the proposed load shedding method
Table 9. Comparing economic losses of load sheddingbased on AHP algorithm and UFLS

Load shedding Methods	ANN-AHP	UFLS
Load shedding (MW)	16.64	16.64
Recovery frequency value (Hz)	59.7	59.7
Lowest value of frequency response (Hz)	59.35	59.31
Time of recovery frequency (s)	44	44
$\begin{array}{c} \text{Economic} & \text{damage} \\ \sum P_{LSi}C_{mi}\left(x10^3\right)\left(\$\right) \end{array}$	4245.7	4351.69

Figure 7 shows that the load shedding method based on ANN - AHP algorithm and load shedding based on UFLS have the recovered frequency value to the allowable value. Both methods have the same set state frequency value. The reason is that they have the same load shedding capacity. However, the frequency response quality of the UFLS method is lower than the AHP method.

The lowest value of frequency response of ANN-AHP method is always higher and better than UFLS method. The reason is that the ANN-AHP method has very fast ANN processing times, so a decision to quickly implement the load shedding control strategy. Meanwhile, the UFLS method must wait for the frequency to drop below the set threshold of the UFLS relay to impact load shedding. That has slowed down the decision of load shedding and the frequency response value is not better than the ANN-AHP method.

In addition, despite having the same amount of load shedding capacity, the method of load shedding based on ANN-AHP has lower damage value compared to UFLS method. This is because the AHP algorithm ranks the loads in order of importance. Loads with low importance will be shed with more power priority. This has contributed to reduce damage caused by power outages.

# **IV.** CONCLUSION

The load shedding ranking and the load importance factor calculation based on the AHP algorithm have contributed to reducing the damage caused by load shedding. The application of ANN network to quickly identify the load shedding control strategy has contributed to improving the frequency response quality of the load shedding solution. The effectiveness of the proposed method has been demonstrated on the 9 generator 37-bus system.

# ACKNOWLEDGEMENTS

This work belongs to the project in 2020 funded by Ho Chi Minh City University of Technology and Education, Vietnam.

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# **Raft Forming System - Gastroretentive drug delivery system**

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Received: 16 Nov 2020; Received in revised form: 07 Dec 2020; Accepted: 15 Dec 2020; Available online: 21 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— In the recent times several studies and research have been conducted on drug delivery system through mouth in order to overcome several problems like emptying time and gastric retention. Taking medication through mouth is the preferable way compared to others, because of easiness in taking medication and compliance of patients. Limited gastric residence time is the limitation of taking medication orally. In order to increase this gastric retention time, several methods have been proposed. This article focuses on floating drug delivery system to overcome the difficulties associated with design of formulation. Advances and highlights of the floating raft system has been reviewed in this article. Formulation, mechanism, and development of raft forming system is also reviewed in this article.

Keywords— Raft Forming System, Drug Delivery System, Human Stomach.

#### I. INTRODUCTION

In our stomach the medicine we take are sometimes poorly soluble or unstable in fluids of intestine. Raft forming system, is a type of floating drug delivery system, remains and helps drugs that are poorly soluble in stomach. Let us discuss more about the needs of Gastroretentive Drug Delivery System [1]. Oral delivery of medication is widely used in pharmacy field in order to treat diseases, but this conventional method of delivery has major drawbacks, where some of the drugs are gets absorbed at a specific rate and site only. Now a day's pharmacy filed is focusing on drugs that will require specificity of site. To deliver drugs at intestine or stomach, one of the site-specific delivery is Gastro -retentive delivery. Site specificity is obtained by controlled delivery of drugs in stomach and intestine. Floating drug delivery system will have high density than stomach fluids, so remain same for a longer period of time without affecting the gastric emptying rate. The drug will slowly be released, at the required rate while system floats on the gastric contents. The residue is emptied from stomach after the release of the drug, which results in proper control of fluctuation in plasma concentration and increased gastric residence time [2]. Some of the potential situations or candidates for gastroretentive drug delivery systems are, Drugs that are degradable in colon like Metformin HCL, Drugs that are poorly soluble in Alkaline like Diazepam, Drugs acting locally in the stomach [3], Drugs that are absorbed in stomach like Amoxicillin [4]. More than half of the total percentage of available drug delivery systems are administered through mouth, as this is the promising drug delivery system route and based on factors like emptying process and time its effective than others.

#### Anatomy of gastrointestinal tract:

The gastrointestinal tract can be divided into three regions:

- 1. Stomach
- 2. Small intestine- Duodenum, Jejunum and Ileum
- 3. Large intestine

Gasterointestinal tract consists of hallow tube which is muscular and it starts from oral cavity where food enters our body continue through pharynx, oesophagus, stomach, intestines to the rectum and anus, and this is where food is expelled. There are multiple organs that help absorb nutrients from the food and secrete the enzymes. Gastric physiology and gastric motility understanding is necessary to understand the approaches for gastro retention, which is the first concept of floating drug delivery system cultured by Davis in 1968.Human stomach when its at rest has a volume of 25 to 50 ml volume, which can expand upto 1500ml after having a meal. Below the diaphragm, on the left-hand portion of the abdomen, stomach is located and looks like J shape. left side of hypochondriac and portion of epigastric is occupied by stomach. Stomach functionality is primarily to hold the food in it temporarily and grind the food and release it into duodenum. It will be helpful to develop dosage form that will reside in small intestine, as drugs are absorbed in there.

In classical anatomy human stomach is divided into 4 sections starting at the cardia [5].

- The section where esophagus empty the contents into stomach is called Cardia [6].
- The curved part which is on the upper side is called fundus.
- The main central part of stomach is called body.
- The section of the stomach which is on the lower side empties contents into duodenum is called pylorus.



Fig. 1 Anatomy of Human Stomach

1. Body of stomach 2. Fundus 3. Anterior wall 4. Greater curvature 5. Lesser curvature 6. Cardia 9. Pyloric sphincter 10. Pyloric antrum 11. Pyloric canal 12. Angular incisure 13. Gastric canal 14. Rugae [6].

The region following the "z-line" of the gastroesophageal junction, is defined as Cardia. Epithelium changes from stratified squamous to columnar happens at this point. Oesophageal sphincter is near to Cardia [6]. Cardia is the region of oesophageal lining and recent studies proved that cardia is not distinct part of stomach.

**Fundus**: This lie above the horizontal plane which passes through cardiac orifice and is a superior part of stomach.

**Body**: This part lies between Fundus and Antrum and is central part of stomach and is also largest part of stomach.

**Antrum**: This lie to right of the angular notch in the imaginary transpyloric plane and on the right joins the pyloric canal. Body and Fundus main function is storage and for Antrum it is grinding and mixing. Gastric contents are exerted pressure by the fundus and sent them toward the distal stomach. Particles need to be of size 1-2 mm in order to pass through pyloric valve. Stomach has limitation -short residence time [9,10,11,12].

**Float Rafting system Design:** There are several factors to be considered to formulate a raft forming system and they are like drug molecule and its physicochemical properties, and one who is diseased and condition of he/she, preference of marketing and population of the patients etc., When we consider physicochemical properties they are like molecular charge, molecular weight, lipophilicity. The factors for formulation need to be considered are osmolarity, temperature, viscosity and spreadability. For the dosage form, to achieve gastric retention of, it needs to be able to satisfy below criteria:

- 1. The release of drug should be slow from the system
- 2. Compliance of patient should be good
- 3. Specific gravity should be maintained lower than gastric contents
- 4. For the force exerted by peristaltic waves in the stomach and griding, churning moments, and contraction, the dosage form needs to be able to withstand the force.
- 5. The device should easily exit out of the system, after the drug is released [13,14,15,16]

# Raft system formulation and the ingredients used:

For controlled release of gastric retention, we should select appropriate person for the formulation, and the ingredients used for the formulation are carbonates or alkaline carbonates, gel forming agent, which can cooperate to the formation of less dense system and is able to float on the gastric fluids [17].

# Raft system and the Drugs Selection Criteria:

For disorders and gastrointestinal infections, to deliver the antacids, raft forming system has gained lot of attention. For esophagitis and heartburn raft forming system is the potential approach. For the drugs that are not stable in intestine or poorly soluble, this system is suitable. For antacids the drugs that re used are magnesium hydroxide, Aluminum hydroxide, aluminum phosphate, calcium carbonate. For  $h_2$  RECEPTOR the drugs used are loxatidine, famotidine, nizatidine, Omeprazole, lansoprazole, pantoprazole, Cimetidine, ranitidine. For helicobacter pylori the drugs used are Amoxicillin [4], clarithromycin, tetracycline, metronidazole etc.,

For gastro retention, criteria for drug selection are as follows:

- 1. Primarily absorbed drugs in the stomach like amoxicillin
- 2. Antacid drugs that are acting locally in stomach for helicobacter pylori
- 3. At Alkaline pH, drugs that are poorly soluble like Diazepam.
- 4. From the GI tract drugs that are rapidly absorbed [18,19,20,21,22]
- 5. Drugs which has window of absorption as narrow.

For gastro retention, criteria for drug that are not suitable are as follows:

- 1. Drugs that are used for selective release in the colon
- 2. If acid solubility is limited for the drugs, then they are not helpful
- 3. In the gastric environment if the drug has instability, it will not fit.

# Raft system and the Polymer Used for Formulation:

In the stomach, which is gastrointestinal tract, to deliver the drug various polymers are employed in floating drug delivery system. IN the formation of the raft forming drug system various natural and synthetic polymers are used. Some of the natural polymers are gellan gum, alginic gum, guar gum etc.., and some of the synthetic polymers are HPMC, poly (DL-lactide-co-glycolide) and poly-caprolactone etc.,

In situ gels the polymers used should have the following characteristics:

- 1. Biocompatibility should exist.
- 2. pseudoplastic behavior should be there.
- 3. Along with increase in shear rate polymer should be capable of increasing viscosity.

# Some of the polymers used for raft forming system:

# Sodium alginate:

Sodium alginate is available naturally and is widely used polymer in Raft Forming system. In chemical terms it is alginic acid salt, consisting of D mannuronic and Lglucuronic acid residues connected by 1,4- glycosidic. The alginates solution form firm gels when di or trivalent ions are present for example like magnesium ions. Sodium alginate salt which is formed from alginate salt is used for preparing gel forming solution. Due to the nature of alginate salts which are nontoxic in nature and biodegradable they are most considered. They also have bio adhesive property.



Fig. 2 Chemical structure of Sodium Alginate

# Pectin:

These are originated from plant which has anionic characteristics and can be divided into two polysaccharides and contain residues of -(1-4) -D-galacturonic acid. In the presence of medium it can for gel, and as till gel formation is possible. Pectin usually forms at pH less than 3.5 and it is a complex polysaccharide which comprise of D-galacturonic acid residues in an a-(1-4) chain.



Fig. 3 Chemical structure of pectin

# Floating Raft Forming System- Advantages:

- 1. Therapeutic efficacy will improve.
- 2. Floating of dosage forms faster than others.
- 3. Administration into the patient is easy.
- 4. It is proved more effective because on gastric contents it forms low density viscous layer.
- 5. Plasma level fluctuation will reduce.
- 6. In the small intestinal region, the absorption of the drug is narrow like delivery of drugs.

 Drug delivery system specific to stomach can be targeted like H. pylori-induced gastric ulcer [23,24,25,26].

#### Limitations of Float Raft forming system:

- 1. The formulation is done in the form of solutions, and it is susceptible to stability problems due to microbial degradation.
- 2. The stability problem can also be cause if the formulation is poorly stored. This is because if the formulation is stored for a long time pH might change or due to inappropriate temperature situations.
- 3. Gel formation is possible if polymer is exposed to radiations like UV, electromagnetic etc.,[28].

# II. CONCLUSION

Raft Forming System which is Gastroretentive drug delivery system is designed in order to increase this gastric retention time, some of the problems we have with other methods of taking medication, as therapeutic efficacy will improve, floating of dosage forms faster than others administration into the patient is easy.

And so a floating Raft System which is promising has been figured out and achieved which might be suitable for some of the population like pediatrics and other people who has difficulty in taking controlled medication solid forms and this could lead to efficacy enhanced patient compliance.

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# Twin Roll Casting of Aluminum Alloy AC7A Using Commercial Scale Machine

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Received: 18 Nov 2020; Received in revised form: 06 Dec 2020; Accepted: 15 Dec 2020; Available online: 21 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— Twin roll casting process is able to produce a strip from molten metal directly. Thus this process has a possibility to reduce total cost of sheet making comparing to conventional rolling process. Strip casting process has some disadvantages. Casting speed depends on the material properties. It is difficult to determine the casting conditions. Twin roll casting of aluminum alloy AC7A using commercial scale machine was operated. The aims of this study is to investigate the effect of the roll speed. Continuous strip could not be produced at the roll speed 5 m/min. Continuous strip could be produced at the roll speed 10 m/min. However, cracks were observed. Continuous strip could be produced at the roll speed 20 m/min. However, cracks were observed too.

Keywords— Vertical type twin roll casting process, Aluminum alloy AC7A, Castability, Surface condition, Strip thickness.

# I. INTRODUCTION

It is important that the improvement of fuel efficiency of transport machine such as automobile through the viewpoint of the global environment and the resource protection. The methods of improving fuel efficiency are the several ways such as improving of power drive system and reduction of running resistance and weight. Among them, weight saving of car weight is an effective method of improving fuel efficiency. Therefore, Aluminum for car structural material is attracted attention from the point of the weight reduction. The demand of aluminum is increasing for recent years in Japan. Especially the demand of aluminum for transport machine is increasing in last years.[1], [2] Therefore, it is necessary to reduce the cost of manufacturing Aluminum strip.

This paper describes a vertical type twin roll strip casting process for producing aluminum alloy strip of AC7A. Aluminum strip[2] is generally produced by multi process such as DC casting, scalping, hot rolling of 200 mm ~ 600 mm thickness slab, repeated cold rolling and annealing.

Form the above, the manufacturing cost of Aluminum strip become high because of the number of processes.

The vertical twin roll strip caster was used in this study. It is possible to produce an Aluminum strip continuously from molten metal directly by twin roll strip casting. The molten metal was solidified on the roll surface and formed to strip. Strip thickness is about 1~3~3~m. Strip casting process is a rapid cooling solidification process. So that the mechanical properties improve. The roll speed is generally high in twin roll casting such as 60~150~m/min. Thus, it is possible to reduce the strip manufacturing cost compared with the conventional rolling process because of the highly productivity. Strip casting process has some disadvantages. Casting speed depends on the material properties. It is difficult to determine the casting conditions.

A lot of study of twin roll casting is reported [3]-[10]. For the purpose of practical application of strip casting, this paper carried out the research of vertical twin roll strip casting of aluminum alloy AC7A using a large equipment. In this report, the effect of the roll speed was investigated. The continuity, surface properties, thickness of the strips and microstructures were evaluated.

# II. EXPERIMENTAL DEVICES AND CONDITIONS

Fig. 1 (a), (b) and (c) show photographs of the experimental apparatus. Fig. 1 (a) is a front view of the device. Fig. 1 (b) is a top view. Fig. 1 (c) is an overall view. This device was manufactured by IHI Co., Ltd. and transferred to Gunma University Ota Campus. This device was manufactured for magnesium alloys. In this time, some modifications were made in conducting experiments on aluminum alloys. The roll material is SKD 61, the roll diameter is 1,000 mm, the roll width is 240 mm, it is a solid material. The maximum rolling load on the design is 75 tons, and it is possible to apply loads up to 312.5 kgf / mm when converted per unit width. The roll gap is fixed type. The roll speed is variable using an inverter and can be varied from 3 m / min to 100 m / min. The capacity of the motor is 3 phases 400 V, 80 kW, and the roll is rotated through the gear box and the universal joint. Fig. 2 shows a photograph of the load cell. Two load cells are installed and it is possible to successively measure the rolling load during twin roll casting that changes every minute. In this study, only the maximum load in the experiment is shown. Fig. 3 shows a photograph of the side dam. The side dam is formed from a mild steel strip and five layers of heat resistant cloth. Heat resistant cloth was pasted to mild steel strip using spray glue (3M, 88). Approximately 2 kg of AC7B alloy was melted in a crucible furnace. Fig.4 shows a photograph of the pouring mechanism. We installed a wire in the crucible box and pour the molten metal by tilting the box by pulling the wire from the mezzanine level of the laboratory for safety. Fig. 5 shows a photograph of the nozzles. The nozzle is formed of stainless plate, heat-resistant cloth and carbon sheet. The nozzle was used to control the solidification distance. A graphite spray (Fine Chemical Japan Co., Ltd.) was used as the release agent for the roll. The experimental conditions are shown in Table 1. The initial roll gap was 1.5 mm. The roll gap was adjusted by tightening the nut and checked with a thickness gauge. The solidification length was 100 mm. In the preliminary experiment, the pouring temperature was set at 640 ° C (5 ° C on the liquidus temperature). The roll speeds were 5 m/min, 10 m/min, and 20 m/min.



(a) Front view

(b) Top view



(c) Overall view

Fig. 1 Twin roll strip casting machine





Fig.2 Load cell

Fig.3 Side dam plates





Fig. 4 Pouring device

Fig. 5 Nozzles

Material	AC7A
Pouring temperature [°C]	640
Initial roll gap [mm]	1.5
Solidification length [mm]	100
Roll speed [m/min]	5, 10, 20

# III. RESULTS AND DISCUSSION

Fig. 6 (a), (b) and (c) show the strips. Table 2 shows the measurement results of the thickness, length and maximum

load of the strips. The strips' width coincided with the roll width. No cracks were observed in the strip with the roll speed of 5 m/min, and the surface properties had metallic luster. In the strip of 10 m/min, the surface condition consisted of metallic luster part and opaque part. Fig. 7 shows an enlarged photograph of the strip with a roll speed of 10 m/min. The solidification cracks occurred in the cloudy part. In the cloudy part, the contact with the roll was insufficient. Therefore, the cooling of the strip was insufficient, and the cracks seemed to have occurred because of the tensile load by the roll rotation without completing the solidification. In the strip with the roll speed of 20 m/min, the surface property was mainly composed of the cloudy part. There was a difference between the roll speed and the discharge speed of the strip. Therefore, it is considered that the gap was not filled sufficiently with the molten metal. The solidification cracks were observed too. The cause of the difference between the initial roll gap and the plate thickness is the problem of the degree of mastery of the equipment, and it is considered that this problem can be solved by setting the initial roll gap for the target plate thickness in consideration of elastic deformation of the equipment. Continuous strips could be produced at a roll speed of 10 m/min and 20 m/min. At a roll speed of 5 m/min, it became the limit load of the apparatus, and it was impossible to make continuous strips because the roll stopped. Fig. 8 shows the results of microstructural observations at a circumferential speed of 10 m/min. More crystallites and precipitates were observed in the center of the rolls than near the surface. It was thought that a supersaturated a-Al solid solution have been formed by rapid solidification.



(a) 5 m/min



(b) 10 m/min



(c) 20 m/min

Fig. 6 Produced strip



Fig. 7 Solidification crack



Center



Near the surface

Fig. 8 Microstructure of the strip (10 m/min)

Roll speed [m/min]	5	10	20
Strip length [mm]	174	764	665
Strip thickness [mm]	2.47	2.01	1.67
Rolling load [t]	75	34	41

Table 2 Strip thickness and rolling load

# IV. CONCULUSION

In this study, the experiments of twin roll casting of aluminum alloy AC7A using a commercial scale machine was carried out to investigate the effects of the roll speed on the continuity, surface properties and strip thickness of strips. The conclusions are as follows.

- When the peripheral speed was 10 m/min and 20 m/min, the thin plate could be produced continuously.
- (2) At a peripheral speed of 5 m/min, the maximum rolling load in the design was reached, and the machine stopped automatically, so that it was impossible to manufacture thin plates continuously, but metallic luster was observed on the whole surface.
- (3) The solidification cracking was observed in the sheet with a peripheral speed of 10 m/min and 20 m/min.
- (4) There was a difference between initial roll gap and plate thickness. This is caused by the skill level of the equipment, and it is considered that the problem can be solved by setting the initial roll gap for the target plate thickness in consideration of the elastic deformation of the equipment.
- (5) The microstructural observation suggested that a supersaturated  $\alpha$ -Al solid solution was formed by rapid solidification.

# ACKNOWLEDGEMENTS

This study was conducted at Monodzukuri Innovation Center, Ota Campus, Gunma University. The project was supported by a grant from Ota City (MRO) to promote joint research in the Ota area, a grant from the Japan Aluminum Association and a grant from Japan Society for Technology of Plasticity.

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# **Control of Battery Charger for Electric Vehicles**

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Received: 20 Nov 2020; Received in revised form: 08 Dec 2020; Accepted: 15 Dec 2020; Available online: 21 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— The increasing environmental pollution caused by fossil fuel emissions from vehicles using internal combustion engines has spurred the development of electric vehicles. The power sources for the electric vehicles to operate are often stored in different types of batteries with different charging requirements. Most batteries are charged from the grid sources through AC/DC converters for charging battery packs. An effective charging system usually consists of a rectifier and a dual-active bridge (DAB). A typical controller consists of the control of DC bus, PFC (power factor correction), constant voltage (CV), and constant current (CC) for the battery. However, most conventional chargers only regulate the voltage or current of the battery when charging. These types are mainly suitable for lead acid types and the power factor correction has not been considered. Meanwhile, new generation battery packs as lithium-ion batteries require charge of CC at first. When the battery charging voltage reaches a certain voltage threshold, then switch to the mode of CV charge. Basing on the analysis of the battery charging requirements of electric vehicles, this paper presents a battery charger control solution with capability of CC and CV control as well as high power factor. The simulation results on MATLAB/Simulink have validated the effectiveness of the presented method.

Keywords— Vehicle battery charger, power factor correction (PFC), dual-active bridge (DAB), constant current (CC), constant voltage (CV).

# I. INTRODUCTION

The increasing environmental pollution caused by fossil fuel emissions from vehicles has spurred the development of electric vehicles [1]. Vehicle electrification is one of the most potentially viable ways to reduce emissions into the environment. The popularity of electric vehicles in the future will significantly impact many different sectors, especially the power grid. Many developed countries have implemented policies to promote electric vehicle deployment, making use of electric vehicles in recent years more and more popular [2]. The operating energy of electric vehicles is usually stored in battery packs, which are in the direct current form. Therefore, chargers are required to convert the AC power of the grid to the DC power to charge the battery packs. The development of electric vehicles has also made the battery and charger technology significantly improved [3] due to the strong investment of car manufacturers. Although electric vehicles have active economic and environmental contributions, however, electric vehicle battery chargers have had a negative impact on the operation of the existing grid [4] - [7]. These impacts mainly cause the peak loads for the power systems during the day. Therefore, battery chargers play an important role in electric vehicle development, charging capacity and charging time will directly affect battery life. Battery charger requirements should have high efficiency and reliability, low cost, light weight, and safety in operation. Electric vehicle chargers must ensure a low current harmonic distortion to minimize negative impact on power quality and a high-power factor to maximize the active power available from the grid.

The power sources for the electric vehicles to operate are often stored through different types of batteries with different charging requirements. The main type of battery used today is lithium-ion [8]. This type of battery has advantages such as high energy density, light weight, low cost, non-toxic, and can use fast charging technology. However, the biggest obstacle to this type of battery is that it can cause an explosion if the charging specifications are inadequate. One of the most important factors in charging is temperature. It can easily lead to fire [9] if the charge is not well controlled. In addition, the high temperature during charging also makes the process of alternating solid electrolysis layers faster. This leads to an increase in the internal resistance of the battery, so the storage capacity and life of the battery are also significantly reduced [10].

Despite the negative effects on the grid, the popularity of electric vehicle battery charging systems could also provide active benefits to a vehicle-to-grid (V2G) technology with a good management of this electrical system [11] - [13]. This has confirmed the important role of the charger control for electric vehicles when connecting to the power grid. The principle of a charge system using an AC grid includes the components shown in the block diagram in Fig. 1.



In particular, the input of the charger must usually use an electromagnetic interference filter (EMI filter) to ensure

that the harmonics of the charger are not generated into the grid. The rectifier is used to convert AC power of the grid to DC power to charge the battery pack. A PFC (power factor correction) boost circuit is used to increase DC voltage in combination with power factor control for the charger. The DC/DC converter is used to control the charging current and voltage for the battery pack and isolated via a high frequency transformer. The DC/DC converter or bidirectional one. Typically, vehicle-to-grid (V2G) and G2V (grid-to-vehicle) (G2G) chargers require the use of bidirectional converters.

There are many methods to charge electric vehicles [14], this paper focuses on the chargers that attach to the electric vehicle. This form of charging is called on-board battery charger (OBC) [15]. These chargers are commonly used for the BEV (battery electric vehicle). The content of this paper focuses on the control of Level-2 charger for battery packs with a rated voltage of 240 V, charging current up to 80 A, and charging capacity up to 20 kW. The charger is researched to use a single-phase AC input source. The charging system principle is shown in Fig. 2.



