Technical Efficiency of Soft Drink Manufacturing Industry in Malaysia

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***Abstract*— The previous studies on technical efficiency (TE) of the soft drinks industry in Malaysia are still under consideration from other industries and existing studies discuss the industry in general. In fact, there is a previous study using industry-level data and does not consider the determinants of technical inefficiency determining the TE level. The purpose of this study is to identify the technical efficiency level and the technical inefficiency of the soft drinks manufacturing industry in Malaysia by 2015 using cross-section data of 118 firms obtained from the Department of Statistics (DOS). Based on the analysis method of stochastic analysis (SFA), the results showed that the level of technical efficiency was high. As a result, inefficient technical analysis finds that salary rates reduce inefficiencies and the ratio of capital workers increases inefficiencies. The basic implication of this study is that soft drinks manufacturing firms need to increase motivation among employees and strengthen network market production through pay increases.**

***Keywords*—** *Technical Efficiency, Technical Inefficiency, Firms, Soft Drink, Stochastic Frontier Analysis*

1. Introduction

Efficiency Efficiency is effectiveness input users influenced by production techniques, technological innovation, management skills and labour skills [1]. The optimum efficiency can be generated and influenced by efficient input factors such as the quality of workers. Based on [2], technical competence is a key element in economic profits as it measures the firm's ability to produce the maximum output from a given set of inputs and it will be reflected in the average operating cost and, consequently, will directly affect competitive position of firms.

Soft drinks manufacturing industry is important for economic growth in Malaysia. The soft drinks industry covers large and small-scale industries. For the large-scale industry, the contribution of the soft drinks industry to support the country's economic growth contributed 9.7 percent equivalent to the food industry in the 2012 industrial market. In 2010-2014 Gross Domestic Product (GDP), the beverage manufacturing industry contributed 13.9 percent food manufacturing industry. Besides that, this sub-sector contributes about 10 percent of Malaysia's manufacturing industry and 6016 SMEs firms are involved in processing and manufacturing soft drinks and making the second largest manufacturing sub-sector (DOS, 2011).

However, based on the statistics of the Gross Domestic Product (GDP) 2016, the soft drinks industry has steadily declined from 2011 to 2016 [3]. In addition, the firm's ability to produce efficient beverage production is unavailable because of inefficient use of inputs and economic downturns which result in the firms themselves unable to get enough resources to carry out beverage production activities [4]. This situation clearly shows that the level of efficiency of the soft drinks industry can be deficit or reduced. Studies such as TE can help to find out the inefficiency problem of manufacturing industry and then use effective methods to help improve TE value.

Most of the previous research find that the study on TE soft drink manufacturing industry is still less attention compared to other industries. Many studies such as [5], [6] and [7] only discuss the beverage manufacturing industry briefly and in small scale and do not conduct research on this industry as a whole in the research conducted. In addition, studies conducted do not care about the efficiency of the industry and further research on the determinants of technical inefficiencies is also not considered for efficiency gains such as studies conducted in neighbouring Indonesia [8].

Furthermore, there were previous studies on the beverage manufacturing industry in Malaysia such as [9], [10] and [11] where the studies have used data at the industry level and do not consider the technical inefficiencies determining factors to determine the TE level. [12] emphasized by considering technical inefficiency factors, firewall-level data play an important role in obtaining more accurate TE values. In fact, data at the firms' level is more effective and more advantageous to overcome some measurement problems and can affect aggregate data at industry level [13].

Hence, based on the problems and gaps of this study, an effort is taken to investigate the extent of the efficiency

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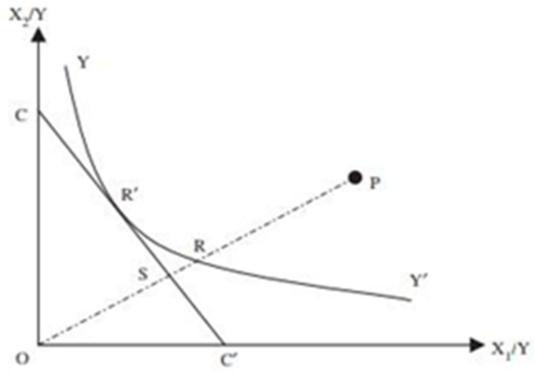
and the determinants of soft drink manufacturing industry inefficiencies in Malaysia using the latest data sources. This study is very important and in line with the national target to develop the soft drink manufacturing industry as one of the competitive industries not only locally but also internationally. This study uses data at the firm's level in 2015 and employing the SFA approach. The first analysis determines the level of technical efficiency, and the second analysis identifies the determinants of technical inefficiency among the firms studied. The second section of this article reviews previous studies. The third section discusses the research methodology, data sources, and model specification. The fourth section analyzes the results of the empirical analysis, and the fifth section provides the conclusions and the implications of this study.