Fig. 2 Principle-diagram of a charge system

# II. CONTROL PRINCIPLE OF CHARGER

The principle of control for the boost circuit is shown in Fig. 3. In which, the DC voltage and current are regulated by using the PI controllers. The rectifier overcurrent protection is implemented by the current limiter. The PWM pulse width  $G_{boo}$  of the booster transistor is modulated by comparing the carriers with the value  $D_{boo}$ . The PFC is also implemented by using the waveform  $V_{rec_0}$  after rectifying to produce the dc reference current. Then, the waveforms of the AC input current and voltage are shown in Fig. 4. In order to charge the battery using the DAB converter, the phase shift method is used in this paper. Then, the primary and secondary voltages of the isolated transformer are defined as follows.

$$V_{pr} = \frac{4*V_1}{\pi\sqrt{2}} = \frac{4*V_{dc}}{\pi\sqrt{2}}$$
(1)

$$V_{se} = \frac{4*V_2}{\pi\sqrt{2}} = \frac{4*V_{bat}}{\pi\sqrt{2}}$$
(2)

Thus, the power transferred to the battery is defined as:

$$P = \frac{8 * V_{dc} * V_{bat}}{\pi^2 * X_{Lr}} \sin \alpha$$
(3)

Where  $\alpha$  is the phase shift angle between PWM pulses of primary and secondary transistors of the isolated transformer. The change of charge voltage  $\Delta V_{bat}$  using the DAB converter is also defined as follows.

International Journal of Advanced Engineering, Management and Science (IJAEMS) https://dx.doi.org/10.22161/ijaems.612.7



Fig. 4 Grid voltage and current waveforms of charger



Fig. 5 PWM pulses of DAB converter

Where R<sub>Load</sub> is an equivalent load resistor of the battery.  $X_{Lr}$  is the reactance of power transfer circuit.

$$M_{bat} \approx \frac{8^* V_{dc} * \cos \alpha}{\pi^2 * X_{Ir}} * \Delta \alpha = C_I * \Delta \alpha$$
(5)



/

Fig. 6 PWM pulse generation for shifting the phase angle

Similarly, the charging current is also controlled according to the phase shift angle  $\alpha$  basing on (5). The control principle of the phase shift angle is shown in Figs. 5-6. Regularly, the CC charge is applied for the first stage and the CV charge is adopted for the second one as Fig. 7 when the battery voltage reaches a defined value.





Description	Value
Normal voltage	1.18 * Nb_ser
Rated capacity	6.5 * Nb_par
Fully charged voltage	1.39 * Nb_ser
Nominal discharge current	1.3 * Nb_par
Internal resistance	0.002 * Nb_ser/Nb_par
Capacity at nominal voltage	6.25 * Nb_par
Exponential zone	1.28 * Nb_ser, 1.3 * Nb_par

Table I.	Parameters	of battery	cells
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The rechargeable batteries in this paper use the model of parallel and serial coupling of Panasonic lithium-ion battery cells [16]-[21] according to the parameters as shown in Table I. According to the charging standard Level-2, the full charged voltage is up to 275 V and charging current is up to 80 A. Therefore, the number of cells will be selected as 198 in series and 6 in parallel, respectively.

# III. SIMULATION RESULTS

The parameters of the charge system are given in Table II. The simulation results are also showed in Figs. 8-13 with three different reference currents as 40 A, 60 A, and 80 A, respectively.

Table II. Th	he system	parameters
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Description	Value
Nominal voltage	233.6V
Rated capacity	37.5Ah
SoC	20%
Booster voltage controller	Kp=5e-4; Ki=5e-3
Booster current controller	Kp=1e-2; Ki=1e-1
DAB voltage controller	Kp=1e-2; Ki=1e-2
DAB current controller	Kp=1e-2; Ki=1e-1
CI	18.8
C <sub>v</sub>	112.8



Fig. 8 Charging voltage and current with Iref=40A



Fig. 9 Charging power with I<sub>ref</sub>=40A



Fig. 10 Charging voltage and current with Iref=60A

The first stage of the charge process is the constant current (CC). When the charging voltage is up to 275 V, the second stage, the constant voltage (CV), is used to charge the battery until the charging current decreases to a trickled current, the charge process will stop.

When using the reference current of 40 A, the characteristics of charging voltage and current are shown in Fig. 8. Then, the charging power is about 10 kW and shown in Fig. 9. This makes the charger spend about 2800 s to finish the charge process.



Fig. 11 Charging power with Iref=60A

Similarly, when the reference current of the CC control is 60 A, the characteristics of charging voltage and current are shown in Fig. 10 and the charging power is about 15 kW and shown in Fig. 11. In this case, the charger only spends about 1950 s to complete the process of charge.



Fig. 12 Charging voltage and current with Iref=80A



Fig. 13 Charging power with Iref=80A

When the reference current is as 80 A, the charging power is greater than 20 kW. The charger only takes 1550 s to stop the charge process.

Therefore, the higher charging current the shorter time the charger takes. However, the high charging current also makes the temperature of the charger increase. This can cause fire and explosion.

Thus, the users can choose the suitable charge mode depending on the specific requirements.

# **IV. CONCLUSION**

This paper has presented a method for controlling the electric vehicle battery charger. The charger control method is based on the DAB converter with the isolated transformer. The control of constant current or constant voltage is relied on the pulses phase shift of DAB converter. The charge process has two stages. In the first stage, the method of constant current is used to control the charger. In the second one, the constant voltage method is used to control the charger until the trickled current, the charge process will end. The effectiveness of the control method has also confirmed basing on the simulation results on MATLAB/Simulink. In addition, the PFC has also considered in the control of the boost circuit. This helps the charger achieve the power factor of unity.

# ACKNOWLEDGEMENTS

This work belongs to the project grant No: T2020-31TĐ. funded by Ho Chi Minh City University of Technology and Education, Vietnam.

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 Assessment of the aging parameters and development of cycle life model," *Appl. Energy*, vol. 113, pp. 1575–1585, 2014.

# Food Supply Chain Strategies during the COVID-19 Pandemic

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Received: 16 Nov 2020; Received in revised form: 01 Dec 2020; Accepted: 06 Dec 2020; Available online: 22 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— Due to its role in fulfilling the community's need for nutrition and a strategic economic commodity, beef is considered pivotal. The early system of beef commodity distribution obliges manufacturers to process beef in several stages, starting from beef cattle farmers to retail beef traders, beforeit reaches consumers. Such a long beef supply chain is allegedly one of the causes which bring about its expensive price, especially during the COVID-19 pandemic. Accordingly, this research aims to collate a beef supply chain strategy during the COVID-19 Pandemic. This research was conducted in GorontaloIndonesia in June-August 2020. Sampling was done using the snowball sampling technique, from the farmers, traders, and butchers. Data analyzed in this research were primary and secondary. The data analysis used was the SWOT analysis. Our findings led us to formulate four beef supply chain strategies, i.e., 1) SO strategy: developing beef cattle breeding centers, delivering technical guidance and intensive socialization to farmers, developing reliable and sustainable institutional partnerships, and socializing agricultural waste-based food processing technology to farmers; 2) WO strategy: exerting the government's supports, i.e., equipment, capital, fodders, breeds, vitamins, storage equipment, and drugs for cattle and farmers, orienting the management system to semi-intensive and intensive patterns through a crop-livestock integration system), socializing a marketing information system to farmers, and using information properly; 3) ST strategy: protecting domestic markets, overcoming reproductive diseases and maintaining cattle health, and socializing digital marketing and product diversification; and 4) WT strategy: developing agribusiness markets and market operation, granting business credits to traders, and complying with the government regulation on the standard price for the sale of beef cattle and beef.

*Keywords*— *resilience*, *food*, *availability*, *consumption*, *distribution*.

# I. BACKGROUND

The aim of agricultural development is to manifest food resilience so Indonesia can regulate and fulfill its community needs for food in a resilient way (Anugrah, 2020). Food resilience by definition is a condition in which we can confirm food fulfillment in households. It is reflected by adequate food availability, in terms of either the number or the quality, which is secure, evenly distributed, and affordable. Developing food resilience is literal community empowerment which builds their independence and capacity, allowing them to make an active engagement in manifesting food availability, distribution, and consumption from time to time (BKP Pertanian, 2020).

In its attempt to fulfill its population needs for food, Indonesia must require food availability in a sufficient number, fulfilling consumption adequacy and the national stock, in accordance with operational requirements of extensive and evenly distributed logistics, especially during the COVID-19 pandemic, which is a non-natural disaster. The COVID-19 Pandemic has started its fifth-month transmission in Indonesia, as of March in which the first confirmed-positive case took place, and now has been extensively impacting various domestic sectors. Trading, transportation, and tourism sectors, including agricultural sectors cannot avoid the impact of the havoc. The everincreasing COVID-19 cases generate unaccessible food sources and inevitable moving restrictions. Burgui (2020) argues that a global pandemic will result in an increase in famine and malnutrition cases.

Agricultural sectors which produce protein, energy, vitamins, and minerals are growing due to raised awareness of the need for nutrition to elevate life quality among the community. One of the animal proteins mostly consumed is beef. Prevailing as a strategic economic commodity, beef is considered crucial in the fulfillment of the community's need for nutrition (Yulianto and Saparinto, 2010). Beef consumption had apparently increased by 18.2%, from 4.4 gram/cap/day in 2009 to 5.2 gram/cap/day in 2014. In other words, in the same timeline, local beef availability reached the percentage of 65.24% of the total national need. The shortage was covered by importing beef, either feeder or frozen beef (DirektoratJenderalPeternakan dan Kesehatan Hewan, 2015).

Supply chain constitutes the sequence of processes (decision-making and execution) and flows (materials, information, and money) which occurs in nature and between stages, from the production to consumption stages, with which producers, transporters, service providers, logistics, retailers, and consumers are engaged (Poerwanto, 2012). The primary objective of a supply chain is to satisfy customers and thereby giving profits to the company. Supply chain activities start from consumers' demand and end when a customer or consumer has been satisfied (Chopra and Meindl, 2010). Meanwhile, a supply chain which is capable of creating and delivering a product and service in a required condition is considered strong (Blackhurst et al., 2011). A supply chain strategy is a set of strategic activities and actions in the supply chain, creating reconciliation between what is needed by customers and the capacity of resources existing in the supply chain (Pujawan, 2014).

The food commodity, in September 2019, contributed to the poverty line by 73.75% (Artha, 2020). As such, all states made policies as the intervention to maintain primary and strategic food price stability. A food price and supply, especially beef, is two interrelated strategic indicators which are often used to identify a food distribution status, several issues engendered by an inefficient primary food distribution food chain, starting from producers to consumers, and food shortage in a region. In the early

system, the beef commodity should pass through several stages before reaching consumers. The stages start from cattle cow farmers to intermediating traders, from intermediating traders to butchers, from butchers to retailers, and from retailers to final consumers. Such a long beef supply chain is considered one of the problems which yield an expensive beef price, especially during the COVID-19 pandemic. Therefore, this research sets an aim to formulate a beef supply chain strategy which is effective to be applied during the COVID-19 pandemic.

# II. METHODS

This research was undertaken in June-August 2020. The research location was Gorontalo Gorontalo Indonesia. The location was selected based on the cow population bred by farmers in Gorontalo District. Sampling was conducted using the snowball sampling technique, starting from farmers, traders, to butchers. Data used in this research were primary and secondary. The first data, which were primary, were in the form of cross-section data taken from farmers, traders, and butchers, which were 20 people in number, and collected through direct interviews built upon a list of questions. Meanwhile, the secondary data were collected from the Animal Husbandry Department, Statistics Indonesia, the subdistrict office, and other relevant institutions. Data analysis used in this research was the SWOT analysis which allowed us to collate a beef cattle supply chain strategy which would likely mitigate uncertainty risks during the COVID-19 pandemic. The SWOT analysis is defined as follows.

- 1. *Strength* is evidence regarding the condition of resources and capabilities an organization owns as a positive comparison in a market.
- 2. *Weakness* is a negative internal aspect of an organization which likely affects its performance.
- 3. *Opportunity* is the future condition of an environment which is possible to achieve for the sake of an organization's sustainability.
- 4. *Threat* is the future condition which potentially impacts enterprise sustainability in an organization (especially the profit one).

# III. FINDINGS AND DISCUSSION

To eradicate uncertainty risks in the beef cattle supply chain during the COVID-19 pandemic in Gorontalo

District, a beef cattle supply chain policy strategy was formulated using a SWOT matrix.

Rangkuti (2005) clarified that the SWOT analysis was a strategic planning method used to evaluate the strengths, weaknesses, opportunities, and threats of a project or business speculation. The four factors then convened the SWOT acronym. SWOT allowed us to determine speculative business or specific project objectives and identify both internal and external factors which supported and did not support the achievement of the objectives. The analysis was implemented by analyzing and sorting aspects which influenced the four factors which then were mapped in a SWOT matrix. The SWOT matrix of the beef cattle supply chain in Gorontalo is indicated in Table 1.

Internal Factors	Strengths (S)	Weaknesses (W)
	S1= Land carrying capacity	W1 = Farmers' limited equipment and venture
	S2 = Local superior commodities	capital
	S3 = Abundant agricultural waste availability	W2 = Traditional maintenance system and poor management and technology applications
	S4 = Experienced worker availability	W3 = Non-transparent information flow from traders
	S5 = Adequate transportation and communication systems	to farmers, including the price and selling price determined by traders
	communication systems	W4 = Long and inefficient distribution, high marketing margin, and farmers' low share
		W5 = Speculative weight-based selling price without
External Factors		actual weighing
Opportunities (O)	SOStrategies	WO Strategies
O1= Market demand	1. Developing beef cattle breeding	1. Exerting the government's supports, i.e.,
O2 = Physical infrastructural	centers	equipment, capital, fodders, breeds, vitamins,
supports	2. Delivering technical guidance and	storage equipment, and drugs for cattle and farmers
O3 = Easiness in the	intensive socialization to farmers	2 Orienting the management system to semi
business permit application	3. Developing reliable and sustainable	intensive and intensive patterns through a crop-
cattle export/import	A Secielizing environments have d	livestock integration system
O4 = High beef cattle	4. Socializing agricultural waste-based food processing technology to farmers	3. Socializing a marketing information system to
demand and distribution	root processing termionsgy to immers	farmers
outside the region		4. Using the price information properly
Threats (T)	ST Strategies	WT Strategy
T1= Imported products/meat	1. Protecting domestic markets	1. Developing agribusiness markets
T2= Beef cattle production	2. Overcoming reproductive diseases	2. Conducting market operation
competition between regions	and maintaining cattle health	3. Granting business credits to traders
T3= Closed cattle markets	3. Socializing digital marketing	4. Complying with the government regulation on
due to the pandemic	4. Diversifying products	the standard price for the sale of beef cattle and
T4= Cattle reproductive and		beef
T5 Unstable 6		
15= Unstable beet prices		

Table 1 The SWOT Matrix of Beef Cattle Supply Chain in Gorontalo 2020

Sources: Primary Data Analysis, 2020

Elaborating Table 1, we explain internal factors which are strengths and weaknesses, and external ones which are opportunities and threats as follows.

# 1. Strengths

# a. Land Carrying Capacity

Gorontalo was a highland 50 meters above the sea level and located between 00.24"-10.02 North Latitude and between 1212.59"-123°.32 East Longitude. The area of Gorontalo was 2,125.47 km<sup>2</sup>, and the widest subdistrict was Asparaga with a total area of 20.25% of the area of Gorontalo District. Furthermore, Gorontalo had a Carrying Capacity of the Agricultural Waste Index (IDDLP) of 5.62. The Index indicates that Gorontalo was secured in terms of fodders, rendering more opportunities for adding cattle.

# b. Local Superior Commodity

Gorontalo was one of the three districts we selected to undertake a crop-livestock integration system program besides Bone Bolango and Boalemo. The district selection was based on the district agricultural and cattle potencies from which we expected the economic growth. The Gorontalo community focused on several primary commodities, two of which were corn and chilies, whose waste could be used to cattle fodders. Developing cow cattle in Gorontalo was supported by the ever-increasing cow population. In 2016, the cow cattle population in Gorontalo was 81,586 in number, which was then increased by 85,576 and 89,110 in 2017 and 2018, respectively (Statistics Indonesia in Gorontalo, 2019). It indicates that beef cattle were one of the superior commodities in Gorontalo following corn and chilies.

# c. Abundant Agricultural Waste Availability

Gorontalo had a highuse potency of waste-based fooderby 2,471,770 tons when the need for fodder was only 439,884 tons.

# d. Experienced Worker Availability

50 experienced beef cattle farmers who had been running their business for 2-20 years were still operating in Gorontalo.

# e. Adequate Transportation and Communication Systems

The transportation and communication systems in Gorontalo had been considered adequate. Traders transferring beef cattle using pick-up trucks and passed through asphalt road to cattle markets or other markets in other subdistricts. Besides, farmers and traders had been equipped themselves with a communication tool or mobile phone, facilitating them with accessible information.

# 2. Weaknesses

# a. Farmers' Limited Equipment and Venture Capital

Farmers used their own money, which was limited in number, as venture capital. It was difficult for them to borrow money from banks as they did not have collaterals. Additionally, traders, especially butchers, had to confront another challenge due to no beef storage equipment, such as freezers. They might have the equipment but very limited in number. As a consequence, beef could not be stored for long.

# b. Traditional Maintenance System and Poor Management and Technology Application

Farmers, in general, did not bother themselves to build cowsheds as cow shelters or toilets. Also, they still used modest tools, e.g., cow drinking places, water places, machetes, and broomsticks. The method used to raise cows was grazing in any season, in either dry or rainy season. Farmers spent for one-two hours a day to graze their cattle which was often tied in the yard. Furthermore, they fed their cattle with green fodders, i.e. Napier grass, as the primary fodder and additional fodder which was bran (Konga). Likewise, farmers had to face several challenges, one of which was diseases. In an attempt to cure their cattle, farmers concocted traditional herbal medicine which was not costly. Besides, they gave neither vitamins nor chemical drugs to their cows due to the medicine expensive rate.

# c. Non-transparent Information Flow from Traders to Farmers, Including the Price and Selling Price Determined by Traders

Information flow, especially in regard to price, from farmers to traders was not transparent. Traders never mentioned the actual cow price to farmers, making farmers unable to offer cows at a high price. Farmers preferred merchant collectors as they had a bond, in the form of either kinship or loans. Merchant collectors or market traders would determine a cow price, in which they occasionally negotiated to cut the price and make profits when farmers would increase their cows' price. However, farmers did not have a bargain position in a price determination as farmers did it by only estimating cow weight. Nevertheless, when the negotiation went nowhere, farmers would likely suffer from loss because the price would go lower. As a result, farmers rarely bargained the price determined by merchant collectors.

# d. Long and Inefficient Distribution, High Marketing Margin, and Farmers' Low Share

A long and inefficient distribution was brought about by the engagement of four marketing institutional levels, which were merchant collectors, market traders, butchers, and cross-regional traders. It created the highest marketing margin value, which was IDR5,500,000.00/cow and the smallest farmers' share which was 38.8%, as on Channel 1. Channel 1 indicates the low selling price accepted by farmers due to a low selling price at the farmer level, which was IDR3,500,000/cow for the beef cattle was distributed to the community as social assistance with a selling price at the collector level which was IDR9,000,000/cow. Meanwhile, merchant collector pleased themselves by a high marketing margin. Channel 1 indicates a low selling price accepted by farmers, which was only IDR3,500,000/cow as the beef cattle would be distributed to the community as social assistance when collectors would sell them by IDR9,000,000/cow. In other words, the latter group took the high marketing margin.

# e. Speculative Weight-Based Selling Price, without Actual Weighing

Farmers would sell a cow aged 1-2 years old to merchant collectors who would pick the cow up at home. However, some other farmers preferred to carry their cows to the market and sold them there. A beef cattle cost at IDR3,500,000-8,000,000. The price fluctuated, depending on the age and weight of the cow, which was 20-60 kg.

# 3. Opportunities

# a. Market Demand

The demand for beef cattle or beef was considered high, especially the demand of consumers who were arranging a celebration or preparing meals for religious holidays, e.g., Eid al-Fitr, Eid al-Adha, and Christmas.

# b. Physical Infrastructural Supports

Gorontalo had both physical facilities and infrastructures to develop beef cattle, i.e., ULIB (Artificial Insemination Location Unit) and RPH (slaughterhouses).

# c. Easiness in Business Permit Application and Recommendation for Cattle Export/Import

Beef cattle businesses in Gorontalo had been supported by administrative infrastructures, namely easiness in the business permit application and recommendation permit provision to export/import cattle.

# d. High Beef Cattle Demand and Distribution Outside the Region

The demand for beef cattle outside Gorontalo was considered high. Evident reveals that before the COVID-19 pandemic attacked, merchant collectors made beef cattle selling-purchase transactions with other traders outside Gorontalo who would send the cattle to Kalimantan. Nevertheless, the PSBB (Large-scale Social Restrictions) application in Gorontalo halted the cross-regional beef cattle trading.

# 4. Threats

# a. Imported Products/beef

Imported beef to Indonesia, especially from India, created an unstable beef price. Imported beef cost lower which was IDR100,000/kg than local beef, which was IDR120,000/kg. This situation threatened the sustainability of domestic beef production.

# b. Beef Cattle Production Competition between Regions

Gorontalo District was not the only beef cattle producer in Gorontalo. Another district, namely Boalemo, which was adjacent to Gorontalo District, also produced the same commodity. That situation engendered high competition in terms of supplying beef cattle in Gorontalo.

# c. Closed Cattle Markets due to the Pandemic

During the pandemic, the government stipulated PSBB (Large-scale Social Restriction), causing most cattle markets to halt their operation and thereby generating a situation in which many farmers and traders found it was difficult to sell beef cattle.

# d. Cattle Reproductive and Health Disorders

Reproductive and health disorders might harm the sustainability of beef cattle production. Poorly handled reproductive and health disorders might result in a decline in beef cattle production. Field evidence suggests that farmers rested on traditional medicine to cure ill cattle.

# e. Unstable Beef Prices

Beef cattle price, at either the retailer or farmer level, fluctuated, especially during the pandemic. The fluctuated price affected beef prices, which before the pandemic occurred, one kilogram of beef cost IDR110,000 but then increased to be IDR120,000.

A strategic matrix of the interaction between internal and external factors is formulated as follows:

# 5. SO Strategies

#### a. Developing Beef Cattle Breeding Centers

Beef cattle breeding centers, through a group institutional development system, could be built in Asparaga and Boliyohuto. Beef cattle breeding centers could be developed at either the provincial or district level to increase the number of cattle, accelerating beef selfsufficiency. The government had stipulated that Gorontalo would be the breeding center or an artificial insemination location unit (ULIB) and thus was allowed to produce superior breeds which could be used by farmers, either local or from other adjacent regions or provinces.

# b. Delivering Technical Guidance and Intensive Socialization to Farmers

Delivering technical guidance and intensive socialization to farmers using a hands-on practice concept to alter their breeding technique and increase production. Also, the farmer group function could be optimized by the intensive assistance and supports from the government and private parties/organizations as well as their members and technical and entrepreneurship training.

# c. Developing Reliable and Sustainable Institutional Partnerships

Developing a beef cattle supply chain to mitigate marketing risks requires a partnership between farmers (farmer group, Gapoktan, cooperation) and traders, business actors, or industries. Asir (2018) argued that one of the sustainable attempts to eradicate problems identified in a commodity supply chain was to amplify a partnership between farmers and business actors or marketing institutions (traders, industries, and exporters). The partnership urgently needed by business actors or stakeholders was price contracts or pricing under the government's stipulation which was directive and controlling. Besides, private supports also contributed to the growth and development of various associations. cooperations, and partnerships profitable. Supports from farmers/members in the form of member participation, cooperation between members and the committee to serve what members needed (production facility procurement, capital, and partnership with other parties) were also pivotal to achieve group independence.

# d. Socializing Agricultural Waste-based Food Processing Technology to Farmers

Technology should be socialized to farmers. The technology needed was usually in the form of fodder technology, artificial insemination, and crop-livestock farmer business waste management technology. The use of land resources was optimized by increasing the number of cow breeds, integrating plants-cattle, and optimizing a group function in production facility provision and product marketing.

# 6. ST Strategy

# a. Protecting Domestic Markets

Imported meat, which was cheaper, prompted a decline in domestic beef prices. Protecting domestic markets could be conducted using the following attempts: protecting the development center areas, developing industries by a means of the government's regulations, conducting a strict technical investigation to imported meat products, and fixing the quota of imported beef continually.

# b. Overcoming Reproductive Diseases and Maintaining Cattle Health

Communicable reproductive diseases would interfere with the reproductive process, yielding an inefficient cattle reproduction. In Indonesia, several communicable reproductive diseases in beef cattle, such as brucellosis, leptospirosis, and infectious bovine rhinotracheitis (IBR), had been identified. The diseases were potential for spreading without thorough prevention and control by the government and farmers, especially through the program of mitigating reproductive disorders by the government. Adjid (2004) clarified some recommended alternative diseases control strategies which were (1) protecting individuals in a group from communicable reproductive diseases, (2) elevating biosecurity, and (3) performing the artificial insemination (IB) program using communicable reproductive disease cement.

# c. Socializing Digital Marketing

Digital marketing constituted all marketing attempts which used electronic devices/the Internet with multiple marketing tactics and digital media, with which producers communicated with potential consumers spending most of their time online. Potential consumers were facilitated with various options to access what was being offered by producers. They could explore any website, blog, social media (Instagram, WhatsApp, Line, and so on) which promoted certain products. From there, they would be able to communicate with producers. Meanwhile, meat was one of the most consumable food ingredients, especially during religious occasions. It should be an opportunity for beef cattle farmers to supply fresh beef. Marketing fresh beef meant concerning beef quality and hygiene and prioritizing health. Several strategies to market packaged beef in retail were establishing a team, paying attention to product quality, providing proper places, determining a target, determining a reasonable price, and promoting.

#### d. Diversifying Products

Product diversification meant producing multiple variants of processed beef which would be launched at the market to minimize loss due to a decline in beef price and abundant beef production. Aligned with an increase in beef cattle farming businesses and population numbers, processed beef product diversification was absolutely required. It was subsequently followed by a shift in the community consumption pattern in processed dairy products, especially meat. From consuming fresh meat, they turned to consume fast-food products. The community farming dominated beef cattle farming in Gorontalo. Most farmers only owned onefour cows. Based on the Data Collection of Beef Cows, Dairy Cows, and Buffalos (PSPK, 2011), the beef cow population in Gorontalo had been able to fulfill the community's need for beef despite a low number of cows slaughtered. There were many ways developed to enhance the usability and storage time of fresh meat, e.g., processing the meat into sausages, meatballs, and shredded meat.

# 7. WO Strategy

# a. Exerting the Government's Supports, i.e., Equipment, Capital, Fodders, Breeds, Vitamins, Storage Equipment, and Drugs for Farmers and Traders

The government's supports in the form of breeds, fodders, vitamins, and drugs rendered to farmers contributed to an increase in beef cow production in Gorontalo. Most beef cow management systems were traditional in nature. Besides, the government's supports were aimed to provide services, namely IB, Poskeswa, RPH, instructors, and Central and Local UPT. Likewise, the supports were required to provide frozen meat storage equipment for traders, preserving the meat longer, and thus encouraging traders to earn more profits.

# b. Orienting the Management System to Semi-intensive and Intensive Patterns through a Crop-livestock Integration System

The beef cow breeding system in Gorontalo was traditional in general. One of the solutions considered effective to enhance beef self-sufficiency was implementing a livestock integration program with plantation crops, crops, or horticulture. The concept delivered a synergic profit or a manifold profit acquired from the interaction between plants and cattle. Also, a crop-livestock integration system was aimed to support the Beef Self-sufficiency Program which was also related to the fodder development aspect. Imran (2020) concluded that the fodder development program remained faithful to the achievement of (fodder) main ingredient self-sufficiency. The program was manifested in several activities, one of which was the application of Ruminantialivestock integration activity, particularly beef cows. Meanwhile, developing the integration between croplivestock through cattle waste processing into organic fertilizer and plant waste processing for cattle, especially in plantation, plants, and horticulture centers was one of the indicators of Ruminantia cattle production improvement program with local resource empowerment to sustain beef self-sufficiency.

# c. Socializing a Marketing Information System to Farmers

A marketing information systemwas an activity conducted by an individual or an organization or a company who was determined to ease and accelerate an advantageous exchange relationship within a dynamic milieu through distributing promotion and determining agoods price.

# d. Using the Price Information Properly

The market information, which was accurate, precise, punctual, and accountable, regarding agricultural commodities was required to corroborate the market information networking regarding agricultural commodities and accelerate information service delivery to market actors/policymakers. Kusumaningsih (2015) believed that asymmetrical market information flow regarding agricultural products resulted in imperfect price transmission, indicated by a significant price disparity between farmers and consumers.

# 8. WT Strategies

# a. Developing Agribusiness Markets

Agribusiness markets were aimed to restrict middlemen's practices by gathering farmers in a cattle market in which a beef cow production auction was held. As a result, farmers might enjoy an increased beef price as evidence suggests that traders took the largest portion of profits.

#### b. Conducting Market Operation

The market operation was the government's attempt to avoid an increase in beef price by a means of dropping or injection which would increase beef supplies through traders or directly through retailers when the cow price was increasing. The objective of the attempt was to mitigate price volatility by selling goods when the market price was increasing and purchasing when it was declining. The market operation was typically performed on goods with a strategic worth, such as beef.

#### c. Granting Business Credits to Traders

The government should render capital assistance to traders through easy business credit with low interest, ushering them necessary capital to beef marketing which required a high marketing cost, which was one of the subjects causing an inefficient distribution channel. Padjung (2018) conveyed that inefficiency in a supply chain might be rectified by creating a business environment where all supply chain actors upheld honesty. It was easily achieved by information openness, especially regarding product price and quality. Besides, a transparent information channel was supported by adequate infrastructures sustaining a product flow from farmers to retailers.

# d. Complying with the Government Regulation on the Standard Price for the Sale of Beef Cattle and Beef

The government had set a policy on purchasing and stipulated the lowest and the highest retail price for the beef commodity, protecting both producers and consumers, as we all knew that a beef price fluctuated. The government should make a regulation on stipulating the Reference Price for Purchases at Farmers and the Reference Price for Purchases at Consumers, especially in regard to strategic food commodities, i.e. rice, corn, soybean, sugar, onion, chili, and beef. Likewise, incentive socialization should be delivered to both farmers and traders.

# CONCLUSION

Food supply chain strategies during the COVID-19 pandemic were:

1. SO strategies:developing beef cattle breeding centers,delivering technical guidance and intensive socialization to farmers, developing reliable and sustainable institutional partnerships, and socializing agricultural waste-based food processing technology to farmers.

- 2. WO strategies: exerting the government's supports, i.e., equipment, capital, fodders, breeds, vitamins, storage equipment, and drugs for cattle and farmers, orienting the management system to semi-intensive and intensive patterns through a crop-livestock integration system, socializing a marketing information system to farmers, and using the price information properly
- 3. ST strategies: protecting domestic markets, overcoming reproductive diseases and maintaining cattle health, socializing digital marketing, and diversifying products.
- 4. WT strategies: developing agribusiness markets, conducting the market operation, granting business credits to traders, and complying with the government regulation on the standard price for the sale of beef cattle and beef.

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# The effect of the OSGIPE learning model based on the Indonesian National Qualification Framework on soft skills of Vocational high school technology Students

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Received: 02 Nov 2020; Received in revised form: 25 Nov 2020; Accepted: 01 Dec 2020; Available online: 22 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (<u>https://creativecommons.org/licenses/by/4.0/</u>).

Abstract— This research is a package that was carried out in a period of 3 years to develop a learning model based on the framework of Indonesia's national qualifications in an effort to improve students' vocational high school soft skills. The first year conducted two years ago, a draft learning model was found, namely the OSGIPE model. In the second year, a formative evaluation was carried out on the OSGIPE model through one on one, small group, and limited field trials. There was a significant increase in students' soft skills amounting to 23.05%. In the third year which is this year, a summative evaluation through wide field trials it have been carried out and still show that there is a significant increase in students' soft skills amounting to 23.44 %. It means that the OSGIPE model was feasible and effectively used to improve the soft skills of vocational high school technology students. So, the OSGIPE model can be used as an operational product concistently.

Keywords—OSGIPE instruction model, Soft Skills.

#### I. INTRODUCTION

Conceptually, competency-based curricula can be recognized as one of the means for implementing teaching and learning processes in the classroom to provide and broaden students' insights about knowledge, skills and other basic values in the hope that they can be reflected in the habits of thinking and acting. However, students have a very strong dependence on how they are treated by educators. That is, the success of students / students mastering competencies (learning outcomes) with regard to how lecturers / teachers practice learning systems in the implementation of learning.

Graduates' competencies for all educational institutions are related to *hard skills* and *soft skills*. In this regard, in general, education today is more about the development of hard skills (90%) than the development of *soft skills* that are only 10% (Santoso, 2008). In fact, the results of research in Europe show that a person's success in the business world is 80% determined by his *soft* 

*skills* only 20% is determined by his *hard skills*(Wahidi in Santoso, 2008). This means that they prioritize *soft skills* rather than *hard skills for* graduates of educational institutions. The survey findings are in line with the opinion of Bergh, et al. (2006) which states that the human resources (HR) that will be able to exist in the 21st century are those who have *soft skills* strong, in the form of the ability to think creatively, productively, make decisions, solve problems, learn how to learn, collaborate, and self-management.

Workers often complain that workers from educational institutions who do not have good soft skills generally cannot stand the world of work, are not honest, get bored quickly, cannot work together, and cannot communicate verbally or write good reports (Irma, 2007). Therefore, various survey results also show that in recruiting workers almost all companies prioritize *soft skills* applicants'rather than their *hard skills* (Sutabri, 2007; Admin, 2008). Based on the description above, it can be concluded that reliable graduates from educational institutions expected by the business / industry are graduates who have high *soft* skills. If these reliable graduates are specified as graduates of Vocational High School (SMK), it means that the teaching staff (teachers) in Vocational Schools are required to first understand and have soft skills as expected by the business / industry to then form and / or develop them in their students through teaching and learning strategies. The logical consequence is that all Educational Teaching Institutions (LPTKs), including the UNIMED Faculty of Engineering's Mechanical Engineering Education Study Program, which will produce prospective teaching staff at Vocational Schools must also be able to form and develop these soft skills to their students as long as they attend college on campus. For this reason, the need for teachers / lecturers to design learning that can shape and develop *soft* skills that are clear and systematic, through needs analysis and developed by accommodating the demands of various stakeholders, and getting full support and commitment from all teaching staff (lecturers / teachers) in their implementation.

The implementation of the competency-based curriculum has been started in Vocational Schools since the 2006 school year. However, based on the results of the questionnaire given to students about the achievements of the soft skills designed in the learning implementation plan it turns out that it has not been in line with the target. Based on the survey of the practical learning process there were several problems. First, most students do not have the willingness to do the best and the standard or prioritize perfection, there is a tendency to just fulfill the task. Second, lack of systematic, well-coordinated work habits that reflect efficient and effective work. Third, lack of work independence, there is a tendency towards dependence on friends and teachers so that there are often process errors or products. Fourth, lack of initiative or creative ideas when encountering problems in the process or product, so the results are not optimal (Sudjimat, 2010).

These problems are due to the learning pattern so far emphasizing the mastery of *hard skills* and giving less portion to the efforts to develop*soft skills* so that they are side by side with *hard skills*.

This is thought to be caused by the learning strategies implemented not relevant to the characteristics of the field of study and the characteristics of students, as stated by Reigeluth (2009) that results that are effective, efficient and interesting are determined by the suitability of learning strategies with the characteristics of the study area and participants. Effective learning strategies are closely related to learning models. Kauchak and Eggen (2012) suggest that learning strategies are wrapped by learning models. Therefore, the assessment of learning strategies requires an assessment of the learning model. That is why the focus of the problems in this study were examined from the aspect of the learning model. The field of study or field of expertise in this study is limited to the field of design and construction, namely the design of metal splicing concentration machine elements.

The main problem in conceptual learning of vocational technology competencies is how to relevance learning outcomes with the Indonesian National Qualifications Frameworkcontained in the planning and readiness of teachers to managetheir learning in order to achieve the desired competencies of students, effectively, efficiently, and attractively, especially in field of welding technology. Achievement of learning outcomes is determined by the learning model applied. Therefore, the focus of the problem in this study is the development of an learning model based on Indonesian's national qualifications frameworkthat can improve students' soft skills.

In this study, the formulation of the problem is: How is the appropriateness and effectiveness of the learning model based on Indonesian's national qualification framework (KKNI) developed in order to improve students' soft skills?

# II. LITERATURE REVIEW

Competence is basic knowledge, skills, and values reflected in the habit of thinking and acting. (Ministry of National Education, 2002). According to Burke (1995) "being able to perform whole work roles, to the standards of expected employment in a real working environment". From this definition, there are three competency criteria: a) able to carry out the overall tasks of the employee, rather than having specific skills or work tasks; b) in accordance with the standards expected in the work; c) in a real work environment that puts pressure on and relates to all work and the actual variations of work.

From the report SCANS (1991) identifies 5 (five) compotencies and 3 (three) basic parts of a person's skills and qualities to be able to handle work, namely: *The five competencies*: (a) *resources: identifies, plans, and allocates resources;* (b) *interpersonal: works well with others;* (c) *information: acquires and uses information;* (d) *systems: understands complex interrelationships;* (e) *technology: works with a variety of technologies. The three-part foundation consists of:*(a) *basic skills: reads, writes, performs arithmetic and mathematical operations,* 

listens, and speaks effectively; (b) thinking skills: thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons; (c) personal qualities: display responsibilities, self-esteem, sociability, selfmanagement, integrity, and honesty.

Competence is a basic characteristic that consists of skills, knowledge and other personal attributes (soft skills) that are able to distinguish a person from *performing* and Spencer & Spencer (1993) classifies not *performing*. competencies as basic characteristics, causal relationships and reference criteria as follows: 1) Basic characteristics are competence as part of an individual's personality and can predict behavior in situations and tasks, namely: a) motives as encouragement from self someone consistently to take an action; b) nature / character, namely physical characteristics and consistent responses to situations or certain information; c) self-concept, namely the values of attitudes or self-image possessed by individuals; d) knowledge, namely information that someone has for a particular field; and e) skills, namely the ability to carry out tasks physically or mentally. 2). Causal relationships are competencies that cause and predict behavior and performance. Motive competency, character / self-concept can predict behavioral actions that can ultimately predict performance results. 3). Reference criteria are the most critical competencies that can distinguish competencies with high or average performance. Thus vocational competence is a manifestation of one's abilities and skills to carry out overall vocational tasks in accordance with the expected standards in a real work environment.

**Soft skills** are broadly classified as a combination of personality traits, behaviors, and social attitudes that enable people to communicate effectively, collaborate, and manage conflict successfully (Snyder, 2020). People with good soft skills tend to have strong situational awareness and emotional intelligence to navigate difficult work environments while providing positive results. Another benefit of soft skills in the workplace is that it helps people adapt to changing circumstances. Able to communicate effectively during times of uncertainty or collaborate with others when solutions are not immediately found.

Soft skills are non-technical competencies that point to personality characteristics. This can be seen in a person's behavior, both when interacting in social situations, language skills, personal habits, or important traits to support optimistic behavior. Based on this, it can be said that *soft skills* are the strength of oneself to change or to overcome various work problems. Mastery *soft skills* of students'is the essence of competence that must be mastered and measured through performance during learning. Learning *soft skills is* seen as part of the effort to form a professional attitude. This attitude will influence behavior caring for quality, fast, right, and efficient, respecting time and reputation (Djoyonegoro, 1998). The attitude formation must be carried out from the beginning through the process of habituation to work that is developed and harmonized with learning needs.

Wagner (2008) emphasizes seven *survival skills* that have important values in this 21st century era. When examined, *skills* theseare *soft skills*, namely: (1) critical thinking and problem solving, 2) collaboration through networks and leading with influence, (3) agile and able to adapt, 4) initiative and entrepreneurship, (5) effective communication both written and unwritten, (6) accessing and analyzing information; and (7) imagination and imagination. Thus, mastery of *soft skills is* important so that graduates are able to survive various work challenges.

In particular for welding technicians, work / industry managers are attracted to knowledgeable individuals with a mix of welding knowledge and skills and interpersonal skills. They become convinced that their new employee will represent a respectable company while doing a thorough job for the client. Here are five soft skills that welding companies / industries need for welding technicians (Nats, 2018), namely 1) problem-solving skills, 2) math skills, 3) organized skills, 4) communication skills, 5) mental and physical fitness.

Wikijob (2020), presents 10 soft skills needed by the world of work, namely 1) communication, 2) selfmotivation, 3) leadership, 4) responsibility, 5) teamwork, 6) problem management, 7) assertiveness, 8) the ability to work under pressure and time management, 9) flexibility, and 10) negotiation and conflict resolution.

From the description of the welding technician's soft skills and those given by Wagner above, it turns out that there are 10 types of soft skills identified by Wikijob. Therefore, a description of each type of soft skill will be presented below.

# 1) Communication

Communication is one of the most important soft skills. Communicators who and can adapt their tone and style to suit their audience, understand and act efficiently on orders, and explain complex issues to colleagues and clients.Equally important are verbal and non-verbal communication skills. Verbal communication skills are key to fostering collaborative, respectful, and, ultimately, productive relationships. It also relates to non-verbal communica-tion orwritten communication. A lot of business communication now takes place via email, so it's important to see good email etiquette and give orders clearly and concisely.

# 2)Self-motivation

Having a positive attitude and the initiative to work properly without supervision at all times are vital soft skills for every employee. It not only demonstrates reliability and commitment, but also demonstrates the ability to fit efficiently into the organizational structure without the need for constant supervision. A worker who is highly self-motivated will show a positive way of thinking, ambition, commitment and initiative.

# 3)Leadership

Leadership is a soft skill needed even though it does not directly manage other people. Those with strong leadership skills will have the ability to inspire others and lead teams to success. A person with good leadership skills will have a variety of skills that are useful in the workplace, including: a positive attitude and outlook, the ability to make quick and effective decisions, exemplary problem solving or conflict management skills, the ability to communicate effectively, a talent for motivating oneself and motivating others.

#### 4)Responsible

Responsibility is a soft skill that is rarely discussed but highly valued. Colleagues who fail to take responsibility for their work are less productive and less successful overall. Someone who has a high level of responsibility will show the following attitudes: trustworthiness, discipline, motivation, awareness, and accountable.

# 5) Team work

As with leadership skills, good teamwork involves a combination of other soft skills. Working in teams to achieve common goals requires intuition and interpersonal intelligence to know when to be a leader and when to listen. A good team player will show an attitude of responsiveness and accept the needs and responsibilities of others.

# 6) Troubleshooting

Problem solving skills not only require analytical, creative and critical skills, but also require a certain mindset. A person who can approach a problem with a cool, calm mind will often come up with a more efficient solution than those who cannot. Problem-solving skills can often rely on strong teamwork. Problems cannot always be solved alone. Therefore, knowing who can help come up with a solution, and how they can do it, can be a huge advantage.

7)Firmness

Assertiveness is characterized by the ability to make quick and effective decisions. Assertiveness combines several different abilities, such as: the ability to put things into perspective considering the choices, assessing all relevant information, anticipating all good and bad consequences. An assertive employee will take effective and judgmental action quickly, especially when under pressure. They are responsible for the consequences of their decisions and can adapt when mistakes are made.

8) Ability to Work Under Pressure and Management Time

Many jobs come with demanding deadlines and, at times, the stakes are high. Recruiters value candidates who display assertiveness, unwavering clear thinking skills, and the ability to isolate and put stress aside. Time management is closely related to the ability to work under pressure, as well as within tight deadlines. Employees who manage their time well can efficiently prioritize tasks and organize their diaries while adopting an attitude that allows them to take on new assignments and deadlines.

# 9)Flexibility

Flexibility is an important soft skill, because it shows the ability and willingness to accept new assignments and challenges calmly and without comment. Flexible employees are willing to help when needed, take on additional responsibilities, and can adapt quickly to changes in plans, display a willing and optimistic attitude, and are not affected by change.

# 10)Negotiation and Conflict Resolution

Negotiation and conflict resolution skills are one of the soft skills employers look for in potential leaders. Being a proficient negotiator is knowing how to be persuasive and exert influence, while sensitively looking for solutions that will benefit all parties. Likewise, conflict resolution depends on strong interpersonal skills and the ability to forge good relationships with colleagues and clients.

*Soft skills* can be observed through performance such as speaking ability that reflects ideas and information, or clearly explains a topic, is easy to understand topics that are unknown, able to interact and work cooperatively in groups. A person with high mastery of *soft skills* will reflect abilities that exceed the capacity as a workforce. This ability arises because the person concerned is independently able to move internal processes to continue learning, trying and finding something that benefits his work or for self-development. Thus *soft skills are* important to master because they are needed by someone to develop themselves in doing work.

Soft skills learning is packaged using an integration model with some ease of consideration. This means that

the implementation of learning follows thelearning pattern *hard skills* implemented in accordance with the applicable curriculum implementation, does not require special funding and is more useful for strengthening *hard skills*.learning of *softs skills* Integratedis implemented with aapproach *connected model*, and *nested models* (Forgarty, 1991 & Drake, 2007).

The integration of *connected models* emphasizes the relationship between *soft skills* and *hard skills* on every topic, concept, skill, and with the world of work today and in the future. *Nested models are* oriented towards achieving *multiple skills* and *multiple targets*. With this model, *soft skills* learning will be easily achieved because *soft skills* integratedare not forced. Every learning activity in it already has *soft skills* that are measured through learning targets.

# Learning Model Development.

Richey (1986) defines the model as an illustration that results from the fact that it has an arrangement of a certain sequence. According to him the model can be used to organize knowledge from various sources then used as a stimulus to develop hypotheses and construct theories into concrete terms / conditions to apply them to practice or test theories.

Gustafson and Branch (2002) which emphasizes the practical function of a model that is a means to facilitate communication, or regular instructions (algorithms) that are prescriptive in order to make decisions, or planning instructions for management activities. Furthermore, it is said that a good model is a model that can help the user to understand what the overall process is fundamentally. The basis of a good model is the connection of several theories. Thus, it can be said that the benefits of the model for the user include: (1) explaining several aspects of human behavior and interaction, (2) integrating what is known through observation and research, (3) simplifying complex humanitarian processes, (4) guidelines to carry out activities.

In relation to learning, the learning model serves to direct educators to design learning that is used as a guide in the implementation of learning in order to achieve effective, efficient, attractive, and humanistic learning. Joice (2009) explains the learning model is a plan or a pattern that is used as a guide in planning classroom learning or learning in tutorials and for determining learning tools and directing us to design learning to help learning participants so that learning objectives are achieved.

Kaufman and English (2008) distinguish 3 (three) types of development models to determine which ones are

appropriate and appropriate to use, namely: (1) inductive models, which depart from students' current behavioral experiences, then grouped, compared, developed and finally evaluated for revisions, (2) deductive models, beginning with determining general goals, determining criteria, finding links between existing / partner elements, collecting data, formulating specific objectives, developing and implementing, then evaluating and revising , (3) classic models, starting with some general requirements of objectives, program development, program implementation, then evaluated and revised.

The University Consortium for Instructional Development and Technology (UCIDT) presents a model that can be applied to the development of learning (Wittich & Schuller (1999). The model includes 3 (three) stages: definition, development, and evaluation, divided into 9 (nine) with each of the 3 (three) steps and are interrelated with each other, namely:

Level I.Defining, including 1) Identifying the problem. In this first step what is done is identifying the problem, namely the gap between what is expected and the one that exists. More specifically, determine the conditions, what and what should be achieved by students, 2) The second step is the analysis of the situation, namely in an environment such as what learning is carried out, including students, learners (teachers), managers, and sources or materials learning, 3) The third step is organizing management, namely the executive leader who is responsible and carries out communication and other authorities.

**Level II**. Development, including 4) identification of objectives, as part of the development stage of learning begins with identifying specific learning objectives, if achieved, then the problem in the first step will be solved. In the formulation of goals must be stated: who are the participants or students (*Audiences*), behavior (*Behavior*) what can be done after the program is completed, under conditions (*Condition*) what they are formed, and level (*Degree*) of expertise achieved, 5) selection special methods or learning methods used to achieve goals, 6) constructing blueprints or *prototypes*, namely the components used, such as teaching preparation, exam materials, and specific guidelines and program evaluation.

**Level III**. Evaluate, copy 7) test the *prototype*. The evaluation phase begins by testing each component of the program. This initial trial was conducted on small samples and observations were held to see the presentation. Student comments are used as an assessment of what they are achieving, 8) analysis of results. The data collected in step seven determines the significance of the extent of the

contribution given by each component to achieving goals, useful or not, 9) implementation / revision. Program improvement is done by looking at the achievement of certain goals, by reevaluating the contribution of learning components to achieving goals.

Regarding the product design model, there are five learning design models identified. The five models are (1) Kemp (1977), (2) Banathy (1978), (3) Calvano (1980), (4) Paul Harmon (1982) and (5) Dick & Carey Models (2005). ) Of the five models, the learning design model from Dick, Carey & Carey was chosen to be used in this study.

# III. RESEARCH METHODS

This research using development research methods. A cycle of research and development is known as "the R & D cycle" (Borg & Gall, 2007) combined with a design model learning from Dick, Carey and Carey (2009). In this study, survey methods were used through needs analysis, trial methods through procedures (a) expert review, (b) one-on-one trials, (c) small group trials, (d) limited scale field trials, and (e) wide-scale fieldtrials to produce operational products. Implementation of large group trials (field trials) using quasi-experimental methods with the design of "*Pretest-Posttest Control Group Design*".

# **Population and Sample**

The population of this study were all students of the State Vocational School in the Field of Welding Technology in North Sumatra Province. The subjects of this study consisted of students from the State Vocational School of Welding Technology, consist of two cities and six regencies. This sampling uses a simple randomtechnique. For one-on-one trialsconsists of three students per school, the small group trialseight students per school, for limited scale field group trials200 students, and 400 students for wide-scale field trials.

Data collection techniques used in this study were questionnaire techniques and interview techniques, as well as documentation techniques to capture data on needs analysis activities, questionnaire techniques to capture data about riviuwer responses and students on expert validation activities and one-on-one trials (individual test) and smallgroup trials (small group test), and test techniques and observations on limited field testing activities as well as large-scale field trials.