2. Literature Review

2.1 Concepts and Measurement of Efficiency

The concept of efficiency can be seen when a department or organization uses all available resources or inputs optimally to produce maximum output. Output refers to the output or service produced by an organization [14]. According to [15] efficiency is a measure of the ratio between output and input, it can describe it as the distance between input and output quantities, and input and output quantities defining borders, the best boundaries for firms in the cluster (industry).

Efficiency measurement covers boundary or frontier efficiency of output use where input combinations are above the output boundary is efficient. The performance of productive units is measured based on efficiency of [15]. Measurement of Farell's efficiency with the assumption of constant return on a scale can be shown in Figure 2.1. YY 'isoquant line is the production boundary that reaches the level of efficiency. The form of an isoquant line represents the minimum set of inputs per unit of output required to produce a unit of production. The TE can be generated when the input combination is located along the isoquant line while the input combination point is above or at the right of the isoquant line such as point P cannot reach TE in production. While OR / OP ratio is TE level and production allocative efficiency at point P is represented by OS / OR ratio. The isocost CC 'line shows the objective function to minimize costs. While overall efficiency (economic efficiency) is equal to OR / OP x OS / OR = OS / OP.



2.2. Empirical Studies of Soft Drink Manufacturing Industry

Based on the previous study, many find out about technical competence towards the soft drinks industry. Studies such as [16] are in Greece where they study the efficacy of beverage production and beverage sales in Athens. Their TE study shows that the production of drinking water products has reached a significant percentage of the revenue from efficient use of inputs and shows a balanced sales turnover over time. In addition, [17] also study the comparison of the efficiency of beverage manufacturing before and after in terms of innovation and innovation in the production of beverage products. The comparison has proven to be a good result of which they place a product that can have a long-term impact on the production of beverages and they also propose innovative ideas on the production of efficient drink products.

For the use of the border approach, this study selected the use of parametric boundary approaches namely Stochastic Frontier Analysis (SFA). Studies such as [18] and [8] use this parametric approach to study the efficiencies of their respective beverage manufacturing in Portugal and Indonesia. In addition, the SFA approach is also used by [19] and [20], respectively in Nigeria and the Netherlands. Both studies use the SFA approach only to measure the efficiency of soft drink manufacturing in general compared to [18] and [8] which emphasize the study of beverage production in the country carefully.

In Malaysia, TE research on the soft drink manufacturing industry is still under consideration. Studies such as [21] and [22], which mainly lead to the manufacturing industry as a whole without having to focus fully on the beverage manufacturing industry in detail and accuracy. In the meantime, studies such as [6] study TE for beverage production but its scope focuses only on small and medium industries.

Finally, only [23] study focuses on the TE of the beverage manufacturing industry which indicates the overall TE level is in good condition. There are also studies such as [24] focusing on the efficiency of beverage production in the SMI sector through innovative development in the production of beverage products. However, both studies do not focus on the inefficiencies of this industry where this study should consider the inefficiencies of factors to better measure the efficiency of the soft drinks industry in Malaysia.

2.3. Empirical Study of Determinant Factors

The first determinant factor is information and communication technology (ICT) spending. The use of high technology information and communications can increase the production efficiency and manufacturing of an in-market industry [25]. They also comment that spending on information technology and ICT can connect among many manufacturers quickly without any problems and obstacles and it can indirectly play an important role in enhancing firm TE. In addition, [26] further reviews the human relations of each other in the use of computer technology. He further said that the use of information technology through the computer is faster than the use of physical energy to link information with information when away. This can increase the efficiency of manufacturing especially in the manufacture of soft drinks that are more positive and detailed.

The second determining factor is the training expenses for the employee. Through training expenses, skills to labor force increase and promote the production of better quality goods and services. Training expenses can also create the use of skilled labor. The use of skilled labor can increase the efficiency of industrial manufacturing such as reliable labor in managing stress in employment, advanced machine control and financial management [27], [27] also noted that the use of skilled labor as a result of consistent training expenses can have a positive impact on the industry's efficiency. [28] commented that firms providing training to employees could provide greater knowledge and easy learning and more innovation. In addition, [29] and [30] states that firms need to implement programs that focus on quality work to make jobs more attractive. In the long run, firms should turn into a professional oriented company with a steady income outlook, a clear career progression direction and a good working environment that can attract young people to the industry. In the short term, firms should offer employees with long-term contract work after having sufficient working experience, and also need to develop a career path to promote employees to supervisors [31]. The investment in human capital such as training to employees is a long-term asset that can provide a positive return over the period of employee service with the firms [32].