The data analysis techniques used are (1) descriptive analysis to describe the data from the results of needs analysis and expert validation and one-on-one and small group trials. (2) t-test to find out the effectiveness of OSGIPE learning model for limited.

# IV. RESEARCH RESULTS AND DISCUSSION

#### **Research Results**

Based on the results of the analysis of the literature study, needs assessment, curriculum of vocational technology, there are six soft skills for welders, that is 1) communication skills, 2) team work and collaboration, 3) adabtability, 4) problem solving, 5) critical observation, and 6) work ethic skills.

Based on the results of learning analysis found the skills map (*hard skills*) for welders as shown below.



Fig.1: Welders Skills Map

Draft of hypothetical learning model based on the analysis of the results of the literature study and characteristics of competency and characteristics of the field of study which in the process raises the soft skills that have been identified based on the result of needs analysis can see as follows.



Picture. 2. Draft of Hypothetical Welding Learning Model Based on KKNI to Improve Soft Skills (OSGIPE Model).

Hypothetical Welding Learning Modelas shown in Figure 2 above is the initial model that will be continued through testing or through formative and summative evaluation as consistency of the application of the Dick, Carey and Carey (2005) models, consisting of six main steps , namely: 1) Orientation, including activities to build motivation, review the initial ability to explain objectives, 2) Select tasks, include activity description of conditions and analogies, 3) Guided exercises, including activities to provide examples, Group assignments, and Feedback, 4) Exercise Mandiri, covering individual task activities and feedback, 5) Projects, including problem analysis activities, alternative solutions, determining projects, completing projects, and 6) confirmation (testing), feedback, and follow-up.

The results of one-on-one trials showed that the feasibility of the OSGIPE learning model were found to be an average of 76.25, the results of small group trials amounted to 80.75, and limited field trials results amounted to 83.75. When compared with the eligibility criteria, it is included in the good category.

The results of testing effectiveness of OSGIPE model related to limited field trials using pretest - posttest analysis showed that there was an increase in student soft skills as an effect of the implementation of the OSGIPE learning model (the average pretest is 59.03 and the average posttest is 86.69). This shows that the increase amounted to 23.05%. Based on the results of the t-test, showed that the increase is significant at the 95% significance level. It means that OSGIPE model effective to improve soft skills of student.

The results of testing effectiveness of OSGIPE model related to wide field trials using pretest - posttest analysis showed that there was an increase in student soft skills as an effect of the implementation of the OSGIPE learning model (the average pretest is 58.57 and the average posttest is 86.70) amounted to 23.43% significantly at the 95% significance level. It means that OSGIPE model effective to improve soft skills of student consistently.

# Discussion

The Learning Model of Welding Engineering Based on KKNI to improve soft skills as described earlier, is the initial product in this study which still requires further testing through formative evaluation and summative evaluation. According to the results of formative tests that have been done show that the OSGIPE learning model is effective for improving students' soft skills.

This is because the model has been built through theoretical studies of learning models that are thought to be able to foster personal competence, thinking skills, social competence, and vocational competence, as adapted from the learning models presented by Joyce, Weil, and Calhoun (2009), as well as Kauchak and Eggen (2012).

In the orientation phase, supported by the ARCS model from Keller (2010), namely the integration of learning motivation theory and research findings that are applied to the design of learning experiences. This is based

on combining behavioristic, cognitive, and humanistic learning theories through his research.

In the task selection phase, it is supported by Gordon's synectict model (in Medsker and Holdsworth, 2001) and Gagne's (1985) condition of learning. According to Gordon, through the synectic model, creativity will be built. Gordon built this theory based on the cognitive learning theory and Gagne combined the theory of kognitivistik learning and the theory of conditioned response (Pavlop and Watson) and the theory of reinforcement (Skinner) in this case is the theory of behavioristic learning.

In the guided training phase, supported by the constructivist theory of Vygitsky and Bruner (1995), cooperative learning based on humanistic learning theory, and Skinner's theory of feedback (reinforcement) which is based on behavioristic learning theory.

In the independent training phase, it is supported by Scandura's (1983) structural learning theory which is based on cognitive learning theory and Skinner's theory of feedback (reinforcement) which is based on behavioristic learning theory.

In the project phase, supported by the constructivist theory of Vygitsky and Bruner (1995), cognitive inquiry (Pallesen, in Medsker and Holdsworth, 2001)

In the evaluation phase, it is supported by Skinner's theory of reinforcement, which is based on behavioristic learning theory.

The learning model is also based on the characteristics of the field of study / expertise and characteristics of students. Reigeluth (1996) suggests that if the learning method is adapted to the conditions of learning it will produce effective, efficient, and attractive results. This is also supported by Nadler (1988) explaining that a good model is a model that can help the user to understand what the process is fundamentally fundamental. Furthermore, it is said that the basis of a good model is the relation of several theories. Because the building of the learning model has been based on the interrelationship between several theories, it can be assumed that the model will be effective, efficient and attractive.

# V. CONCLUSIONS

The OSGIPE learning model based on the Indonesian National Qualification Frame-Work feasible and effective to improve soft skills of vocational high school technology students consistently.Soft skills referred to here are:1) communication skills, 2) team work and collaboration, 3) adabtability, 4) problem solving, 5) critical observation, and 6) work ethic skills. The OSGIPE learning model has six main components:1) orientation, including motivation building activities, reviewing the initial ability to explain goals, 2) choosing assignments, including activity description conditions and giving analogies, 3) guided training, including activities to provide examples, group tasks, and giving feed-back, 4) independent training, includingcovering individual task activities and giving feedback, 5) projects, including problem analysis activities, alternative solutions, determining projects, and completing projects, and 6) evaluation includes confirmation activities, giving feedback, and follow-up.Improvement of students' soft skills amounted to 23.05% as a result of the implementation of the OSGIPE learning modelrelated to limited field trials and 23.44 % related to wide field trials.

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## **Production Planning and Control: Improvement Proposal for the Stock Management of a Hotel Located in a Brazilian Metropolitan Region**

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Received: 25 Nov 2020; Received in revised form: 12 Dec 2020; Accepted: 18 Dec 2020; Available online: 22 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— Studies show that the application of Production Planning and Control (PCP) in micro and small companies, mainly in the service sector, encounters many resistance from companies. This work explored this finding by conducting a study in a hotel located in the Metropolitan Region of the Paraíba Valley and North Coast located in the Sao Paulo State, Brazil, with the aim of detailing the situation from the perspective of Production Engineering. The methodology of the bibliographic research in periodicals on the application of the PCP in micro and small companies, in the area of services and in the hotel sector was used, and the results confirmed the possibility of improvements for the sector, contributing to a more rational management of resources and an increase in the reliability of the services provided by the enterprise.

Keywords—Hotel Sector, Inventory Control, Production Planning and Control.

## I. INTRODUCTION

At the beginning of 2019, the [1] projected a 3% to 5% growth in the hotel occupancy rate for the current year. Data from the [2] point out that in 2016, the Metropolitan Region of Vale do Paraíba and North Coast (RM Vale) generated 4.8% of Gross Domestic Product (GDP), with approximately 2.5 million inhabitants in 2018. Combining these data with the strong religious tourism that the Paraíba Valley provides, headed by the Basilica of Our Lady Conception Aparecida, the Sanctuary Frei Galvão and Canção Nova, one can point to the hotel sector of the region a horizon of opportunities. In this context, this study was conducted at a hotel located in RM Vale, here called Hotel Zeta.

From this synthesis of the hotel sector at RM Vale, one can conceptualize the PCP. For the author [3], Planning and Control is the "conciliation of the operation potential of supplying products and services with the demand of its consumers". It is a set of activities that are performed daily in order to ensure that the manufacturing operations of the organization occur in a continuous way [3]. [4] also state that "PCP is also an information transformation system, because it receives information about the existing stocks, expected sales, product line, production capacity".

The PCP acts as an internal integrator of the organization: planning and control, finance, marketing, sales, purchasing, product engineering and production [5]. It is related to planning and control when preparing demand forecasts and analyzing production capacity when determining the organization's annual planning; with finances the PCP has a direct relationship with the budget forecasts that will be necessary to achieve the goals proposed by the planning; it is also directly involved in defining the human resources that will be needed to fulfill the planned production; With marketing and sales, the PCP maintains a close relationship in order to ensure that the goals are feasible from the point of view of all productive resources; with product engineering and production, the relationship becomes even closer, because it is necessary to ensure not only the capability of the processes, but also

to schedule the production, developing its control and feedback with continuous improvements.

At first, this work sought to study the possibility of implementing the PCP in a micro or small company, checking the gains that could be achieved. However, a small search in the Periodical Portal of the Coordination for the Improvement of Higher Level Personnel (CAPES) and in the site of the Brazilian Association of Production Engineering (ABEPRO) showed that the application of PCP in micro and small companies is still a factor that meets many resistance from companies, especially when it comes to the service production sector.

The evidence on PCP studies in the hotel sector confirms this characteristic found in relation to micro and small companies, however, it also demonstrates that the sector shares the same processes of an organization producing tangible goods, which makes a hotel susceptible to the same tools and methodologies of PCP [6]. This finding aroused the interest of understanding a little beyond the possible gains with the application of the PCP, it even suggested a niche that could be explored for future egresses, and contributed to the objective of the study in detailing the reality of Hotel Zeta from the perspective of Production Engineering, delimited by the application of PCP methodologies and tools and present a solution proposal for one of the problems that was diagnosed in the company.

The work was carried out based on bibliographic research in journals on the application of the PCP in micro and small enterprises, in the area of services and in the hotel sector, with due emphasis on planning and stock control in the context addressed. From these bibliographic researches, some data from Hotel Zeta were collected, some PCP tools were applied, and the results were analyzed and compared to the reality of the enterprise.

he final product of the whole study, besides the proposal of initial use of an inventory control spreadsheet that proved to be easy to understand and implement should the company choose to use the resource, revealed that the methodology and tools can result in promising improvements for the hotel sector and, specifically in the case of inventory planning and control, it contributes to a more rational management of resources, protecting from critical shortages and increasing the reliability of supplies in the services provided [7].

#### II. **BIBLIOGRAPHICAL REVIEW**

The expected professional profile of a Production Engineer, among other requirements, is the ability to act in the planning and improvement of productive systems of goods and services and to develop solutions to complex problems within these systems [8]. In production management, stock planning and control is a topic directly linked to Production Planning and Control (PCP) activities, hence the importance of the topic for the formation of the production engineering student.

As an area of wide application in production engineering, to study the application of PCP at Hotel Zeta, we started the bibliographic review in books, journals and other publications, such as newsletters and articles on sites available on the Internet, involving topics on the following applications of PCP: in micro and small businesses, in the services area, in the hotel sector and in stock management. In order to carry out the research in journals, the CAPES Journals Portal and ABEPRO's website were consulted, using the words: production planning and control, hotel sector, micro and small companies, services and stock management as descriptors. The main results for the purposes of the study were gathered in the following table 1.

РСР	Objectives	Results	Suggestions / Gaps	N° of
Applications				Publications
				Researched
Micro and	Application of PCP	Development of a decision support	Application of other	5
small	resources to improve	spreadsheet for production planning;	improvement tools	
enterprises	the performance of a	methodology proposed to assist in the	(stock control,	
	micro company; use	development of the PCP for small	feasibility study,	
	of PCP resources	businesses; increase in delivery	action plan); adoption	
	such as Demand	punctuality; reduction of lead time;	of software for the	
	Forecasting, short,	reduction of waiting time in line;	optimization of	
	medium and long	increase in capacity utilization;	programming; how to	
	term planning;	identification of variables and basic	minimize the risk,	
	improvement of the	indicators for the implementation of the	what is the impact of	

Table 1: Summary of the bibliographic review in journals: results and gaps found

DCD

	PCP of a small company; process mapping.	PCP.	restructuring in the decision-making process; critical analysis of processes.	
Services area	Use of PCP to improve planning of hosting services; sales and operations planning in the service sector.	Improvement of the management of services in the capacity of attendance with quality and efficiency; capture, organization and analysis of data referring to the demand and the capacity of the company.	Application of other improvement tools.	2
Hotel Sector	Evaluate restaurants located in hotels with a focus on management improvement; evaluation of the hotel supply chain and its impact on operational and financial performance.	Application of the quality tools; application of the PCP methodology in the evaluation of the supply chain.	Application of other PCP tools; study of demand management in the supply chain and inclusion of other means of hosting.	3
Inventory Management	Importance of stock control processes and their impacts on the company's growth impact; demand forecasting and stock management; ABC curve application; JIT and Kankan application to optimize the stock; application of the lean company tools in a civil construction company.	Application of stock control techniques and company readaptation showing favorable results; tools and methods of demand forecasting and stock management allow a more efficient, faster and intuitive control; ABC curve allows identifying the items of greatest financial importance; JIT and Kanban are not restricted to the industrial scenario, and can contribute to reducing inventory and costs even in environments where robust IT systems are lacking; use of MRP in the development of a tool, using Visual Basic (VBA) programming language in MS Excel; use of physical inventory of inventory; use of Lean practices and visual management for the construction industry; supply the demand and absence of a safety stock.	Implementation of continuous stock control; safety stock by product type; application of other PCP methodologies; implementation of MRP II; detailed analysis of stock control in restaurants from PCP tools.	15

From the delimitation of the object of the study and after analysis of the problem in the light of some publications found (table 1), it can be stated that the problem of application of the methodologies and tools of the PCP becomes more scarce when delimiting the space of micro and small companies added to those of service provision. This statement is also mentioned by other authors when they look at the application of the PCP in small and medium enterprises, such as the conclusions presented by the author [9]. In light of this finding, this study involving Hotel Zeta sought to answer some of the questions regarding the following gaps found: application of other improvement tools (stock control), implementation of continuous stock control, and safety stock by type of product. Brazil has 6.4 million establishments and of this total, 99% are micro and small enterprises (MPE) that account for 52% of jobs with signed portfolio in the private sector [10], which leads to the conclusion of the existence of an expressive niche for the application of PCP methodologies and tools. Studies have shown that this part of the undertakings, together with the services production sector, could become even more productive with methods and techniques of production planning and control.

## 2.1 The production of services in the Hotel Sector

The provision of services in the hospitality sector is directly related to the hospitality industry, although it is not the focus of this research, it is therefore important to emphasize that the activities performed in the provision of services in a hotel are transversal to the universe of this industry. For the author [11], the guest does not have any obligation to return, because he is just making a monetary exchange, being the entrepreneur to satisfy him in the measure and in the expected quality so that he starts to wish a return visit. In front of this statement, to apply the quality tools in the planning and control of the stocks is necessary to guarantee not only the satisfaction of the requirements of the client, but also its fidelity and, of this transaction, the profit for the enterprise. The vision of applying PCP tools in the service sector, especially in the hotel sector, is corroborated by [12] when he states about "the need for evolution in managerial processes in order to obtain primacy in the provision of their services, and therefore ensure survival in a scenario of increasing change.

## 2.2 Demand Planning and Inventory Control

The production process begins with the observation of a client's need, from which a solution is idealized, followed by a demand forecast. The author [5] conceptualizes the demand as the willingness of customers to consume goods and services. From this concept, it can be stated that demand is constantly suffering influences from the economic, operational, political environment: inflation, exchange rate, employment level, fiscal policy, product availability, price, place of sale, politics and trade barriers. In addition to the influences that demand suffers, some patterns in the way demand occurs can also be identified. For example, buying a daily rate at a hotel is a very "oneoff" activity for any citizen, however, for an executive who is always in contact with potential customers and suppliers in charge of a large company, this activity can follow a "repetitive" pattern.

Thus, knowing the demand and understanding its patterns, identifying its trends, is fundamental to perform the demand forecasting [5], being an important factor for the success or failure of a company. As the forecast is an inference about the future, based on real company information, mathematical and statistical methods are used to perform it. It should be noted that there is no forecast that does not carry a margin of error, since it is something inherent to "forecasting". The most used methods for demand forecasting are: moving average (simple or weighted), exponential damping (simple or with trend adjustment), linear regression and multiple regression [7].

Demand forecasting, as a methodology for planning, also has levels of detail of information and decision making, and can be exemplified in Fig. 1 below [5]:



## Fig. 1: Demand forecast in production planning Source: [5]

Demand forecasting techniques are used in conjunction with planning and control, in view of their importance for decision making: how much to ask, when to ask and how to control the system.

Some methodologies suggested by [7] were applied at the Zeta Hotel to support stock decisions: use of the economic lot of purchase (LEC) to support how much to order and application of the ABC curve to support stock management control. It should be noted that, after initial data collection from the enterprise, it was found that the demand forecast per occupation is performed by a company contracted for this purpose. The forecast of the demand for occupied rooms is carried out routinely, as it is from this that the other activities of the enterprise are programmed. This way, the forecast of occupied rooms directly influences the amount of items in stock that will be demanded both for guest service (clothing, hygiene products, etc.) and for those that will be demanded by the food service at Zeta Hotel (breakfast, restaurant, beverage machine, etc.). It should be noted that the authors [13], after conducting a study involving stock of a micro food company, found that the use of the ABC curve contributes to diagnose which stock items need better financial

management, helping in the formulation and use of a stock policy for each class of item.

According to [7], stock can be defined as the accumulation of material resources needed due to the difference in pace between supply and demand, and this difference directly influences its level of reduction. There are several types of stock, however, considering the Zeta Hotel the work is tied to the safety stock, which is the one necessary to compensate for the uncertainties inherent to demand supply [7]. An excellent stock management can be exemplified by one that does not "stall" the company's financial resources and, also, does not cause losses in customer service [14]. In practice, stock control should take into consideration the characteristics of each business, that is, not always what goes very well in the manufacturing area, will go so well in the service area. The way an inventory is controlled can affect the quality, availability, reliability, flexibility of choice and cost of a supply [7].

2.3 Planning and Quality Control

Quality is one of the additional factors directly related to production and can be understood as meeting customer expectations [14]. The authors [15] emphasize quality in the hotel services sector as a factor directly related to customer service, overcoming and satisfaction.

According to Ishikawa, "ninety-five percent of qualityrelated problems can be solved by using seven basic quantitative tools" [16]. These tools are represented by: process diagrams, Pareto analysis, cause and effect diagrams, correlation diagrams, histograms, process control charts and check sheets. To support the solution of the Zeta Hotel stock problem, the quality tools will be used: Pareto analysis and cause and effect diagrams.

Pareto's analysis allows to analyze in a fast and direct way, among several listed problems, which produce the greatest effects, consequently allowing to create actions to solve them first. After the second interview with a representative of the Zeta Hotel, several shortcomings related to stock management were raised. The Pareto analysis tool was applied and figure 3 was generated to visualize the problem.

The cause and effect diagram, also called the Ishikawa or herringbone diagram, is a simple tool, but has proven very effective in problem analysis. [14] suggest its use in combination with Pareto analysis, further stating that, in the case of manufacturing, the 6Ms (machine, labor, measurement medium, material, method and environment) are usually used. In the case of service operations, the 4Ps (places, procedures, people and politics) are used. Stock planning and control is the target of many researches, from the PCP point of view, because its tools tend to cause great positive impact of the management of this activity inside any researched company. This statement can be confirmed by means of the surveys in periodicals mentioned in table 1. The author [17] strengthens this idea when he points out as one of the possible technical restrictions for the implementation of PCP in small companies the absence of a quality control system.

## III. METHODOLOGY

This study has an applied nature, exploratory objective and qualitative approach. As for the method employed, it is an action research, since the student will be participating in a cycle in which research is done on the object of study and proposes a change to improve his practice [18]. The action-research method is characterized by a cycle that can be represented by four phases: planning of an improvement of the practice; action to implement what was planned; monitoring of the action and description of its effects; and evaluation of the results of the action taken. This cycle requires a constant action and at the same time an investigation [18].

The use of this method is justified, since the study in question begins with an investigative look in the search for the problem, at the same time as the applications of the PCP are investigated more rigorously. From these two steps, a solution is outlined, the planning is done and the behavior of the application of this solution is observed, measuring - even if statistically - its effects and results on the investigated problem.

In order to develop the work and find a PCP tool that best fits the scope of the study for implementation in a real company, as well as develop the theoretical basis of the project, the first step to talk about the subject and achieve the objective of the work was the bibliographic research in books and articles involving topics related to: Production Planning and Control, the PCP in small companies, the PCP in Stock Control and the PCP in the Hotel Sector. The initial milestone was the authors [14], as well as articles, monographs and dissertations published in digital repositories ABREPO and CAPES.

The collection of data referring to the Hotel Zeta, object of the investigations of this study, was carried out through the elaboration of research questionnaires and participation in meetings in the researched environment. The face-to-face meetings, in which some initial data were collected and also the characteristics and organization of the stock were observed, were held at the establishment and included the participation of one of the hotel owners and one of the students. OpenProject software was used to plan the study schedule, which proved to be a very accessible tool to manage the research project. Some interviews took place through electronic questionnaires for data collection using Google Forms, an online platform. To support the organization and analysis of data in charts and figures, Microsoft Excel® software was used, as well as XMind software.

The seven quality tools listed by the authors [14] were used, and the tools of the Pareto diagram and Ishikawa analysis were discussed at Hotel Zeta. The next step in the investigation of improvements in stock control at Hotel Zeta, from the PCP perspective, was the application of the following tools: ABC curve, economic purchase lot (LEC) and safety stock (ES).

As a final product of the work, a proposal for an improvement solution was presented for Hotel Zeta, however, the decision to implement it was not included in the scope of the study. Thus, the measurement of the results followed the application of inferential statistics, being up to the owners of the enterprise to apply or not the suggested tools, in whole or in part.

## IV. RESULTS OBTANEID

The application of PCP in micro and small companies is still a factor that encounters a lot of resistance from companies, especially when it comes to the service production sector. The most common thing in available literature is the finding that the PCP involves activities developed by a Production Support Area, responsible for the coordination and application of productive resources in order to best meet the plans established at the strategic, tactical and operational levels of a plant [3].

The author [9] states that there is a great lack of articles relating PCP to small and medium enterprises and mentions in his analysis that many PCP articles deal with software. This same observation is made by the author [17], that the difficulty of applying PCP in this sector occurs because most of the studies in PCP involve modeling methods that require data entry, which are often not available in small and medium enterprises.

Although the scarcity of work involving the application of the PCP in small and medium enterprises, an analysis in the bibliography consulted showed that the methodology and tools can result in promising improvements for the sector and, specifically in the case of stock planning and control, contributes to a more rational management of resources, protecting from critical shortages and increasing the reliability of supplies in the services provided [7].

Hotel Zeta was chosen to perform an action-research defined by the cycle formed by the revision of theoretical concepts and research in the practice of the methods already employed or the forecasting of improvements that the PCP methodologies can provide. From the first meeting held with one of the owners of Hotel Zeta, it was concluded that stock management was one of the main niches for the application of the study on the implementation of the PCP methodology and tools in the company's service production area. A second analysis, carried out through an interview, highlighted the real problems that the hotel has been facing in stock control planning. Based on this diagnosis, the research was started so that, based on the theoretical reference, it could elaborate a suggestion for the improvement of the activities performed in the hotel and that would prove to be a great opportunity for increasing productivity, with reflexes in the satisfaction of the clients and, consequently, with the possibility of maximizing profit.

The result of the next step, resulting from the research conducted to identify the failures in stock management, can be represented by the following Table 2 and respective Fig. 2:

Representation Problem	Problem Reported	Occurrence	Individual Participation (%)	Accumulated Participation (%)
А	The stock did not present total control of its products	90	39,82	39,82
В	There was expired product in stock	0	0	39,82

Table 2: Identifying Zeta Hotel's stock control and planning failures for a period of 90 days (one quarter)

## International Journal of Advanced Engineering, Management and Science (IJAEMS) <u>https://dx.doi.org/10.22161/ijaems.612.10</u>

С	There was a need of some product and, after verification, it was missing	20	8,85	48,67
D	The periodic audit was not performed	1	0,45	49,12
E	Although it does not exist, the need was felt for a method to predict what, when and how much to buy	20	8,85	57,97
F	It was necessary to estimate the cost of the stock	0	0	57,97
G	It was necessary to make separate controls for the hotel and restaurant stock	30	13,28	71,25
Н	It was necessary to know who took products out of stock, but it was laborious or impossible to get the information	10	4,42	75,67
Ι	It was necessary to know the balance of the stock and the information took longer than expected	10	4,42	80,09
J	Some employee demonstrated not to have understood the instructions for stock control, although he was trained	5	2,21	82,30
K	It was thought to optimize the capital invested in stock without compromising the quality of services provided	20	8,85	91,15
L	It was thought to create a manual of operating procedures for the employees who work in the inventory	20	8,85	100,00
TOTAL	-	226		





According to the author [7], it can be concluded from the analysis of figure 2 that eliminating the flaws represented by A and G, corresponds to solving 80% of the initial problems related to the control and planning of the Zeta Hotel stock. In other words, it becomes necessary to

develop an inventory planning and control, which can be easily implemented by the hotel management.

Continuing the application of the quality tools selected to support the resolution of problems presented by Hotel Zeta, the Ishikawa diagram was applied in a third interview, considering the 4Ps indicated for the service 3. operation. The data from this analysis are presented in Fig.



Fig. 3: Ishikawa diagram for the 4Ps

After this third interview, it was verified that the enterprise is a family business, which has sought a more professional management, through the hiring of managers with experience in other renowned chain hotels, but which also does not give up a more "familiar in some aspects" management by one of the partners. At the time, it is important to point out that this family management allowed for significant evolution not only in the physical accommodations of the undertaking, but also in the client portfolio. It was also observed that the employees are trained for the tasks performed and, currently, the hotel is hiring two new managers for the strategic areas of the business.

Continuing the suggestion of improvements, with a proposal adherent to the methods of control and production planning, a visit was made to observe the place of stock, the survey of resources employed (labor, equipment, financial and technological) and the layout adopted. With this data and other data related to the current stock control, the organization was organized in spreadsheets in order to analyze and apply the suggested procedures for decision making aiming at improving the reported problems. The summary of these spreadsheets was presented in Table 3.

ITEM	UNIT	ANNUAL DEMAND (UNID)	AVERAGE ANNUAL COST (R\$ 1,000.00)	ACCUMULATED ANNUAL DEMAND (R\$ 1,000.00)	ACCUMULATED ANNUAL DEMAND (%)
filet mignon	kg	416	23.296	23.296	16,17
coffee capsule	unit	5200	15.548	38.844	26,96
salmon piece	kg	312	14.040	52.884	36,71
chicken filet	kg	1040	10.192	63.076	43,78
рарауа	unit	2600	7.800	70.876	49,20
orange	box	260	7.800	78.676	54,61
milk	unit	1872	6.084	84.760	58,84
trout	unit	520	5.720	90.480	62,81
multipurpose diprol 5 liters	bucket	104	4.576	95.056	65,98
melon	unit	1300	4.550	99.606	69,14

Table 3: Survey of items in stock

## International Journal of Advanced Engineering, Management and Science (IJAEMS) <u>https://dx.doi.org/10.22161/ijaems.612.10</u>

salted	unit	1300	4.160	103.766	72,03
pineapple	unit	1040	4.160	107.926	74,92
potato sticks bag 5 kg	bag	156	3.588	111.514	77,41
gourmet hamburger	unit	520	3.380	114.894	79,75
butter cookies	unit	520	3.120	118.014	81,92
toilet paper	unit	2600	2.080	120.094	83,36
strawberry	box	520	2.080	122.174	84,81
beans	kg	312	2.028	124.202	86,21
5 liter diprol disinfectant	bucket	52	1.872	126.074	87,51
cherry tomato	box	416	1.456	127.530	88,52
chocolates	unit	1560	1.404	128.934	89,50
apple	kg	312	1.342	130.276	90,43
rice 5 kg	kg	104	1.300	131.576	91,33
waste bag 20 liters	one hundred	52	1.300	132.876	92,24
water	unit	1560	1.248	134.124	93,10
beer stella	unit	312	1.111	135.234	93,87
american lettuce	unit	624	936	136.170	94,52
5 liter chlorine	bucket	52	936	137.106	95,17
banana	dozen	260	910	138.016	95,80
powder soap	package	104	884	138.900	96,42
lemon	kg	156	780	139.680	96,96
grape Italy	kg	104	728	140.408	97,46
disposable cup	unit	4160	624	141.032	97,90
coconut soap	package	52	538	141.571	98,27
butox	unit	156	524	142.095	98,63
disposable gloves	unit	260	507	142.602	98,99
pen	unit	780	437	143.038	99,29
tonner for printing	unit	20800	416	143.454	99,58
floor cloths	unit	312	312	143.766	99,79
A4 sheet	unit	13000	260	144.026	99,98
pencil	unit	104	35	144.062	100,00

After collecting the stock data, and the organization in chart 3, Pareto's analysis was again applied, with the objective of elaborating the ABC curve that should indicate which items can be classified as A, that is, although in small numbers they are responsible for most of the hotel's annual demand. These are the items selected to receive the greatest attention in stock control [14]. It can be observed that about fifteen items in the stock are responsible for 80% of the total accumulated value of the annual stock, these will be considered as the class A items in the stock.



Fig. 4: ABC curve for the items in stock at Zeta Hotel

Fig. 4 shows that, according to the ABC Curve tool proposed by Ishikawa, approximately 20% of the items (A class items) represent about 80% of the annual stock demand (in R\$); the following 30% of the items (B class items) represent 10% of this demand (in R\$); and the remaining 50% of the items (C class items) represent 10% of the annual demand (in R\$). Therefore, it is confirmed the need to more accurately manage the class A items, since they represent a significant portion of financial investments in the enterprise's stock [7].

Based on the class A items of the ABC Curve, and considering the costs involved in placing a purchase order for each of these items, the economic purchase lot (LEC) was calculated. According to [7] the LEC is configured as an approach to stock planning and control that assists in deciding how much to order for a certain item.

To exemplify this tool, and considering the coffee capsule item of class A, because it has a longer expiration date by which it does not lose its qualitative characteristics, the formula for calculation of LEC proposed by [7] was used. After a survey, considering the estimated costs for placing the order, stock maintenance and annual demand, a LEC corresponding to 252 was found, meaning that this is the best purchase quantity for this item for each purchase made. It is important to point out that, although Hotel Zeta maintains a portfolio of suppliers that deliver some products directly to the address where the project is located, the purchase for this item is made weekly and in fractioned quantities of 100. Therefore, if the LEC found was adopted, the enterprise could save both in the amount spent per trip (cost of the order), as well as in the value of each item, because usually for larger items, the cost per unit tends to decrease.

Once the value of the LEC is calculated, it becomes important to estimate the Security Stock, because even if the purchase is made directly by the hotel, it does not occur automatically: there is a time needed to place the order and it arrives and is available for the hotel's activities. This time is called lead time and is used to decide when it is necessary to place an order. Although these two values may vary, as they depend directly on the demand and the time in which the restocking will occur, their estimates tend to guarantee that the lack of stock will not occur and that the hotel will be able to meet its demand forecast [7].

All these issues, LEC, lead time, safety stock and order placement point were considered, from the approach of the [7] in the elaboration of the stock control spreadsheet and forwarded in the suggested improvement proposal to Hotel Zeta.

It should be noted that although the LEC approach and other issues mentioned above theoretically demonstrate many advantages for stock planning and control, there are some criticisms that deserve to be mentioned, such as the real costs of stock when in operation (which may not be adherent to the LEC model); not always minimizing the cost of stock is adequate, several factors must be considered; the model becomes simplistic, since it works with a certain stability of demand, with a fixed cost for placing the order, with a cost of stock maintenance expressed by a linear function and other variables that are not actually represented as they behave on a daily basis [7]. And, considering a stock that serves the hotel's food sector, the analysis should be even more incisive, because cost x savings factors should not be taken into account in the foreground, but the maintenance of product quality, expiration dates and the very control of perishable products.

## V. CONCLUSION

The main objective of this study was to detail the reality of Hotel Zeta from a Production Engineering perspective, delimited by the application of PCP methodologies and tools and to present a solution proposal for one of the problems that was diagnosed in the company. After the initial data collection, through interviews with one of the owners, it was found that the problem to be analyzed in the study would be the hotel's stock management.

It can be concluded that the study met the proposed objective, since it demonstrated that the PCP methodologies and tools can be adopted to constitute an improvement in the management of the Hotel Zeta stock.

It is important to note that the results obtained with the study corroborate the bibliographies researched on PCP in small and medium enterprises, specifically in the services sector, confirming the absence of PCP applications in this sector and the possibilities of improvement, consequently, of profit maximization. As important as confirming these premises about PCP for this niche of companies, is to be able to conclude a bias of opportunities for the production engineer in the service sector.

Considering the analysis of all the data collected, the interviews and questionnaires, it can be affirmed that Hotel Zeta, although a profitable business with a family management that is giving positive results, has great potential to become even more productive, "leaner" and, consequently, more profitable, by applying the PCP methodologies and tools suggested in this study, which are easy to use through Microsoft Excel®.

As the study did not aim to exhaust the subject, and considering other possibilities within the areas of Production Engineering, other proposals for improvement can be researched and elaborated, such as the development of software or electronic systems to serve this part of the hotel market.

## ACKNOWLEDGEMENTS

The authors wish to acknowledge the University of the State of São Paulo, Faculty of Engineerng of Guaratingueta, for its assistance during the research period.

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## **Challenges Encountered by Parents in the Education of their Children during COVID-19 Pandemic**

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Received: 23 Nov 2020; Received in revised form: 11 Dec 2020; Accepted: 18 Dec 2020; Available online: 22 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract—This study described the challenges encountered by the 100 selected parents in the education of their children, enrolled at the primary level, during the COVID-19 Pandemic. Based on the survey conducted, most of the parents preferred online distance learning for the education of their children. As to the facilities used in distance learning, 96% of the respondents have an internet connection, and 89% utilized Wi-Fi to have internet access at home. Personal computers were the most used gadget in the studies of their children. The main challenges encountered by the parents were: lack or limited access to the internet and the poor internet connection in the Area. As to the quality of printed modules, there are items that are not readable and some colors of the figures are not appropriate.

Keywords— COVID-19, distance education, online learning, pandemic, primary students.

## I. INTRODUCTION

One of the most recent public health emergencies of global concern is the COVID-19 pandemic, which started in China and almost infected every country in the whole world. "This disease is caused by a novel coronavirus (SARS-CoV-2, previously known as 2019-nCoV) and has received global attention from growing infections and on how to eradicate the disease and flatten the curve of infections" (Guo et al., 2020). The Covid-19 pandemic has made everyone stay at home but it has not stopped the world. People still need to work, students need to learn and teachers need to teach (Vasquez, 2020).

Nowadays, people are staying in their homes due to the lockdown policy implemented by the government. However, learning should not halt. Different countries worldwide have introduced various answers during the pandemic to continue the education process using distance learning. Thus, online learning platforms such as google, TV broadcasts, guidelines, resources, video lectures, and online channels were introduced (Tria, 2020).

In the Philippines, the Department of Education (DepEd) formulated and implemented policies, plans, and programs to continue the education of the Filipino students during the time of pandemic (Dep.Ed.,2020). They spearhead the pure online, blended learning, and modular approach of teaching depending on the capacity and capability of basic education students. The program proves successful since it makes the students continue their studies during a time of crisis.

However, there are challenges that the parents, teachers, administrators, and students encountered in distance learning education which the researchers have heard and therefore, needed to be investigated and explored in order for this learning program to be sustained. Hence, this study focused on the issues and concerns encountered by the parents in the distance education of their children in these difficult times.

## II. METHODOLOGY

This study utilized a descriptive research design to gather data relevant to answer the objectives of thisresearch. The researchers utilized a purposive sampling technique. A total of 100parents were selected as respondents from selected public primary schools in Cabanatuan City, Philippines. The data gathered were from the researchers' made questionnaire. Frequency and percentage were used to analyze the data of this study.

### III. RESULTS AND DISCUSSION

#### **1.**Teaching Approaches Employed in Distance Learning

Based on the survey conducted from the respondents, Table 1 shows that 64.3% used online distance learning in the education of their children, 28.6% adopted blended distance learning and 7.1% use modular learning. The finding shows that online distance learning was preferred instruction by parents during this time of crisis. This finding is similar to the situations of South Korean students where they are responding to classes from their teachers online (Li & Lalani, 2020). It seems that parents in different parts of the world are in one that online distance learning is the appropriate approach to education during situations where contagious diseases is present.

Items	Percentage
Online Distance Learning	64%
Modular Distance Learning	7%
Blended Learning	29%
Total Respondents	100%

### 2. Facilities use in Distance Learning

As to the facilities used in distance learning Table 2 shows that 96.40 % of the respondents have an internet connection and 3.60% have none. Among the 96.4% respondents, 89.3% utilized Wi-Fi while the remaining 7.1% make use of their cellular phone data.

<i>1 uble 2. Internet Connection at 110me</i>	Table 2.	Internet	<b>Connection</b>	at Home
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Response	Percentage
Yes	96%
No	4%
If Yes, What Kind of Internet Connection	
Wi-Fi	89%
Data	7%

This finding shows how internet connection has improved the educational system in the world. It confirmed that the Internet has immense potential to improve the quality of education, which is one of the pillars of sustainable development (Internet Society, 2017) especially when face to face learning is not possible (Mina, et.al, 2020).

## 3. Kind of Gadget Use in Distance Learning

Department of Education required to use desktop or laptop for online study (Llego) which was also revealed in this study as shown in Table 3, that91% of the respondents used desktop in the distance education of their children.

	Percentage
Cellular phone	80%
Desktop	91%
Laptop	67%
Tablet	15%

Table 3. Kind of Gadget Use in Distance Learning

### \*Multiple response item

According to Rodger (2017), "computers, particularly desktop, have long become a necessity within education over the last few years. In fact, I'd go as far as to say that they are now a fundamental element within a 21st-century learning environment".

## 4.Challenges Encountered during the Distance Learning of their Children

The respondents are all very appreciative of the efforts of the Department of Education to continue the learning of their children despite the pandemic by implementing online distance learning, modular learning, and blended learning. However, there are some challenges they have encountered in these different approaches. As to online distance education, it may not be 100% effective due to different reasons like the lack or limited access to the internet and the poor internet connection in the Area. As to the quality of printed modules, there are items that are not readable and some colors of the figures are not appropriate.

### IV. CONCLUSIONS AND RECOMMENDATIONS

Based on the survey conducted by the respondents, most of them preferred to use online distance learning in the education of their children. As to the facilities used in distance learning, 96.40 % of the respondents have an internet connection, and 89.3% utilized Wi-Fi to have the internet at home. Department of Education required to use desktop or laptop for online study (Llego) which was also revealed in this study as shown in Table 3, that 91% of the respondents used desktop in the distance education of their children. The study revealed that the main challenges encountered by the teachers were (Abelardo, et.al., 2019): lack or limited access to the internet and the poor internet connection in the Area. As to the quality of printed modules, there are items that are not readable and some colors of the figures are not appropriate.

With these, it is recommended to increase the MBPS of the internet connection in the country. Have open communication with the teachers about the situation of the children so that the teachers can accommodate challenges encountered by the parents on the day to day basis. Before the opening of classes in January, President Duterte should intensify his request to the telecommunications company to improve their services (Duterte, 2020). Department of Education Secretary Leonor Briones should allot appropriate funds for the modules being disseminated to every part of the country to ensure the quality of the materials and for the non-readable printed modules, the teachers may provide the parents an e-copy so that they can already view the modules on the gadgets that they use.

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# Six Sigma and the application perspectives of various industries: A bibliometric analysis

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Received: 14 Nov 2020; Received in revised form: 07 Dec 2020; Accepted: 15 Dec 2020; Available online: 30 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— In recent years, quality in companies has become a priority issue which, according to the organization, is a matter of very little investment and dedication in the production lines, so a quality tool can be the solution to this problem. The present research work is to demonstrate the state of the art on Six Sigma and the perspectives in several industries through a bibliometric analysis using Bibliometrix. A database from Scopus is used, which includes a total of 857 articles in a time span from 2016 to 2020. From the results obtained, some characteristics of the articles are illustrated and analyzed (keywords, main authors, country of origin, main journals, scientific production and collaborative networks). The results obtained from the analysis show the existence of an exponential increase trend on Six sigma, being the basis for improving the quality of the processes.

Keywords—Six sigma, Lean six sigma, Bibliometrix.

## I. INTRODUCTION

Six Sigma is defined as a methodology for the pursuit of continuous improvement in the field of Quality Management, which goes beyond the reduction of defects and emphasizes process improvement. It emerged as an innovative alternative in the organizations and became the focus of attention of general and quality managers.

Six Sigma, on the other hand, is a tool that is practiced in the field of management to address complex organizational problems that require extensive data analysis, confirmation of results and validation of real long-term benefits. In other words, it offers more guarantees to management to solve the deep-seated and complex performance problems of their organizations.

The objective of this article is to analyze the state of the art on the subject, through various databases to determine the impact of this quality tool in various industries, addressing aspects such as identification of countries, most cited publications, main authors on the subject.

## II. LOCALIZED DEFINITIONS OF SIX SIGMA IN THE LITERATURE

Several definitions of Six Sigma were found in various publications and are shown in Table 1. This allows us to observe how Six Sigma is approached by different authors in different approaches from the application theme, methodology, philosophy and implementation models.

Table 1. Six Sigma Definitions

Autho	ors	Definition
O.M. Ikumap Akinlabi, F.M O.S. Ogbonna (	bayi, E.T. . Mwema, 2020)	Six Sigmas is a profit maximization technique achieved by meeting the need of the consumer.
M. T. Pereira Bento, L. P. Fe Sá, F. J. G. Silv	n, M. Inês rreira, J. C. a (2019)	Six Sigma is a methodology that aims to reduce process variation, reduce manufacturing costs and improve customer satisfaction.
Eva N	ledeliaková,	Six Sigma is aimed at two levels of quality, potential and actual quality, the

Vladimíra Štafanaová	difference between them is		different degrees	
Štefan Kudláč (2017)	a waste.		authorities, and	
Erdil, NO, Aktas, CB y	Six Sigma is a data-driven methodology that focuses on reducing variation. In terms of statistics, Six		responsibilities are given to staff depending on the type of education they have received	
Arani, OM (2018)	Sigma implies process output with no more than 3.4 defects per million.	Cherrafi, A., Elfezazi, S., Chiarini, A., Mokhlis, A. y Benhida, K. (2016)	Six Sigma is an organized, parallel-meso structure to reduce variation in organizational processes	
Kaswan, MS y Rathi, R. (2020).	based approach that works on a project-by-project basis and incorporates qualified tools that can complement the GL		through the use of improvement specialists, a structured approach and performance metrics to achieve strategic objectives	
Silich et al., 2012; Singh y Khanduja, 2014	methodology. The idea behind Six Sigma is that, if imperfections can be measured, then the solution can be planned to eliminate them.	Zu et al (2008)	The objectives of Six Sigma are to improve process performance and achieve high levels of quality by investigating and eliminating the root	
	Six Sigma is different from other approaches and organizational structures. In Six Sigma organizations,	Chen, S., Fan, S., Xiong, J.	minimizing process and product variability The five stages of the Six	
Erdil, NO, Aktas, CB y Arani, OM (2018)	different degrees, authorities, and responsibilities are given to staff depending on the type of education they have received.	y Zhang, W. (2017).	Sigma DMAIC improvement model (define, measure, analyze, improve, control) is the central Six Sigma management system based on the JMP / SAP system.	
Kaswan, MS y Rathi, R. (2020).	Six Sigma is an organized, parallel-meso structure to reduce variation in organizational processes through the use of improvement specialists, a structured approach and performance metrics to	Laureani, A. y Antony, J. (2015).	Lean Six Sigma is a business improvement methodology that aims to maximize shareholder value by improving quality, speed, customer satisfaction and costs.	
Silich et al., 2012; Singh y Khanduja, 2014	achieve strategic objectives The idea behind Six Sigma is that, if imperfections can be measured, then the	Niñerola, A., Sánchez- Rebull, MV., y Hernández-Lara, AB. (2019	Six Sigma is a business process strategy that combines statistical and management approaches.	
	solution can be planned to eliminate them	Schroeder, Linderman, Liedtke y Choo, (2008)	It is based on the principle of measurement,	
Ertürk, M., Tuerdi (Maimaitiaili. Tuerdi), M., y Wujiabudula, A. (2016)	Six Sigma is different from other approaches and organizational structures. In Six Sigma organizations,		monitoring and control of processes and provides an organizational structure for continuous improvement.	

International Journal of Advanced Engineering, Management and Science (IJAEMS)
<u>https://dx.doi.org/10.22161/ijaems.612.12</u>

Nourelfath, M., Aldowaisan, T. y Hassan, J. (2016).	Six Sigma is a quality philosophy and methodology that aims to achieve operational excellence and delighted customers. The cost of poor quality depends on the sigma quality level and its corresponding failure rate	Rathilall, R. y Singh, S. (2018)	The intention of the Six Sigma technique is to eliminate process variation and strive for defect-free products. It is associated with the acronym DMAIC which stands for Define, Measure, Analyze, Improve and Control. This	
Laureani, A. y Antony, J. (2017).	The term 'Lean Six Sigma' refers to the integration of 'Lean' and 'Six Sigma' business improvement methodologies, where 'Lean' is a process		serves as the basis and the systematic five-step problem solving methodology followed to find the causes of variation in system processes	
	improvement methodology used to deliver products and services better, faster and at a lower cost, while 'Six Sigma' is a data-based	Navas, RKB, Akash, RP, Sathish, G. y Azharudeen, JM (2016)	Six - sigma is a quality management strategy, which can be used to achieve the goal of engineering education.	
Rinawati, DI, Andini, AR y	achieve stable and predictable processes The sigma measurement scale (a) is correlated with		It provides a scientific and statistical basis for the evaluation of the quality of all processes by measuring the level of quality	
Sui, Di (2017).	characteristics such as defects per unit, parts per million defects and the probability of failure	Parmar, PS y Desai, TN (2020).	The SS methodology aims to eliminate the root causes of process variations, and seeks to reduce defects by	
Pavlickova, M. y Bogdanovska, G. (2016).	The Six Sigma method is a complete and flexible system to achieve.	Source: Own elaboration	improving the process	
	determine and maximize business success. Six Sigma is based on understanding the needs and expectations of customers, using data and statistical analysis, resulting in the improvement and creation of new business processes, production and work	The Six Sigma quality indices for the evaluation of the quality levels associated with the unilateral, bilateral and Finally, it presents three cases and numerical experiment to demonstrate the practical applicability of the proposed method, that method was the use of the multipl characteristics process capability analysis chart to determine if the quality of the process is sufficient to react the quality level and meet the client's requirements Cudney et al., 2020; Navas et al. 2017; Sony et al., 2020; Unfortunately, the other methods proposed in these studie		
Cardiel Ortega, JJ, Baeza Serrato, R. y Lizárraga Morales RA (2017)	The Six Sigma methodology is widely used in business to improve	can only identify the range achieves (Nourelfath et al., 2 et al., 2016).	of quality level that a process 2016; Foster, 2007; Nourelfath	
	quality, increase productivity and reduce costs, which impacts business improvement	The integrating Lean and S approach to continuous im Lean Six Sigma framework South Africa where quantity	Six Sigma tools as a unified provement and developing a for selected organizations in tative research methods were	

adopted and therefore the results of the study showed that the organizations had a very low success rate in adopting Lean and Six Sigma as stand-alone systems, as they found it difficult to sustain the transition from theory to practice (Allen, 2018; Parmar & Desai, 2020; Rathilall & Singh, 2018).

The integration of the ecological approach and the Six Sigma approach to overcome limitations, and evaluate the performance of the ecological approach. Measurement system analysis and instrument control are used as a methodology to measure process variations in order to decrease unfavorable ecological impacts of companies' products or services, while improving environmental efficiency (Sagnak & Kazancoglu, 2016; Waurick, 2014).

Related the automotive field presents a creative solution to improve an assembly process in an automotive company, through the use of the statistical thinking methodology and DMAIC Six Sigma, so it resulted that the introduction of the SS methodology provides innovative quality improvements in a reasonable time (Pereira et al., 2019; Pugna et al., 2016; Rinawati et al., 2019).

## **III. METHODOLOGY**

For the accomplishment of this article, it was divided in three phases; these will be detailed in chronological form next: In the first stage, different reliable sources of information were gathered for their respective consultation on the related topic and the evaluation of such information from the articles related to Six Sigma. The databases used for consultation: Scopus, SpringerLink and Taylor & Francis, these sources were used for their large number of articles related to this topic and for the impact of these.

In the second phase, we started with the collection of information from the analyzed papers and submitting our database generated from the review. The data was loaded into Bibliometrix to start with the bibliometric analysis and observe the behavior of the construct (Aria, & Cuccurullo, 2017).

In the third stage we proceeded to perform a brief analysis with the information provided by Bibliometrix and understand the state of the art of Six Sigma and its impact on the industries today.

By gathering the 2016-2020 information on Six Sigma and Lean Six Sigma information in the Scopus database, the following information was obtained. Figure 1 shows the annual scientific production of articles related to Six Sigma and its behavior in the study period. A total of articles on the subject already mentioned were obtained in their respective year, with 2019 being the most active year for the authors with a total of 857 articles published.



Fig. 1 Scientific production

## IV. RESULTS

On the other hand, a comprehensive review found that 2016 was the year with the highest average number of citations per article and per year. Being this the year with the highest number of citable years; it should be emphasized that the same year was the penultimate year with the lowest number of articles published in the study period. In addition, it should be mentioned that the year with the lowest number of articles published (2017) is the one that is closest to 2016 on average, both by article and by year.

As can be seen in figure 2, the most cited countries in the period 2016-2020 the one that presents the greatest interest and development of Six Sigma reference articles is India with a total of 192 citations up to the moment of data collection, it is worth mentioning that the second most cited country (Morocco) with a total of 146 citations is the country with the highest average of citations with 48,667; much higher than the average of India with 5,647.



Fig. 2 Most cited countries

Figure 3 shows the countries with a greater interest in development and research on the subject, being India, which is observed a total of 34 articles published in the period between 2016-2020, followed by the equality between 2 world powers that are the United States and China with 22 articles each one, giving to speculate that the interest by this subject has potential by the interest of great powers like by the developing countries, being the European and American continent with greater presence in the subject.