The third determinant factor is based on wage rates. The wage factor also contributes to the efficiency or inefficiency of a firm and industry. A balanced wage rate with training and skills to employees can lead to positive efficiency in the industry. [33] and [34] commented that the effect of training participation on hourly pay rates is quite clear; usually wages are reduced by 3-7 percent. It is important to note here, though, that we do not consider the impact of participation on the overall labor income. The estimated negative impact on hourly wage rates may, in large part, be offset by higher attachments to the labor market in terms of marketability.

The fourth determinant factor is the firm size. The size of the firm itself determines that the firm is experiencing positive efficiency or otherwise. According to [35], with reference to modern mediation theory, larger firms are more cost-efficient and less likely to fail. This theory shows that being a bigger proxy is one of the advantages in reducing the accumulated risk through a large number of contracting parties, thus reducing the likelihood of failure. Hence, larger institutions are believed to have more profitable investment opportunities, higher efficiencies, greater diversity and lower risk levels. In addition, [36] showcase a large company with a conservative attitude which can lead to creative reduction of researchers and creative entrepreneurs, thereby reducing research and development (R&D) efficiency. [37] suggested that larger firms could not change rapidly to respond to radical innovations as they often had standard procedures and excessive bureaucratic controls, and there developed efficient routines, and their information flow was slower and more complex [38].

The fifth determinant factor is about R&D. Through research and development spending, skills to the labor force are increasing and promoting the production of better quality goods and services. Labor force with expertise in innovation in product production can increase the firm's TE level. [39] suggests that firms can invest in R&D on product development as a long-term asset that can give positive returns to firms. Continuous research on the production of a product can stabilize and improve the efficiency of firms in the industry [40], [41] and [42] studies show that firms that promote development in product production can produce high quality and satisfy customers with the adequacy of the desired product specifications. R & D spending is indeed an effective measure to help provide positive efficiency in the manufacturing industry.

The sixth determinant factor is the capital-labor ratio. Through capital-labor ratio analysis, the amount of capital utilization per employee can be identified in the production process. The labor capital ratio is associated with high technology utilization whereby the higher the utilization ratio can improve product production efficiency [43]. [44] explains that capital-labor ratios need to be given priority in economic development where capital and labor capital utilization factors are crucial in finding good competitiveness in production and thus boosting the economic status of a country to a better. In addition, the difference between developed and developing countries comes from the ratio of labor-capital [45]. [46] discussed the increasing use of machines in the production process as a result of high capital utilization can have a positive impact on efficiency and increase production levels. Meanwhile, studies such as [43] proves that the capital-labor ratio can reduce the inefficiency of the technique thus increasing the efficiency of the firm. However, [47] and [30] found that labor-ratio factors have no significant relationship with the firm's technical competence. Total excess capacity in capital utilization has resulted in an increase in technical inefficiency and a decrease in efficiency in industry [48].

The seventh determinant factor is education level. Educational status is an important factor in determining a firm TE. Firms with many educated employees are better at maintaining and controlling existing technology and adopting modern or new technologies [49]. [50] notes that education is a very important factor in technology level to improve the efficiency of a firm. In fact, workers with high levels of education and skills gain high wages that can contribute to development, research and development and thus increase production efficiency [51].

3. Methodology

3.1 SFA Approach

The boundary approach used is Stochastic Frontier Analysis (SFA). SFA is a parametric method to estimate the firm's technical competency score or sector level by exploiting the tendency of error in production function specifications ([52]; [53]) This model was also proposed by [54] to obtain firm TE value. [54] proposed a model for technical inefficiencies in stochastic boundary production functions for panel data. Provided that the effect of inefficiency is stochastic, this model allows estimates of both technical changes in different stochastic boundaries and technical instability [55]. This SFA model is used to obtain strong TE value. Efficiency at firm level can be measured by estimating SFA production boundary model affected by sample achievement or best firm to demonstrate that technology changes are being used in the industry.