Fig. 3 Countries with a greater interest in development

In order to illustrate the most cited sources in the period between 2016-2020, figure 4 shows the International Lean Six Sigma Magazine as the largest producer of reference material with a total of 86 registered articles published, this being a magazine dedicated to the particular topic. With just over half (48) of the articles published, there is an equality between the magazine of Total Quality Management and Business Excellence and the International Journal of Quality Management and Reliability, being this because they are related to the management and administration itself that is part of Six Sigma.



Fig. 4. Most relevant sources

## V. CONCLUSION

Six Sigma is a methodology for improvement in the field of Quality Management. It has been successfully applied in many companies, however, in other companies when applying it, the same results were not found. The successes and/or failures are generally attributed to many aspects that are ignored during the implementation phase. Organizations behave differently different in circumstances, times and places.

The objective of this work was to identify those aspects related to the publications on the subject, the authors who carried out works on it and the importance or relevance in different countries of the world, as well as the analysis of its history at the time of its implementation and that subsequently affect the resolution of those problems that arise as Six Sigma improvement projects. On the other hand, this article will serve as a contribution to the new generations of students to promote research interest in the subject, as well as the realization of projects with this tool.

It should be noted that with the research, the implementation of such tool requires a good vision of senior management, participation and commitment of all levels of an organization, appropriate strategies based on practical experiences, good training in the use of statistical tools and dissemination of knowledge in statistical methods at all levels of the company, effective coordination through proper project management, quality leadership, motivation at all levels and teamwork of managers and other staff of a company.

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## An Analysis of Outlier Detection through clustering method

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Received: 08 Nov 2020; Received in revised form: 03 Dec 2020; Accepted: 12 Dec 2020; Available online: 30 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— This research paper deals with an outlier which is known as an unusual behavior of any substance present in the spot. This is a detection process that can be employed for both anomaly detection and abnormal observation. This can be obtained through other members who belong to that data set. The deviation present in the outlier process can be attained by measuring certain terms like range, size, activity, etc. By detecting outlier one can easily reject the negativity present in the field. For instance, in healthcare, the health condition of a person can be determined through his latest health report or his regular activity. When found the person being inactive there may be a chance for that person to be sick. Many approaches have been used in this research paper for detecting outliers. The approaches used in this research are 1) Centroid based approach based on K-Means and Hierarchical Clustering algorithm and 2) through Clustering based approach. This approach may help in detecting outlier by grouping all similar elements in the same group. For grouping, the elements clustering method paves a way for it. This research paper will be based on the above mentioned 2 approaches.

Keywords—detection of an outlier, data set, clustering approach, abnormality.

## I. INTRODUCTION

Mining, in general, is termed as the intrinsic methodology of discovering interesting, formerly unknown data patterns. Outlier detection has important applications in the field of data mining, such as fraud detection, customer behavior analysis, and intrusion detection. A number of approaches are used in the process of detecting the outlier (Bezerra et al., 2016). Clustering can be termed as a set-grouping task where similar objects are being grouped together. Clustering, a primitive anthropological method is a vital method in exploratory data mining for statistical data analysis, machine learning, and image analysis and in many other predominant branches of supervised and unsupervised learning.

Outlier detection is related to unwanted noise in the data. As far as the analysts are concerned, noise in data is not important but acts as a hindrance to data analysis. Noise removal is the process of removing unwanted objects before any data analysis is performed on the data(Bhattacharya et al., 2015).

A large number of domains apply Outlier detection directly. This results in the development of innumerable outlier detection techniques. A lot of these techniques have been developed to solve focused problems pertaining to a particular application domain, while others have been developed in a more generic fashion(Pimentel et al., 2014).

## II. DATA IN DATA MINING

Generally, we are drowned in information, but starving for knowledge. Data can be collected from multiple sources. The purposes can be categorized as Business, Science, and Society. Business purposes can use the data for Web, E-Com, Transaction, and Stock Marketing. Scientific data can be used for Remote sensing, Bio-informatics, and Scientific Simulation. Social data can be used for News, DigiCam, and YouTube.



- Data: a collection of facts usually obtained as the result of experiences, observations, or experiments
- Data may consist of numbers, words, images, ...
- Data: lowest level of abstraction



**Data mining Techniques:** 

There are six such data mining techniques namely Decision Trees, Sequential Pattern s, Clustering, Prediction, Association, and Classification, out of which we deal with Clustering.

## **Learning Patterns**

In data mining, how we now had to split the instruction two classes particularly, process into Supervised understanding and Unsupervised understanding. Back in Supervised mastering, it's a kind of procedure by which the two entered and desired output numbers have been all provided. Input and output signal numbers are tagged for classification to supply an understanding foundation for prospective data processing system systems. The word tricked learning stems out of the notion an algorithm is learning more by your training data set, which is looked at whilst an educator. The calculations include underneath Supervised finding out are Conclusion bushes, Similarity finding out, Bayesian logic, Service vector machines (SVM). Back in Unsupervised mastering, there's not any requirement to oversee this version. As an alternative, the version is permitted to get the job done in its to detect advice. It largely handles all the unlabelled info. Unsupervised learning calculations enable us to do more intricate processing responsibilities in comparison to learning. Even though, experiential learning could be unpredictable compared with additional all-natural learning procedures. In this paper, we focus on Hierarchical Clustering and also Kmeans Clustering(Arthur & Vassilvitskii, 2006).

## **Clustering:**

Having similar faculties clusters objects need to shape, using the automatic procedure. We utilize clustering, to specify lessons. Then suitable things have to place in each class. Cluster calculations could be categorized based on the cluster models readily offered based on the type of info people we try to analyze [2]. In machine learning, perspective clusters correspond to both hidden patterns, the search for clusters is still unsupervised understanding, and the resulting system represents an information concept. From a practical standpoint, clustering Has an extraordinary role in data mining programs like scientific information exploration, information retrieval, and text mining, spatial database applications, Net analysis, CRM, promotion, health diagnostics, computational biology, and Others(Manning et al., 2008).



Cluster formation mechanism(Xu & Wunsch, 2005)

Cluster-based Ways for outlier detection in Statistics Sets assist them to develop a set of equal aspects or bunch of information details. Clustering methods are tremendously Helpful for grouping related information objects from Data sets and following this by employing space predicated calculations, detection of Outliers has been accomplished, which truly have been termed cluster-based outlier detection.

The reward of this bunch of established approaches is they usually would not need to become tricked. Moreover, clustering established approaches have been capable to be found in an incremental manner i.e later after learning how the clusters, so fresh things might be fed into the machine and also analyzed for outliers. 1 drawback of clustering established procedures is They Are computationally costly since they demand computation of pairwise distances(Bhattacharya et al., 2015).

Clustering established outlier detection is also an unsupervised outlier detection procedure at which category

tagsas "ordinary" or even"outlier" usually are perhaps not introduced. Clustering signifies learning observation as opposed to learning samples. Clustering established an outlier detection method for expanding information flow that allots burden to feature based on its own significance in mining endeavor(Manning et al., 2008).

The outlier detection procedure is also rather effective while the info out of your database has been segmented into clusters. In most bunch just about every data,the stage is called a qualification of their registration. Even the outlier is discovered with no hindrance from the clustering system. Clustering on flowing information is distinguished by grid established and kmeans/k median System(Xu & Wunsch, 2005)*J*.

## **Hierarchical Clustering**

A hierarchical clustering system operates by grouping info items to some tree of clusters. The standard of the pristine hierarchical clustering system is affected by the own inability to do alteration the moment a mix or divide decision was implemented. In other words, when your special unify or divide decision afterward ends up to have now already been a lousy option, then the procedure can't backtrack and fix it. In hierarchical clustering delegate every single and every item (info stage) into your bunch. Subsequently, calculate the length (correlation) among every one of the clusters and then combine both similar clusters. Let us know further by resolving a good model.

## Dendrogram

**Objective:** For the one-dimensional data set **{15,20,30,50,63}**, perform hierarchical clustering and plot the dendogram to visualize it.

Solution: First, let's visualize the data.



Observing the plot above, we can intuitively conclude that:

- 1. The first two points (15 and 20) are close to each other and should be in the same cluster
- 2. The third point (30) is closer to the first formed cluster(15, 20). So it is merged with the first cluster next.
- 3. Now the newly formed cluster is (15, 20, 30).
- 4. Then, the next closer clusters are 50 and 63. So merge them in the next step, i.e. (50, 63).

Merge, in each step, the two clusters, whose two closest members have the smallest distance.



Two clusters formed are : Cluster 1 : (15,20,30) Cluster 2 : (50,63) Hierarchical clustering is mostly used when the application requires a hierarchy, e.g creation of a taxonomy. However, they are expensive in terms of their computational and storage requirements.

## **Agglomerative Hierarchical Clustering**

This bottom-up strategy starts by placing each object in its own cluster and then merges these atomic clusters into larger and larger clusters until all of the objects are in a single cluster or until certain termination conditions are satisfied. Most hierarchical clustering methods belong to this category. They differ only in their definition of inter-cluster similarity.





## **K-Means Clustering**

Hierarchical clustering is most beneficial at detecting embedded buildings inside the info. But it neglects in locating aconsensus' round the complete data set. Hierarchical clustering can place with clusters that seem shut, however, no more advice concerning additional things can be thought. K means procedure simply consider a little neighborhood of points that are nearby and also additionally don't regard the complete data set.

At a feeling, k means believes just about each and every single point from the data set and makes use of this advice to evolve that the clustering above a succession of iterations. K means has become easily the hottest clustering algorithm which reduces the total amount of their within-cluster variances.

K means have plenty of variants to Boost for particular sorts of information. To a top degree, All of Them do something such as that:

K means selections points from multi-purpose distance to reflect every one of the clusters. All these are termed as centroids. Every individual will likely probably be nearest to an inch of those bronchial centroids. They won't always be nearest to the exact same individual, therefore that they'll produce a bunch on their closest centroid. That which we are clusters and just about every affected person is presently an associate of the bunch. K means subsequently locates out the center for every one of the k clusters predicated on its own audience members (yep, employing the affected person vectors!). This center gets to be the brand's newest centroid for your own audience. Due to the fact the centroid is at another place today, sufferers could be more closer to additional centroids. To put it differently, they can change audience membership. Duplicate before centroids no-longer shift, and also the bunch memberships stabilize. That really is known as convergence.

The essential selling purpose of k means is its own simplicity. Its ease means that it's generally speedier and better compared to many other calculations, notably during large data sets. It becomes easier: k means may be utilized to pre-cluster that a more gigantic data-set accompanied closely with way of an expensive audience examination around the sub-clusters. Kmeans may likewise be utilized to immediately "drama" with k and research if you will find missed styles or connections inside the data set.

The flaws of K Means are its own significance to Outliers, also its particular own sensitivity for the very first selection of

centroids. 1 closing Thing to stay in your mind is how k means is intended to use on steady statistics. You will find plenty of implementations to get K Means clustering accessible on the market, A Few Of these are Apache Mahout,

A Far More Comprehensive collection of software that uses outlier detection is:

- 1. Fraud-detection discovering deceptive applications for bank cards, say advantages or discovering fraud using charge cards or even cellular telephones.
  - a. Advance application processing company to find fraudulent software or maybe socialize clients.
  - b. Intrusion-detection discovering rapid accessibility in pc system networks.
  - c. Task tracking discovering mobile-phone fraud by tracking cellphone exercise or questionable transactions at the equity markets.
  - d. Network effectiveness tracking the operation of personal computer programs, such as to find system bottlenecks.
  - e. Fault investigation tracking procedures to find flaws in engines, generators, pipelines, or distance tools on distance shuttles such as.
  - f. Biomedical flaw detection tracking producing lines to find faulty generation operations such as busted beams.
  - g. Satellite picture evaluation pinpointing publication options or misclassified attributes.
  - h. Discovering novelties in graphics to get robot geotaxis or surveillance procedures.
  - i. Movement segmentation discovering image includes relocating independently of this desktop.
  - j. Timeseries tracking tracking safety vital software like high-speed or drilling milling.
  - k. Medical requirement tracking including as for example for instance heartrate screens.
  - 1. Pharmaceutical exploration determining publication molecular arrangements.
  - m. Discovering novelty in the text to find the beginning of information reports, such as subject detection and monitoring to get dealers to directly successfully nail fairness, products, foreign currency trading reports, outperforming or under-performing goods.

n. Discovering unexpected entrances in Data Bases for information Mining to find glitches, valid or frauds however abrupt entrances(Xu & Wunsch, 2008).

## III. CONCLUSION

This research paper deals with the process of detecting outlier through the clustering approach. Outlier which is known as an unusual behavior of any substance present in the spot. This is a detection process that can be employed for both anomaly detection and abnormal observation. This can be obtained through other members who belong to that data set. The positives and negatives of dealing with K-Means and Hierarchical Clustering have been discussed. The algorithm must be modified in order to obtain proper results for detecting outlier. Further study on this research will concentrate more on enhancing the algorithm to obtain a better result.

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## **Review on the Effect of Shear Connectors on Composite Deck Slabs**

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Received: 25 Nov 2020; Received in revised form: 15 Dec 2020; Accepted: 18 Dec 2020; Available online: 30 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— This paper presents a review on the effect of shear connectors on composite deck slabs. Composite deck slabs consist of profile deck sheet and concrete. Several researchers have been studying the behaviour of composite slab but due to its complex behaviour yet it is not completely understood. The behaviour of composite slab directly depends on the deformability and contact strength. Here, some important literature reviews regarding composite slab behavior incorporating different profiles were discussed.

Keywords— Composite Deck Slab, Shear Connectors, Modern Constructions, Profiled Steel Deck.

## I. INTRODUCTION

Composite steel-concrete structures are used widely in modem bridge and building construction. The fact that each material (steel or concrete) is used to take advantage of its best attributes makes composite steelconcrete construction very efficient and economical. However, the real attraction of composite construction is based on having an efficient connection of the steel to the concrete, and it is this connection that allows a transfer of forces and gives composite members their unique behavior. Shear connectors are provided to transfer load from composite steel deck to the steel beam. Shear flow forces have to be resisted by the shear flow strengths of the mechanical shear connectors that are used to tie the concrete component to the steel component. The shearing force at composite beams with profiled sheet is not introduced directly through the base of the shear connect, but is transferred onto the shank of the shear connector. The increase of load produces crushing of concrete in front of the shear connector and transfer of shearing force exclusively via bending.

## **II. TYPES OF STEEL DECK**

## 2.1 Box Profile 34/1000 Sheets (for roofing and cladding):

Cladco Profiles 34/1000 trapezoidal sometimes referred to as box profile single skin sheet gives maximum sheet strength with 7 rigid profiles of 166mm pitch across the sheet width and 34mm profile height. It's made from wider coated steel strip to give a secure weather proof lap and gives 1000mm actual width cover when lapped as shown in figure (1).



Fig.1: Box Profile 34/1000

## 2.2 Box Profile 32/1000 Sheets (for roofing and cladding):

Cladco Profiles 32/1000 trapezoidal sometimes referred to as box profile single skin sheet gives robust sheet strength with 6 profiles of 200mm pitch across the sheet width and 32mm profile height. Some users prefer the appearance of this profile as it has lower and less profiles. It's made from coated steel strip and gives 1000mm actual width cover when lapped as shown in figure (2).



Fig.2: Box Profile 32/1000

## 2.3 Corrugated Profile 13/3 (for roofing and cladding):

Cladco Profiles traditional 13/3 'corrugated iron' profile. 13 corrugations of 3 inch/76mm round corrugation gives 3ft 3inch/990mm sheet cover when lapped as shown in figure (3).



Fig.3: Profile 13/3

## **III. PREVIOUS STUDIES**

Wang Yu Hang and NIE JianGua, 2015 [1], studied theoretical model for ultimate load carrying capacity of composite slabs cast with profiled steel sheets considering the relation between ultimate moment carrying capacity of the section and tensile force resisted by the profile deck sheet. Analytical study was carried out by considering two span continuous slabs subjected to one-point load, twopoint load and uniformly distributed load. Based on the developed stress diagram an equation was derived for all these three cases. The study was also carried out by experimentally testing the specimens considering same loading conditions to validate the theoretical work. The investigators state that the results of other, analytical and experimental study are found to be similar. It is recommended that though the M-K method is convenient for designing the composite slabs, it cannot be used for direct practical approach it is repetitive in nature and this tends to uneconomical design. Hence, in this paper researcher suggested an alternative method for calculating ultimate load carrying capacity of the composite slab known as simplified calculation method. The method is based on the dimension less parameters considering both flexure and longitudinal failure but can be used only in case of uniformly distributed loading condition.

**M. A. Bradford** *et al*, **2011** [2], studied the long term effect due to shrinkage of concrete which will result in initial indirect strain in composite slab as creep in concrete is observed in initial stage after casting. The researcher derived anew for deflection and stress equation based on

virtual work method by considering the partial shear interaction between concrete and steel sheet subjected to shrinkage straining. It was observed in experimental study that quantification of the shrinkage and partial interaction is seen in the uncracked area as it allows strain to be transferred through the depth of the slab due to difference in corrugation depths of the profile deck sheet. The results indicated that forecast response for the slab was complex as the combination of the shrinkage and partial interaction gave rise to the small concrete stresses which should be analytically studied for giving the application based structural mechanism.

M.E. A-H Eldib, 2009 [3], studied the behavior of twoway composite slab using finite element analysis in COSMOS/M26 software. The researcher compared one way and two way slabs using nonlinear material properties and full-scale models with varying parameters such as slenderness ration and slab aspect ratio. The analytical results were compared in respect of ultimate load carrying capacity, reaction distribution and deflection of composite slab. The side perpendicular to the ribs of profile deck sheet of a composite slab is usually the weaker side, whereas the side along the ribs is stronger. Hence, the study of behaviour of composite deck slab along the weaker side helps in enhancing the ultimate load carrying capacity of the slab. The investigators report that, though the slab is a two way slab its failure at ultimate load resembles as that of one-way slab, because value of load factor at serviceability limit and percentage of reaction is greater on weak side. However, Shear connectors and cold steel straps fixed at bottom steel deck prevents or say reduces the deflection and considerably increase the strength of composite slab.

Redzuan A. and W. Samuel, 2008 [4], studied new procedure to estimate the horizontal shear in which slab slenderness ratio is considered to be the predominant factor affecting the horizontal shear force. The researcher derived new equation based on force equilibrium method for deriving the relation between shear bond stress and end slip. The justification of the derived relation was also carried out with the conventional partial interaction method. The relation between shear bond stress and end slip was similar by both the methods. To validate the results of the analytical work experimentation carried out for bending test with two-point load bending test and slip observed was larger in compact slab than in slender slab. For full interaction slab shear bond and end slip curve was plotted along the vertical axis i.e. end slip does not occur for the slab with full interaction. While in partial interaction the shear bond is unchangeable. The researcher concluded that the shear bond property changes with

change in combination of slenderness or geometry or material. For particular case for same material and geometry the only property that affects shear bond is slenderness. So most important property horizontal shear bond stress–end slip relation can be obtained from force equilibrium method which is very important for numerical analysis.

Emad El Dardiry and Tianjim Ji, 2006 [5], studied the dynamic behaviour of composite slab using isotropic and orthotropic plate model. The properties of section where kept same in both directions for isotropic model but different in orthotropic model. The analytical results of the study indicate that the mode shapes checked for each panel are either concave or convex though the complex behaviour is taken in consideration. However, the isotropic model proves to be slightly better than orthotropic model. In case of effect of boundary condition, orthotropic model proves to be stiffer and its effective thickness remains constant, while good performance was noted for isotropic plate where thickness varies from 5 to 6%. In case of load combination less error was noted for isotropic plate i.e. 4 % and for orthotropic plate 10% was noted. Now eccentricities are considered to find effect on natural frequency and it was found that ratio of natural frequency for model with and without eccentricities vary from 74% to 78%. Natural frequency is not sensitive to location of natural axis of slab and beam as far as eccentricity is considered. The composite slab contributes 16% of total stiffness of structure. The prediction of natural frequency is affected by the thickness of slab.

Marciukaitis et al; 2005 [6], studied the connection between profiles sheet and concrete directly affect the overall

deflection for the composite slab which directly depends on the shear stiffness due to connection. The researcher evaluated a new method to evaluate deflection of composite slab considering all the factors starting from loading to the ultimate moment. The connection between profile sheet and concrete is not rigid or stiff, but it is partially in contact with each other. The stiffness between the layer's changes with the action of external forces. As there are two different materials they will undergo different deformations under loading. Though there are shear deformations these deformations are largely governed by the difference in deformation. For small shear forces the slab behaves elastically and for larger shear forces the plastic behaviour is noted. According for elastic small deformations is noted and large deformations are seen in plastic behaviour. The equation where derived by considering two layers' composite member deflection. The

researcher proved that there is no stiff bond between profile sheet and concrete. Hence partial stiffness should be considered while calculating deflection.

**K. N. Lakshmikandhan et al., 2013** [7], have experimentally studied three types of mechanical connector and found that three connector schemes exhibited full shear interaction and produced a negligible slip.

Milan Veljkovic, 1996 [8], Studied and investigate analysis based on interaction characteristics evaluated from small scale tests has been shown to accurately describe the behaviour of composite slabs. The interaction characteristics considered are mechanical interlocking resistance, reduction of the mechanical interlocking due to strains in the sheeting and the friction at the support. The validation is, however, limited to comparisons with full-scale test on one particular profile. The load bearing resistance of slabs increases as the loading becomes more uniform when longitudinal shear failure governs. For one example where longitudinal shear failure governs, the increase of the resistance with respect to 2-point loading is 20%, 30% and 40% for 4-point, 8-point and 16-point loading, respectively. All slabs have the same shear span. Due to a change of the failure mode, differences between the bearing resistances decrease as the span increases.

**Hyeong-Yeol Kim, Youn-Ju Jeong, 2010** [9], investigated the ultimate behavior of a SCC composite deck slab system with profiled steel sheeting and perfobond rib shear connectors. Eight specimens were prepared and develop composite deck slab for girder bridges that spans longer but weighs less than conventional reinforced concrete slab, which were evaluated using empirical m-k method. The ultimate strength under bending was at least 20% less than RC deck. The load carrying capacity is approx. 2.5 times greater, while concrete cracking load is 7.1 times greater with total weight 2.5% lesser.

Amar Prakash, N. Anandavalli, C. K. Madheswaran, J. Rajasankar, N. Lakshmanan 2011, [10] proposed nonlinear behavior of stud connected to steel-concrete composite girders numerically. 3D modeling through ABAQUS is analyzed. Specimen of 4 m length and width of 0.665 m with 3.8 m is simply supported. Maximum load observed was 360 kN analytical to 330 kN experiment outcome. The deflection obtained 136 mm analytical to 138 mm experiment outcome. Comparison of interface slips at three different values of deflection.

## **IV. CONCLUSIONS**

The study until now was performed on analysing and predicting the behaviour of the composite steel structure with

concrete deck slab. Many researchers derived the expressions for deflection, ultimate moment, load carrying capacity and many more. Some questions regarding the behaviour of the slab for horizontal shear resistance and design requirements to achieve ductile failure. The optimization of the design for the proper combination of different corrugated profile sheets and type of mechanical interlocking to be provided is not yet completed. Though codal provisions are based on experimental results the finite element analysis of composite deck slab with nonlinear contacts between the profile, shear connectors and concrete is required to be studied for the complex composite action.

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## **Entrepreneurial Strategies of Gardening Business in Cabanatuan City, Philippines**

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Received: 01 Dec 2020; Received in revised form: 18 Dec 2020; Accepted: 25 Dec 2020; Available online: 30 Dec 2020 ©2020 The Author(s). Published by Infogain Publication. This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

Abstract— Five to six thousand-year before Christ, gardening was in vogue. The importance of gardening is realized by every individual now in the globe. Gardening which was only an art and science in the earlier days has now emerged as a huge industry. With the importance and need of gardening in improving and conserving the environment being strongly felt now, the concept of landscaping and gardening is growing rapidly. Ornamental gardening and landscaping have expanded as a multi-faceted industry encompassing activities such as propagating and rearing ornamental plants, landscaping, production of growing media, pots and other accessories, generating huge employment opportunities and simultaneously promoting activities that would improve the environment (eagri.org). Farming has become the primary source of livelihood for Novo Ecijanos (N.Natividad, 2020) but due to a growing and phenomenal flourishing of gardening business in Cabanatuan City, Nueva Ecija, Philippines, the researchers want to investigate the entrepreneurial strategies used by the owners as the respondents to survive their business and be on the top. This study used a descriptive method of research which is very helpful in interpreting the gathered data in a survey questionnaire answered by 13 selected gardening business owners in the City of Cabanatuan. It was concluded that there are some entrepreneurial strategies often used by the business were given by the researchers at the end of the study.

Keywords— Gardening Business, Entrepreneur, Strategies, Cabanatuan City, Nueva Ecija.

## I. INTRODUCTION

Gardening is an art that uses flowers and plants as paint, and the soil and sky as the canvas-Elizabeth Murray. Gardening has become a popular phenomenon these days. Many people turn their interest in planting trees and other ornamental plants that beautify the surroundings and make the environment clean and green. Thus, the gardening business also booms nowadays and many entrepreneurs tried their luck into this, taking advantage of the peoples' phenomenal attention. This kind of business is already existed a long time ago but not just like others, it is not considered a growing business until COVID 19 Pandemic occurs. The market grows from time to time, it is driven by the increasing number of buyers from first-time householders who increased their interest in gardening. Many people are spending a lot of money just to maintain good health and a strong immune system to prevent sickness. (D. Pastorfide 2020) This pandemic helps the people realized the importance of good health through a better environment, that is why planting and gardening businesses are now in the spotlight. Furthermore, gardening became one of the hobbies, an outlet or stress reliever to many during pandemic that resulted to an increase in demand of various plants and other products/services associated to it.

Nueva Ecija, the province of Cabanatuan City is the Rice Granary of the Philippines. This province has a fertile soil wherein plants can grow faster even without proper cultivation, that is why there are some gardening businesses established near the national road of this province. Selling beside the road is what we so-called the traditional way of selling and marketing the plant to the people, but now, there is a rare phenomenon where you can see sellers selling their plant products in the internet, and even inside the shopping malls with a shocking price. Setting up a plant nursery or gardening business can be an overwhelming venture, but it can be extremely rewarding if you have a passion for greenery and a firm knowledge of how to grow and cultivate plants. (wikiHow.com, 2020).

There are many gardening businesses in Cabanatuan City, some are new but many were already established because the current owner inherent this kind of business from their parents and relatives. In all kinds of business, strategies are the key factor to grow and be still on the right track even with different competitors. Thus, the researchers wish to study the entrepreneurial strategies of the gardening business in Cabanatuan City and to evaluate the strategies used and performed by the businessmen that help them to be more profitable amidst this pandemic and even afterward.

### II. OBJECTIVES OF THESTUDY

Business has its own strength and weaknesses, and if the owner did not manage it accordingly the growth of the business will not prosper and the worst is, it might be bankrupted or be closed immediately. To avoid it, entrepreneurial strategies are very necessary.

The study was conducted to evaluate the entrepreneurial strategies of gardening business in Nueva Ecija. Specifically, it sought to answers the following questions:

1. How may the business profile of the respondents be described in terms of:

- 1.1 Type of Business
- 1.2 Number of years in the gardening business
- 1.3 Type of business ownership
- 1.4 Number of employees
- 1.5 Estimated monthly income before pandemic
- 1.6 Estimated monthly income during pandemic

2. Describe the entrepreneurial strategies of the business in different aspects such as:

- 2.1 Marketing;
- 2.2 Products and Services;

- 2.3 Organization Management
- 2.4 Financial Management

3. Problems encountered by the business in their day to day operation.

### III. METHODOLOGY

The researchers will employ the Descriptive Survey Method of research. According to Zulueta (2010 Survey research) is the most widely used non- experimental type of educational research. It is used in various situations to investigate a large number of different research problems as they occur in the natural setting to determine the status quo of some variables. Surveys are used to measure opinions, attitudes, or achievements.

The study wishes to find out and describe the present profile of the selectedGardening Business in Cabanatuan City, and assess the problems encountered by the business owners/caretakers in their day to day operation. In addition, it seeks to investigate the different entrepreneurial strategies that they performed to overcome problems and maintain a successful operation.

This study used 13Ornamental Gardening Business Owners or Caretakers in the City of Cabanatuan as respondents. They were randomly selected to answer the casual interviews and questionnaire interpreted by the researchers. The data gathered were used only for the study and treated with supremeprivacy.

After all the data needed were gathered, the frequencies of answers in each question were tallied and their percentage was obtained. The Frequency, percentage, weighted mean, and mode of their answers were calculated in order to obtain its verbal interpretation.

The hereunder scale with its corresponding description was used as a guide in interpreting the response to the items.

SCALE	WEIGHT	VERBAL INTERPRETATION
4	3.26 - 4.00	ALWAYS
3	2.51 - 3.25	OFTEN
2	1.76 - 2.50	RARELY
1	1.00 - 1.75	NEVER

Table 1: Scoring Method

## IV. RESULTS AND DISCUSSION

According to the result of the survey conducted with the 13Gardening Business Owner or Caretakers in the City of Cabanatuan as respondents, the following results were:

### PROFILE OF THE RESPONDENTS BUSINESS

It was noted that out of 13 respondents, the majority or 10 are sole proprietorships, and the remaining which is 3 isa partnership.

Five (5) from 13 businesses started2 years ago, the other 5 businesses started 3 to 7 years ago, and the remaining 3 started more than 10 years ago.

Most of the respondents are renting their gardening business location, they were 8 out of 13 respondents and the remaining 5 garden locations are owned by the entrepreneurs.

The survey also revealed that this kind of business can be managed and run by thefamily members alone, employees were needed only if necessary, thus, 9 of the respondents answered they employ only 1-2 individuals as helper or assistant and the rest employed 3 or more.

With regard to the monthly income before COVID 19 pandemic,4 of the respondents answered they had an income of 0-P5,000, 5 businesses had P5,0001-P10,000, 2 businesses had P10,0001-P20,000, and the remaining 2 had P20,001 and above. However, during COVID 19 pandemic up to the present, their sales increases by 20% and still growing, this is due to the responsiveness of the people about the importance of a healthy environment as well as the increase in the number of individuals who made gardening and planting as their new hobby.

Table 2	Entrepreneuri	al Strategies	Used by	Gardening	Business
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Factors	WM	VI		
Marketing				
The business used prints, commercials, or social media as a form of advertisement and online selling.	2.23	Rarely		
The business gives promotion like discount and freebie to the customers.	3.54	Always		
The owner is using a focus strategy by selling products cheapest offering than other competitors.	2.38	Rarely		
The owner is using a differential strategy by selling products higher offering but high quality than other competitors.	2.85	Often		
The business is using suggestive selling to help the customer	2.92	Often		
General Weighted Mean	2.78	Often		
Product and Services				
The business considers product positioning wherein the in-demand items are place in the front.	2.85	Often		
Use private labeling or applying brand name.	1.77	Rarely		
Modify or Innovate the products and services.		Often		
Set strategic goals to motivate and inspire performance.		Often		
Make strategic planning in selling products and services.		Rarely		
General Weighted Average	2.49	Rarely		
Organization Management				
The owner gives a bonus and incentives to their employees.	2.08	Rarely		
The employer gives necessary safety and protection measures to their employee	2.62	Often		

The employer provides motivation such rewards and other intrinsic motivation.	2.00	Rarely		
The owner attend seminars or training to add new information about gardening.	2.46	Rarely		
The owner give trust to the employees for them not to leave the organization.	2.15	Rarely		
General Weighted Average	2.26	Rarely		
Financial Management				
The business has a monthly income kept on their own house	3.15	Often		
The business deposit their sales and income in the bank.		Rarely		
The business accepts E-Payment such as GCash, Paypal, Pay Maya, and the like, other				
than cash.	1.46	Never		
The business use checks and bank transfer in paying the supplier.	1.77	Rarely		
The owner uses the sales and income of the business for personal use.	3.08	Often		
General Weighted Mean	2.27	Rarely		

Moreover, the problems encountered by gardening business owners are as follows:

- 1. Pest and plant diseases
- 2. Water during dry season
- 3. Over supply of water during rainy season
- 4. Weeds
- 5. Lack of buyers

## V. CONCLUSION AND RECOMMENDATIONS

Based on the aforementioned outcome of the research study the following conclusion and recommendations were drawn by the researchers:

1. With regards to the profile of the business, this kind of business does not need a high capital because sole proprietorship and partnership investors can start up one. The researchers also conclude that the gardening business is good because according to the survey conducted, there were businesses that were established 10 years ago and still operating up successfully until now.One of their advantages is the fact that they are not renting their location. Rental fees can add up to their expenses instead of adding to their net income. If someone wants to start a gardening business, they can use the help of their family members instead of hiring an employee, or get an on-call employee if necessary, like a landscaper. Furthermore, it can be concluded that due to COVID 19 pandemic, the sales of the gardening business increased and continue increasing until now. 2. The main objective of this study is to assess the entrepreneurial strategies used by gardening businesses in the City of Cabanatuan. Thus, based on the survey conducted, the researchers conclude the following:

2.1 Marketing Strategyrefers to a business's overall game plan for reaching prospective consumers and turning them into customers of the products or services the business provides (A. Barone 2020). Based on the data in Table 2, the gardening business in the City of Cabanatuan hasrarely used prints or commercial, for advertisement. Some of them have a Facebook Page Accountand other social media page where they promote their products, but not all of them. To gain customers, one of the most common marketing strategies is giving discounts and freebies to the customers, with this, the answer of the respondents has a weighted mean of 3.54 which has a verbal interpretation of Always. The researcher easily concludes that this strategy was constantly used by all the respondents. Also, Focus Strategy is the way of selling the products at the lowest prices than the competitors, is Rarely done by the respondents. The reason behind this is, they are not adding a high mark up and they are much aware of giving discounts and freebies than using the focus strategy. However, they Often use the Differential Strategy wherein they are selling their products in higher offering but high quality than other competitors. The researchers conclude that the gardening business produces or sells quality plants that can effortlessly transfer from their nursery to the buyer's home that can surely will not easily weather. The researcher concludes also that the respondents used another marketing strategy which is Suggestive Selling
wherein they introduce another product in exchange for the unavailable one or as another good option to buy. Based on the survey conducted, it has a weighted mean of 2.85 with a verbal interpretation of Often. With a general weighted average of 2.78 with a verbal interpretation of Often, the researcher concludes that Marketing Strategy was practiced by the respondents. However, the researcher suggests to study more about other marketing strategies to make their business more appealing, attractive, and innovative which will surely maintain customers' loyalty, repeat purchase and attract more new customers that will resulted to a more or increase income.

2.2 Product and Services Strategy deals with the number and diversity of products, product innovations, product scope, and product design. (I.Jayant, 2014). The strategies like Product Positioning wherein the in-demand items are placed in the front, Product Innovation or development of new products, and Setting of Goals to motivate the performance that will produce good product and services are Often used by the respondents. The researchers suggest to continue using these strategies for the benefit of the business. Thus, Private Labeling or applying their name to the product or with their own branding, and Strategic Planningwas Rarely done by the business, with this, the researchers recommends to try doing strategic planning. There are different books and articles in the internet that teaches courses in strategic planning like coursera.org, imd.org, and sgs.ph. Having a general weighted average of 2.49 with a verbal interpretation of Rarely, the researchers recommend to use or add strategies in their products and services by studying or reading articles on the website enumerated above.

2.3 Organization Management Strategy is the sum of the actions a company intends to take to achieve long-term goals. Also, top management creates the larger organizational strategy, while middle and lower management adopt goals and plans to fulfill the overall strategy step by step. (S.Johnson 2019). Therefore, this is a joint cooperation of the whole organization to attain their common goal for the benefit of the business. Based on the survey conducted and recorded in Table 2, the researchers conclude that this is the strategy that is not prioritized by the respondents. (a) Giving Bonus or incentives to the employees to keep their trust in the business, or (b) Giving Intrinsic Motivation because, time and again, researchers have found that people with high intrinsic motivation for example, (c) Giving the Employee Trust, to make them driven by internal rewards and satisfaction, perform much better than people offered high extrinsic motivation or external rewards (viGlobal.com 2018). The owner (d) *Attend Seminars or Training* to add new information about gardening, these strategies are Rarely used by the respondents. Having a general weighted average of 2.26 and a verbal interpretation of Rarely, the researchers recommend to do and adopt these strategies because it can give a positive effect not only on the employees but also on the organization itself. However, the employer Often gives necessary safety and protection measures to their employee to avoid unnecessary circumstances which the researcher recommends to continue.

2.4 Financial Management Strategy is an approach used for managing the finances of a company to meet its strategic goals (corporatefinanceinstitute.com). The researchers noted that some of the Financial Management Strategies like Accepting E-Payment or Electronic Payment like Pay Maya, Paypal, G Cash were not or Never use by the respondents. The researchers recommend this strategy because it is important nowadays to avoid the use of physical money which is prone to counterfeit, and theft and also to avoid the possible spread of the corona virus. Also, the Usage of Checks and Bank Transfer in depositing their sales and income was Rarely done by the respondents, that is why the researchers highly propose to deposit their sales and income on a regular basis, and use the service of the banks like savings, checking, other wire transfer transactions. Having a bank account is also a good strategy because banks can help them grow and expand their business operations by providing loans.Furthermore, the use of bank services and not keeping the sales or income of the business at their home makes the owners avoid spending the money of the business for personal use.

3. With regards to the problems encountered by gardening business owners the researchers' recommendations are as follows:

Prevent Pest and Plant Diseases with Good Gardening Practices. According to Colleen Vanderlinden 2020, Prevention is much easier than treatment. To avoid it, follow good sanitation practices, fertilize to keep plants healthy, before accepting from the suppliers, inspect plants for diseases to avoid infecting other plants, allow the soil to warm before planting, water in the morning, and mulch to maintain soil moisture and keeping weeds down, provide good air circulation, watch out for insect pests, and remove diseased stems and foliage immediately. If the gardening business owner follows these, surely it will lessen or eliminate the pests and plant disease.

Due to climate change, the gardening business is suffering from an undersupply of water during the dry season, with this, the researchers recommend to have a deep well for watering the plant during dry season, and do mulching. When quality mulches cover the soil, they prevent the loss of soil moisture as by reducing evaporation. They increase water infiltration while also preventing soil compaction due to dryness. Mulches also control the germination and growth of weeds and inhibit the spread of soil-borne diseases. These mulches can also serve as insulation to stabilize the soil temperature and protect the roots from extreme temperatures during the summer or rainy season. (JK Cooper, 2017). On the other hand, during the rainy season where an oversupply of water is unnecessary, the researcher recommends the use of the net or netting the garden, and have a properly constructed canal for the right flow of unwanted water.

Continuous research and development in the field of entrepreneurial strategies in the gardening business is highly encourage. Therefore, new and improved discoveries on strategies, inputs, and production methods can contribute to the gardening business's future development.

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# Research on the industrial upgrading effect of China's outward foreign direct investment on equipment manufacturing industry

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Abstract— Based on the panel data of 30 provinces in China (excluding Tibet) from 2004 to 2017, this paper uses a two-way fixed effect stepwise regression model to analyze the impact of China's outward foreign direct investment on the high-end rate of equipment manufacturing industry, and empirically studies the effect of China's outward foreign direct investment on the upgrading of equipment manufacturing industry. The empirical results show that: China's outward foreign direct investment has a significant impact on the upgrading of high-end equipment manufacturing industry. From the regional level, the northeastern region has the most significant positive impact, followed by the eastern region, the central region has a negative impact, and the western region has no obvious impact. Finally, this paper puts forward corresponding countermeasures and suggestions on how to use outward foreign direct investment to promote the upgrading of equipment manufacturing industry.

Keywords— outward foreign direct investment, equipment manufacturing industry, high end, industrial upgrading.

# I. INTRODUCTION

At present, although the trend of anti globalization is surging in Europe and the United States, economic globalization is still the mainstream of global economic development, and international capital flow is still the main factor driving economic globalization. With China's entry into a new round of reform and opening up, China's foreign direct investment continues to maintain a rapid growth momentum. According to the statistical bulletin of China's foreign direct investment, from the perspective of two-way investment, China's OFDI exceeded the actual foreign investment (FDI) in the same year for four consecutive years from 2015 to 2018, and China has begun to become a net capital exporter. Especially in recent years, China has been ranked in the top three of the world's foreign direct investment flow for seven consecutive years, and China's foreign direct investment has become a booster of world economic growth. According to the theory and practice of foreign direct investment, foreign direct investment will certainly bring important influence to the industry of home country, such as resource

allocation effect, industrial upgrading effect, reverse technology spillover effect, technological progress effect, etc. From the current situation of China's manufacturing industry development, due to the limited international division of labor pattern of global manufacturing industry, China's manufacturing industry, especially the equipment manufacturing industry, has been in the "low-end locking" position in the global value chain for a long time. It is urgent to accelerate the transformation and upgrading of the equipment manufacturing industry and enhance international competition through foreign direct investment, overall utilization of international resources and markets to promote the equipment manufacturing industry to the high end of the global value chain. Therefore, it is very important to study the industrial upgrading effect of China's foreign direct investment on the equipment manufacturing industry.

# II. LITERATURE REVIEW

With regard to the definition of OFDI, the International Monetary Fund (IMF) believes that OFDI refers to an

investment activity in which a country is engaged in production and operation abroad and obtains continuous income. Its main purpose is to have the management power of overseas enterprises.<sup>[1]</sup> The OECD points out that the so-called outward foreign direct investment refers to the investment activities that can gain economic benefits and effectively control them by establishing long-term strategic cooperative relations with enterprises in other countries.<sup>[2]</sup> According to the Ministry of Commerce of China, outward foreign direct investment is an economic activity in which domestic investors establish and purchase overseas enterprises in the form of physical objects, cash or intangible assets in Hong Kong, Macao and Taiwan, and control 10% and above equity of the enterprise and control its operation and management rights. [3] This paper mainly refers to the formulation of the Ministry of Commerce of China, and holds that outward foreign direct investment is the behavior of multinational enterprises to invest in cash, material objects and intangible assets in order to gain effective control over the operation and management of foreign enterprises.

Foreign scholars have studied the meaning of industrial upgrading earlier. Porter (1990) first introduced the concept of "industrial upgrading" in the global value chain, believing that industrial upgrading is a process in which the production efficiency, production quality and profitability of enterprises in the industrial chain continue to improve <sup>[4]</sup>. According to Gereffi (1999), industrial upgrading is a process in which manufacturing enterprises gradually climb to the high-end value-added link in the global value chain <sup>[5]</sup>. Ernst (1998) classified industrial upgrading into five parts: inter industry upgrading, inter factor upgrading, demand upgrading, function upgrading and chain upgrading <sup>[6]</sup>. According to Poon, the process of transferring products produced by enterprises from low added value to high added value is industrial upgrading <sup>[7]</sup>. The time when domestic scholars put forward the concept of "industrial upgrading" is similar to that of foreign scholars. Li Hongji (1987) and Wu Chongbo (1988) first proposed the concept of "industrial upgrading". However, most of the domestic explanations of "industrial upgrading" before this were still at the macro level of "industrial restructuring", mainly focusing on the adjustment and optimization of the proportion of China's three industries. After the concept of "industrial upgrading" was put forward, it soon affected the whole academic circle in China. Domestic scholars studied from different perspectives, such as the adjustment of industrial structure, the use efficiency of factor endowment, product upgrading, value chain upgrading, and the improvement of industrial quality and efficiency. The conclusion is quite

similar to that of foreign scholars. Based on the views of scholars at home and abroad, this paper holds that industrial upgrading is a process of continuously improving the added value of products through the optimization of factor allocation, structural adjustment, efficiency improvement, quality improvement and value chain upgrading.

As for the research on the relationship between OFDI and industrial upgrading, scholars mainly study whether OFDI has an impact on industrial upgrading, and whether the impact effect is positive or negative. Scholars at home and abroad have drawn different conclusions based on different research perspectives and methods. To sum up, there are three main types.

The first point of view: OFDI has a significant role in promoting the industrial upgrading of the home country. Most studies have shown that OFDI can promote the industrial upgrading of home countries. Adler (1974) through the study of outward foreign direct investment in South Korea, outward foreign direct investment can improve the added value of enterprise products, but also can promote the upgrading of home country industry<sup>[8]</sup>. Kojima (1978) first analyzed the connotation of "marginal industry expansion theory", and discussed the internal relationship between OFDI and industrial upgrading. The main point of the theory is that through the transfer of domestic overcapacity and inferior industries to overseas, the resources will be concentrated on the development of advantageous industries, which is conducive to the optimization and upgrading of industrial structure and the healthy development of foreign trade <sup>[9]</sup>. Blomstrom et al. (2000) took Japan as an empirical research object, explored and analyzed the internal relationship between its overseas investment and economic structure optimization, and the results showed that overseas investment was conducive to improving the efficiency of enterprise resource allocation and promoting the transfer of marginal industries in Japan<sup>[10]</sup>. According to the research of developing countries and transition countries (regions), outward foreign investment can significantly enhance the industrial competitiveness of developing countries, and show significant technology spillover effect and correlation effect, which can significantly improve the overall development level and competitive advantage of related industries [11]. Rossel (2000) pointed out that through the overseas transfer of low-end industries, South Korea realized the concentration of production resources to domestic advantageous industries through the overseas transfer of low-end industries, which significantly improved the technical level of domestic industries and

provided a significant driving force for industrial upgrading <sup>[12]</sup>.

Based on domestic empirical data, domestic scholars also study and analyze the impact of China's OFDI on industrial upgrading. Yang Dakai (2003) believes that high-tech enterprises can not only effectively utilize the local human capital elements, but also improve the technical level and management experience of enterprises by making outward foreign direct investment in technology or knowledge intensive countries and regions, so as to reverse promote the technological progress of the home country and have a positive impact on the industrial upgrading of the home country. Gao Lifeng et al. (2013) also reached the same conclusion through the analysis of the relationship between foreign direct investment and industrial upgrading in the United States from 1966 to 2010. At the same time, he also pointed out that the outward investment of manufacturing, wholesale and retail industry, and oil industry had the most obvious effect on industrial upgrading [13]. Zhang Yuanpeng and Li Yujie (2014) believe that the larger the scale of China's outward foreign direct investment, the better the efficiency of industrial structure upgrading. Outward foreign direct investment in high-tech industries has significantly affected the optimization level of domestic industrial structure<sup>[14]</sup>. The empirical research results of Li Dongkun and Deng Min (2016) pointed out that China's overseas investment has a significant spillover effect, and the increase of outward foreign direct investment is conducive to improving the level of industrial structure, and can also significantly improve the rationality of industrial structure of related industries and neighboring regions<sup>[15]</sup>.

The second view is that OFDI has no significant effect on industrial upgrading of home country. A few scholars believe that the promotion of OFDI on the optimization of industrial structure of home country is not significant, or even does not exist. Pan Sukun and Yuan Ran (2014) divided the 58 host countries of China's outward direct investment from 2003 to 2012 into three groups: resource seeking, market seeking and technology seeking. Through empirical analysis of relevant data, it is found that OFDI with three different motives has no significant effect on China's industrial optimization. Yang Ying and Liu Caixia's (2015) research based on VAR model shows that there is a one-way promotion effect between the two, that is, the adjustment of industrial structure can promote the expansion of OFDI scale, but the effect of OFDI on the industrial adjustment of home country has not yet appeared. The calculation results of Zhang Yuanpeng and Li Yujie (2014) show that the correlation degree between them is only 0.73, which means that the promotion effect

of OFDI on industrial optimization is relatively weak. This is related to the late start and small scale of China's outward foreign direct investment, as well as the deep foundation of domestic traditional industries and the imperfection of domestic supporting facilities, resulting in the effect of promoting the optimization of industrial structure is not obvious.

The third point of view: outward foreign direct investment hinders the industrial upgrading of the home country. There are also many arguments about whether OFDI will hinder the industrial upgrading of home countries. Some of them think that OFDI brings hollowing out of the home country's industry, which will lead to the decline of the related industries in the home country. Qi Jianhong et al. (1996) believed that with the expansion of Japan's foreign investment scale, Japan appeared "industrial hollowing out" in the mid-1980s. Among them, the flow of investment, speed, industry type and other factors determine the size of the negative effect of outward foreign investment on industrial upgrading <sup>[16]</sup>. Shi Liu et al. (2013) <sup>[17]</sup> and Wang Rong et al. (2015) <sup>[18]</sup> respectively studied outward foreign direct investment and industrial "hollowing out" from the perspective of Guangdong Province and Yangtze River Delta region, and concluded that although outward foreign direct investment does not lead to the hollowing out of equipment manufacturing industry in Guangdong Province and the Yangtze River Delta, with the development of outward foreign direct investment, equipment manufacturing in Guangdong Province and the Yangtze River Delta region has become increasingly prominent It is concluded that there is a trend of "hollowing out" in the industry. In order to prevent "hollowing out" of industries, Sang Baichuan et al. (2016) put forward the principle of "grasping both ends and opening up the middle" in outward foreign direct investment on the basis of analyzing the experiences and lessons of outward foreign direct investment of the United Kingdom, the United States and Japan<sup>[19]</sup>.

To sum up, a large number of domestic and foreign literature on the relationship between outward foreign direct investment and industrial upgrading, mainly concentrated on the macro level, most of which are about the impact of outward foreign direct investment on the optimization and upgrading of the three industrial structure, while the analysis of a specific industry or sub industry is less. From the research results, it is also relatively scattered, with different views. Generally speaking, the positive is more than the negative, and the impact is significantly more than not significant. In addition, there are few researches on the impact of OFDI on the upgrading of equipment manufacturing industry in home country, which needs to be further strengthened.

# III. ANALYSIS ON THE MECHANISM OF OFDI PROMOTING THE UPGRADING OF MANUFACTURING INDUSTRY IN HOME COUNTRY

The optimization and upgrading of an industry or industry involves many factors, including national macro industrial policy, industry development planning and business behavior of enterprises. Based on the above literature research and analysis, this paper draws on the research results of Fang Yu (2013) <sup>[20]</sup>, Zhu Chunlan (2017) <sup>[21]</sup>, etc., analyzes the industrial upgrading effect of OFDI on the equipment manufacturing industry, and studies from the perspective of enterprise to industry from the micro and medium level.



Fig.1: The impact mechanism of OFDI on the upgrading effect of manufacturing industry at the enterprise level

#### 3.1 Enterprise level

According to the different motivations of OFDI by scholars at home and abroad, it is concluded that the OFDI behavior of enterprises can be roughly divided into four types: resource seeking, market seeking, efficiency seeking and strategic asset seeking. These four types of OFDI have different effects on the upgrading of manufacturing industry, but they have promoted the upgrading of manufacturing industry from different aspects. The mechanism is shown in Figure 1.

#### 3.1.1 Resource seeking

Resources are the first condition to support the development of industry, and obtaining cheap resources is one of the key motivations of OFDI. Resource seeking OFDI refers to foreign investment activities in order to obtain cheap natural resources such as minerals and oil, as well as labor resources. The impact of resource seeking OFDI on the upgrading of manufacturing industry is mainly through outward foreign direct investment, establishing stable resource supply channels in the world, increasing resource supply, obtaining key resources needed for industrial development, easing the constraint

pressure on domestic resources and environment, breaking the resource bottleneck, providing resource support and guarantee for the development of manufacturing industry and improving industrial competition At the same time, it can promote the upgrading of manufacturing industry through industrial competition effect and correlation effect.

#### 3.1.2 Market seeking

Market seeking OFDI refers to foreign investment activities to stabilize or seize the market share of host countries, improve market share and expand overseas development space. In international trade, in order to protect domestic manufacturing industry from external shocks and improve local employment rate, countries often set up trade barriers, implement trade protectionism, and encourage foreign capital to invest in their own country. Therefore, in order to avoid trade barriers and open up overseas markets, enterprises often invest and set up factories abroad, and begin to shift from export trade to outward foreign direct investment, thus expanding overseas market share. The impact of market seeking OFDI on the upgrading of manufacturing industry is mainly manifested in two aspects: on the one hand, outward foreign direct investment into the production and sales of the host country can not only avoid trade barriers, but also achieve scale effect and reduce production costs by expanding supply, at the same time, it can drive the output of relevant products and services, optimize the export structure of products and promote the structural adjustment of manufacturing industry. On the other hand, with the help of the host country market, enterprises can have a close relationship with the international market, understand the demand preference of foreign markets for products, track the situation of competitors in time, and drive domestic research to develop new products, new businesses and new processes, promote product deepening and realize the upgrading of manufacturing industry.

# 3.1.3 Efficiency seeking

Efficiency seeking OFDI refers to foreign investment activities to improve production efficiency. Generally speaking, the efficiency seeking type is higher in level and wider in scope than the resource and market seeking type mentioned above. This type of outward foreign direct investment is systematic. Enterprises carry out crossborder integrated investment through overseas subsidiaries, relying on international factor resources and market division of labor, reorganize production, sales and service in the world, so as to realize the maximization of scale economy and efficiency. The impact of efficiency seeking OFDI on the upgrading of manufacturing industry is mainly manifested in two aspects: on the one hand, enterprises rely on their own comparative advantages, re integrate factor resources in the global scope, make use of foreign cheap resources and skilled labor, reduce the production costs of enterprises, improve the production efficiency of enterprises, enhance the international competitiveness, promote enterprises to increase revenue and reduce expenditure, and have the ability to do more research. On the other hand, in order to improve the inputoutput efficiency and firmly control the foreign market, enterprises export high-cost and low-value-added production or assembly links to overseas with the help of outward foreign direct investment, while leaving highvalue-added R&D design and marketing service links at home, focusing on product design, technology research and development and sales services, and promoting enterprises greatly improve their efficiency level, continuously improve the ranking in the global value chain, and promote the upgrading of domestic manufacturing industry.

# 3.1.4 Strategic asset seeking

Strategic assets are the core competitiveness of enterprises, which are difficult to obtain in the external market. Different from the above three kinds of investment mobility, OFDI with strategic asset seeking refers to the outward direct investment activities to obtain strategic assets such as advanced technology, knowledge patent, trademark brand, management skills and sales network. Some scholars list technology acquisition OFDI separately, which also reflects the importance of advanced technology as a strategic asset. OFDI with strategic asset seeking belongs to the investment behavior of creating superior resources and improving ability. Its main goal is to help enterprises build new competitive advantages and maintain and consolidate their dominant position in the market. The impact of strategic asset seeking OFDI on the upgrading of manufacturing industry is mainly manifested in two aspects: on the one hand, through new investment or cross-border M&A, enterprises acquire advanced technology strategic assets with the help of reverse technology spillover effect of outward foreign direct investment, and help enterprises break through technical barriers through external economy, demonstration effect, learning imitation and industrial association, improve the labor production efficiency of the whole manufacturing industry and promote the upgrading of the manufacturing industry in the home country. On the other hand, the acquisition of strategic assets such as brand and marketing network helps to form the brand effect of enterprises, enhance the popularity of enterprises, broaden the sales channels, increase the export orders of enterprises, expand the export effect of products, and promote the structural adjustment and upgrading of the manufacturing industry in the home country.

# 3.2 Industry level

It can be seen from the previous literature that OFDI has the effect of industrial upgrading, which has been recognized by most scholars at home and abroad. To sum up, from the industrial level, as far as manufacturing industry is concerned, OFDI promotes the optimization and upgrading of manufacturing industry through industrial transfer effect, industrial correlation effect and industrial competition effect. The influence mechanism is shown in Figure 2.



Fig.1: The impact mechanism of OFDI on the upgrading effect of manufacturing industry at the industry level

#### 3.2.1 Marginal industry transfer effect

Kojima (1978), a Japanese economist, analyzes the mechanism of OFDI promoting industrial upgrading. The core meaning of the theory is that OFDI should be carried out in turn from the "marginal industries" of the country, that is, the industries that have been or will be in a comparative disadvantage. Generally speaking, marginal industries have dual meanings. For investment countries, they may be industries that have lost their comparative advantages in international trade, including industries with overcapacity, and industries with high energy consumption and high pollution that are incompatible with the local development environment of the home country; however, for the host country, they may be industries with comparative advantages and can extend their life cycle. The marginal industry transfer effect of OFDI on the upgrading of manufacturing industry is mainly manifested in two aspects: one is that the investment country transfers the marginal industry to the host country through OFDI. The marginal industry has a comparative advantage in the host country, which is equivalent to prolonging the time for the transferred industry to play the comparative advantage of the industry. At the same time, it can also make use of the local cheaper production factor resources to obtain the higher investment income, which can be returned to China, can also provide financial guarantee for the development of domestic emerging manufacturing industry or transformation and upgrading of traditional manufacturing industry, expand the increment of domestic manufacturing industry and promote the upgrading of manufacturing industry. Second, with the help of outward foreign direct investment, the traditional marginal industries or industries with excess capacity can be transferred to foreign countries, which can release the capital, technology, labor force and other production factors deposited in the marginal industries. The released production factors can be transferred to the domestic emerging or comparative advantage manufacturing industries, or used to upgrade and transform other traditional advantageous manufacturing industries in China. The optimization of domestic manufacturing stock can also release more pressure on population, resources and environment, provide support for the development of these industries in terms of manpower, technology, capital and environment, and promote the upgrading of manufacturing industry.

#### 3.2.2 Industrial linkage effect

Referring to Albert Otto Hirschman's "industrial relevance theory", this paper points out that there must be such an industry in the chain of industrial association, which has the highest correlation coefficient with its forward and backward industries in the input-output relationship. The development of this industry has a greater role in promoting the development of its forward and backward industries. In the process of OFDI, manufacturing industry will influence the industrial chain and all links of manufacturing industry through the forward and backward correlation effect between industries, so as to promote the upgrading of manufacturing industry. In the industrial chain, the upstream industry is located at the beginning of the whole industrial chain, often holding important resources, including core technology, etc., while the downstream industry refers to the end of the whole industrial chain. In the extension of the industrial chain, the extension of the industrial chain to the upstream generally makes the industrial chain enter into the basic industry link, as well

as the technology R&D design link, while the downstream expansion enters the market expansion and product service link. The impact mechanism of OFDI forward correlation effect is mainly reflected in: in the process of OFDI, downstream industries will certainly expand the overseas production scale of their industries, stimulate the product demand of upstream industries in their home countries, stimulate the scale expansion of upstream industries, and obtain economies of scale benefits. In addition, facing more fierce international market competition in OFDI, we need stronger international competitiveness to promote upstream industries to strengthen technological innovation and progress, increase technological research and development and product upgrading, and improve product quality. Through the pull relationship between the industry chain from the bottom to the up, and then promote the overall quality of the domestic manufacturing industry chain. The mechanism of OFDI backward correlation effect is mainly reflected in: upstream industries produce primary and intermediate products in the host country in the process of OFDI, and promote the conservation of domestic production factor resources. Through the promotion relationship from upstream to downstream of the industrial chain, the domestic production factors can be effectively released and reallocated, which makes the domestic downstream industries more likely to concentrate capital, technology and human capital to improve product production and R&D, and improve production efficiency. In a word, whether it is the pull of forward linkage or the promotion of backward linkage, it is conducive to the expansion of manufacturing industry chain and the upgrading of manufacturing industry.

#### 3.2.3 Intra industry competition effect

Michael E. Porter, an American economist, has made a detailed study on the promotion of competition to industrial upgrading in his "Diamond Model" theory. According to its competition theory, an industry in a country should not only face the international competition, but also intensify the domestic competition of the industry, and eventually lead to the whole industry in the international competition. The influence mechanism of OFDI on the intra industry competition of manufacturing industry is mainly manifested in two aspects: one is to take the lead in "going out" multinational enterprises through outward foreign direct investment, and obtain intangible asset spillovers such as technology, management and brand through various forms such as active M&A and green land investment. In order to adapt to the fierce international competition, OFDI constantly carries out technology research and development to improve product competitiveness. And in the same industry in the domestic

market to obtain advantages, and occupy a favorable competitive position. This kind of enterprises bring survival competition to domestic enterprises in the same industry. In order to consolidate, maintain and expand the original competitive advantages and meet the challenges of leading multinational enterprises taking the lead in "going out", other enterprises must also increase investment in technology research and development, seek innovation and breakthrough, innovate management methods, and reduce production costs, so as to improve their comprehensive competitiveness. This kind of enterprise competition leads to intensified industry competition, improves the overall quality of the whole industry, and finally promotes the optimization and upgrading of industrial structure. The second is the introduction of standardized international market competition mechanism by multinational enterprises with outward foreign direct investment. This competition mechanism is transmitted to the domestic competitive market of the same industry, forming an intra industry demonstration competition mechanism, driving the comprehensive reform and healthy competition of domestic peers and related industries, improving the overall quality of the home country industry, and finally promoting the upgrading of the manufacturing industry.

# IV. RESEARCH DESIGN AND VARIABLE SELECTION

Because the panel data model has more significant advantages that it can take into account the relationship between variables in time and space. Therefore, this paper uses the panel data of 30 provinces in China from 2004 to 2017 (due to the special characteristics of Tibet, the lack of economic data is relatively serious, which is excluded from the samples of empirical analysis; in addition, some missing data are supplemented by means of mean filling method), and further analyzes the industrial upgrading effect of OFDI on the equipment manufacturing industry of each province in China.

# 4.1 Variable selection and data source

#### 4.1.1 Explained variables

The explained variable is the high-end rate of equipment manufacturing industry (HRE), which is the ratio of the total industrial output value of advanced equipment manufacturing industry and manufacturing industry, and is an important indicator to measure the upgrading effect of equipment manufacturing industry. This paper assumes that the upgrading effect of equipment manufacturing industry is reflected in the rationalization and coordination of industrial structure and the high-end of industrial structure. The advanced equipment manufacturing industry has been constantly upgrading its weight and status in the manufacturing industry, reflecting the continuous development of equipment manufacturing from low technology to high technology and high technology, reflecting the advanced nature of the development of equipment manufacturing industry. Therefore, this paper uses the proportion of advanced equipment manufacturing industry in the total output value of manufacturing industry as an indicator to measure the high-end level of China's equipment manufacturing industry upgrading. There is no clear definition of advanced manufacturing industry at present. This paper holds that the advanced equipment manufacturing industry should include the equipment manufacturing industry of high-tech industry and the highend equipment manufacturing industry. The National Bureau of Statistics has clearly defined the division of high-end equipment manufacturing industry (see Table 1 for specific division explanation). The relevant data are

from China Statistical Yearbook, China Industrial Economic Yearbook, China Industrial Yearbook and China High Tech Industry Statistical Yearbook. The data of advanced equipment manufacturing industry are from aviation, spacecraft and equipment manufacturing industry, electronics and communication equipment manufacturing industry, computer and office equipment manufacturing industry, medical equipment and instrument manufacturing industry and transportation equipment manufacturing industry in the list of equipment manufacturing industry (excluding some duplicate data of aviation, spacecraft and equipment manufacturing industry). After 2012, as the relevant statistical yearbook no longer publishes the gross industrial output value, it is replaced by the main business income index. Due to the lack of some data, the 2017 data was backfilled with the average data of the previous two years.

 Table 1 Classification of equipment manufacturing industry, high-tech industry, high-end equipment manufacturing industry and advanced equipment manufacturing industry

Equipment manufacturing industry	High tech industry (Manufacturing)	High end equipment manufacturing industry	Advanced equipment manufacturing industry
Metal products industry	Pharmaceutical manufacturing	Aviation equipment industry	Aviation, spacecraft and equipment manufacturing
General equipment manufacturing industry	Aviation, spacecraft and equipment manufacturing	Satellite and application industry	Manufacturing of electronic and communication equipment
Special equipment manufacturing industry	Manufacturing of electronic and communication equipment	Rail transit equipment industry	Computer and office equipment manufacturing
Automobile manufacturing industry	Computer and office equipment manufacturing	Marine engineering equipment industry	Medical equipment and instrument manufacturing
Manufacturing of railway, ship, aerospace and other transportation equipment	Medical equipment and instrument manufacturing	Intelligent manufacturing equipment industry	Rail transit equipment industry
Electrical machinery and equipment manufacturing industry	Information chemicals manufacturing		Marine engineering equipment industry
Computer, communication and other electronic equipment manufacturing industry			
Instrument manufacturing industry			

According to the Classification of National Economic Sectors in 2017 (GB/T 4754-2017)	According to the Classification of High-tech Industry (Manufacturing Industry) published by the National Bureau of Statistics (2013)	According to the Classification of Strategic Emerging Industries (2012) released by the National Bureau of Statistics	At present, there is no clear definition of advanced manufacturing industry. In this paper, advanced equipment manufacturing industry includes high-tech equipment manufacturing industry and high-end equipment manufacturing industry.
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#### 4.1.2 Explanatory variables

Outward foreign direct investment (OFDI) is used as the explanatory variable. The stock data of outward foreign direct investment of each province in each year is selected, which is derived from the statistical bulletin of China's outward foreign direct investment.

#### 4.1.3 Control variables

4.1.3.1 Enterprise scale (ES), the ratio of the total industrial output value (main business income) of provincial equipment manufacturing industry to the number of enterprise units reflects the scale level of equipment manufacturing industry in each province. It is calculated according to the relevant data of China's industrial economic statistics yearbook and China's industrial statistical yearbook over the years.

4.1.3.2 The proportion of sales output value (PSE), the ratio of sales output value of equipment manufacturing industry to total sales output value of Industrial Enterprises above designated scale reflect the operation status of equipment manufacturing industry in various provinces. It is calculated according to the relevant data of China's

industrial economic statistics yearbook and China's industrial statistical yearbook over the years.

4.1.3.3 The proportion of scientific research personnel (PSA), the ratio of scientific research personnel in advanced equipment manufacturing industry to employees in industrial enterprises above designated size at the end of the year reflects the scientific research level of equipment manufacturing industry in various provinces. It is calculated according to the relevant data of China's industrial economic statistical yearbook, China's high-tech industry statistical yearbook and China's science and technology statistical yearbook.

# 4.2 Variable descriptive statistics

The descriptive statistics of each variable are shown in Table 2.

			1		
variable	Observations	mean value	Standard deviation	Minimum	Maximum
RE	420	16.05	13.30	0.400	56.85
OFDI	420	292.2	823.1	0.0800	9663
ES	420	2.222	1.278	0.277	6.414
PSE	420	25.56	15.44	3.090	59.97
PSA	420	0.637	0.624	0.0100	3.590

Table 2Descriptive statistics of main variables

# V. EMPIRICAL PROCESS AND RESULT ANALYSIS

Based on the literature of experts and scholars, the following regression model is set up in this paper.

$$\begin{split} HRE_{it} &= \alpha + \beta_1 \quad OFDI_{it} + \beta_2 \quad ES_{it} \quad {}_t + \beta_3 \quad PSE_{it} + \beta_4 \\ PSA_{it} + \beta_5 D + \beta_6 St + \epsilon_{it} \end{split}$$

Among them, HRE<sub>it</sub> is the high-end rate of the equipment manufacturing industry of the i province in the t phase,

that is, the proportion of the advanced equipment manufacturing industry and the total industrial output value of the manufacturing industry (after 2012, the total industrial output value will be replaced by the main business income);  $OFDI_{it}$  is the total outward foreign direct investment of the i Province in the t phase. In order to eliminate the influence of exchange rate and price factors, all OFDI values in this paper are exchanged with exchange rate;  $ES_{it}$  is the enterprise scale of the equipment

manufacturing industry of the i province in the t phase, that is, the ratio of the total industrial output value (main business income) of the provincial equipment manufacturing industry to the number of enterprise units; PSE<sub>it</sub> is the ratio of the sales output value of the equipment manufacturing industry of the i Province in the t phase to the total sales output value of the industrial enterprises above the scale; PSAit is the ratio of the scientific research personnel in the t phase of advanced equipment manufacturing industry in the i province to the employees of Industrial Enterprises above the designated scale at the end of the year.  $\alpha$  is a constant term and  $\varepsilon_{it}$  is a random disturbance term.

The panel data model mainly includes fixed effect model, random effect model and mixed model. Before estimating the panel data model, it is necessary to determine which of the three forms is used. The empirical method is to consider the reasonable model form according to the economic relationship of the sample space selected by panel data. The fixed effect model is more suitable.

In this part, two-way fixed effect stepwise regression model is used, and Stata fixed effect model command is used for data regression. The explained variable is the ratio of advanced equipment manufacturing industry to total industrial output value (main business income) (HRE), and the explanatory variable is OFDI.

# 5.1 Overall analysis of the whole country

According to the empirical analysis at provincial level, the specific regression results are shown in Table 3. The OFDI coefficient in column (3) of the table is positive, which indicates that OFDI has a positive impact on the high-end rate of equipment manufacturing industry under the control of individual fixed effect, time fixed effect and other factors. It shows that HRE increases by 0.0337% for each unit of OFDI investment. At the same time, the influence of other control variables on HRE is positive, indicating that the enterprise scale, sales share and scientific research level of equipment manufacturing industry have a positive and significant impact on the high-end process of equipment manufacturing industry, and the influence of scientific research level is more significant.

	(1)	(2)	(3)
	HRE	HRE	HRE
OFDI	$0.000840^{***}$	0.000101	0.000337*
	(0.000)	(0.557)	(0.036)
ES		-0.382716***	0.909957***
		(0.000)	(0.000)
PSE		0.752459***	0.797787***
		(0.000)	(0.000)
PSA		2.047640***	1.902811***
		(0.000)	(0.000)
Time effect	No	No	Control
Individual effect	Control	Control	Control
_cons	15.801202***	-3.671009***	-4.160542***
	(0.000)	(0.000)	(0.000)
N	420	420	420
$R^2$	0.042	0.594	0.695

Table 3 Regression results of the model

F	16.970014	141.343152	49.960451	

*p*-values in parentheses

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

#### 5.2 Empirical Analysis on regional level

This paper analyzes the differences of Eastern, Middle, Western and Northeastern China. In this section, we will set three dummy variables, E, M and W. E is the eastern dummy variable. When E = 1, it means that the region is the East, otherwise it is other regions; when M = 1, it means that the region is the middle, otherwise it is other regions; when W = 1, it means that the region is the west, otherwise it is other regions. In order to analyze the regional heterogeneity of OFDI to HRE, this paper multiplies each dummy variable with OFDI to form the cross term OFDI\_E, OFDI\_M, OFDI\_W. This shows that the northeastern region is taken as the comparison object, and the differences among different regions are compared.

Table 4 below shows the regression results. Column (1) is the result of uncontrolled time effect, and column (2) is the result of controlling time effect and individual effect. The result that OFDI is significantly positive indicates that HRE increases by 0.375% for each additional unit of OFDI in the northeastern region. OFDI E coefficient is significantly negative, indicating that the positive effect of OFDI on HRE in the eastern region is significantly lower than that in the northeast by 0.0035 points. The coefficient of OFDI M is significantly negative, indicating that the positive effect of reducing OFDI on HRE in Central China is significantly lower than that in Northeastern China by 0.0108 points. Although the OFDI\_W coefficient is negative, it is not significant, indicating that the difference between the western region and the northeastern region is not very significant. Furthermore, when the coefficients of OFDI and OFDI\_E are combined, they obtain 0.00025, while the coefficients of OFDI and OFDI\_M are added to

obtain -0.00713. The results show that the effect of OFDI on HRE is significantly positive in the eastern region, and the HRE increases by 0.025% for each additional unit of OFDI, while it is significantly negative in the middle region, i.e. the HRE decreases by 0.713% for each additional unit of OFDI.

The empirical results of the above regional level are basically in line with China's regional conditions. Northeastern China is an old traditional industrial base of China, where there is a large proportion of equipment manufacturing industry and a good foundation. Moreover, the equipment manufacturing industry in Northeastern China has a great advantage in the "Belt and Road" construction area. The eastern region is the frontier area of China's reform and opening up. Most of the equipment manufacturing industry is high-tech industry with high technology content. The high-end upgrading effect of outward foreign direct investment is not as significant as that of Northeastern China. The equipment manufacturing industry in the middle region is in an important stage of rising, which urgently needs large capital investment. However, outward foreign investment has a "crowding out effect" on the investment of equipment manufacturing industry in the middle region, so outward foreign direct investment has a negative impact on the upgrading of equipment manufacturing industry. The western region is a resource-based and underdeveloped region, and its equipment manufacturing industry foundation is weak, and the scale of foreign direct investment is relatively small. Therefore, the impact of foreign direct investment on the upgrading of equipment manufacturing industry in the western region is not significant.

	(1)	(2)
	HRE	HRE
OFDI	0.00040	$0.00375^{*}$
	(0.833)	(0.038)
ES	-0.28729**	0.82308***
	(0.004)	(0.000)

Table 4	Regression	results of	of the	model

International Journal of Advanced Engineering, Management and Science (IJAEMS)
https://dx.doi.org/10.22161/ijaems.612.16

DCE	0 85/17***	0 85225***
LOE	0.63417	0.83223
	(0.000)	(0.000)
PSA	2.39827***	2.28205***
	(0.000)	(0.000)
OFDI_E	-0.00043	-0.00350*
	(0.820)	(0.050)
OFDI_M	-0.01192***	-0.01088***
	(0.000)	(0.000)
OFDI_W	-0.00065	-0.00011
	(0.798)	(0.963)
Time effect	No	Control
Individual effect	Control	Control
_cons	-6.43224***	-5.65000***
	(0.000)	(0.000)
Ν	420	420
$R^2$	0.630	0.719
F	93.11621	47.36715

*p*-values in parentheses

\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

#### VI. CONCLUSION AND SUGGESTIONS

Based on the panel data of 30 provinces in China from 2004 to 2017, this paper uses a two-way fixed effect stepwise regression model to analyze the impact of outward foreign direct investment on the high-end rate of equipment manufacturing industry, and empirically studies the effect of China's outward foreign direct investment on the upgrading of equipment manufacturing industry. The empirical results show that: China's outward foreign direct investment has a significant impact on the upgrading of equipment manufacturing industry. Further analysis from the regional level, the northeastern region has the most significant positive impact, followed by the eastern region, the middle region has a negative impact, and the western region has no obvious impact. Firstly, the direct impact of outward foreign investment on China's high-end equipment industry is based on the empirical results. Therefore, based on the continuous expansion of outward foreign investment in China's equipment manufacturing industry in recent years, we should continue to increase the

scale of outward foreign direct investment in equipment manufacturing industry, and promote the transformation and upgrading of China's equipment manufacturing industry through "capital going out". The second is to implement the differential incentive policies for outward foreign investment in different provinces. The eastern developed areas and northeastern old industrial bases are also important ones of equipment manufacturing industry. The empirical results show that the effect of outward foreign direct investment on the upgrading of equipment manufacturing industry is positive and significant. Therefore, it is urgent to formulate targeted foreign investment incentive policies to accelerate the pace of equipment manufacturing enterprises in these regions to go global. Third, due to the "crowding out effect" of OFDI, especially in the middle and western regions, it is necessary to adjust measures to local conditions and reasonably control the scale of outward foreign direct investment, so as not to affect the transformation and upgrading of equipment manufacturing industry in these regions.

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