The stochastic boundary production model based on the Translog function is written as follows;

$$u_i = \delta_0 + \delta_1 \ln(W/L)_i + \delta_2 \ln(TRE)_i + \delta_3 \ln(ICT)_i + \delta_4 \ln(RND)_i + \delta_5 \ln(SD/L)_i + \delta_6 \ln(TR/L)_i + \delta_7 \ln(C/L)_i + \delta_8 (DFSME)_i \quad (2)$$

Where u_i is technical inefficiency, W/L_i represents the total wage rate for i-th firm, TRE_i represents the amount of employee training expenses for the i-th firm, ICT_i is the communication cost for the i-th firm, RND_i is the research & development cost for the i-th firm, SD/L_i represents the ratio of employees trained at diploma level and STPM or equivalent for the i-th firm, TR/L_i represents the ratio of employees trained at higher level including advanced degree or equivalent for the i-th firm, C/L_i is the total capital ratio divided by the number of employees for the i-th firm, and DFSME is the dummy for the i-th firm with small firms size represent 1 and others are considered 0.

3.2 Sources of Data

This study uses data on the level of beverage manufacturing industry obtained from IMS DOS. The firm's choice is provided by DOS based on the research needs and objectives of a dependent and independent variable. Selected data is randomized through ranking simulations including identifying larger firms, medium and small, total output, number of employees and capital used. Although the amount of data is only 30 percent, the results are efficient. Based on the original data provided by DOS, information filtering must be done because some less-needed firms such as capital and output value are unclear. The objective of the research is to measure the value of TE based on the data at the firm level using the computer software called FRONTIER 4.1.

3.3 Data Analysis

This study uses computer software programs namely FRONTIER 4.1 and Microsoft Office Excel 2016 to analyse data. The FRONTIER 4.1 software uses the Fortran77 programming language which is a software used specifically to estimate the production of stochastic boundaries. This program is used to calculate TE value estimates for firms obtained from the Translog approach. Microsoft Office Excel 2016 is used to help in analysing and calculating data to align with the format used in FRONTIER 4.1.

4. Results and Discussion

4.1 Descriptive Statistics

This study was conducted on 118 soft drink manufacturing firms in Malaysia in 2015. Table 1 displays descriptive statistics of the variables used for SFA estimation. The table exhibits the overall average amount of output produced the soft drink manufacturing firms which was RM70 million with a minimum of RM2 million to a maximum of RM1 billion. Intermediate input value is a major expense for soft drink manufacturing firms with the average spending of RM51 million between RM736,000 to RM1 billion. The second higher expense is capital which average at RM20 million between RM15,000 to RM382 million. In addition, the average number of employees employed was 96 people ranging from 4 to 1129 people. The study also found that the ratio between capital and labour in the soft drink manufacturing firms ranged from RM877 to RM2 million with an average of RM181,000. Furthermore, the soft drink manufacturing firms had spent an average of RM51,000, with expenditures ranging from RM0 to RM1 million, for the cost of employee training. Besides, the average ratio of employees with the highest qualification, including advanced degree or equivalent, was 0.073 ranging from 0.000 to 0.500. As for the ratio of employees having a diploma and Malaysian Higher School Certificate or equivalent, it shows an average range of 0.138, ranging from 0.000 to 0.670. Furthermore, the firms' employees average R&D in the year was RM289,000 ranging between RM0 to RM8 million. The average of wages in that year was RM28,000 ranging from RM12,000 to RM104,000. The firm had also spent an average of RM60,000 for ICT with minimum spending of RM50 and maximum Spending of RM1 million. Meanwhile, SME dummy showed that 90 percent of the firms involved in this study were small-sized and medium-sized firms. Standard deviation showed that the variance fell over the entire sample. The result also showed that there was too much dispersion in the soft drink manufacturing firms.

Table 1: Descriptive statistics of the variables

Variable		Mean	Minimum	Maximum	Standard Deviation
Y	(RM)	70320.78	2412.97	1525982.51	200803.983
K	(RM)	20470.89	15.48	382874.47	53393.833
L	Number	96.37	4	1129	147.441
II	(RM)	51859.94	736.69	1062940.1	150908.4636
K/L	Ratio	181.133	0.877	2691.497	365.809
TIER	Ratio	0.073	0.000	0.500	0.077
SED	Ratio	0.138	0.000	0.670	0.108
TRE	(RM)	51.25	0	1827.76	213.028
R&D	(RM)	289.38	0	8644.06	1142.280
W	(RM)	28.68	12.22	104.35	14.863
ICT	(RM)	60.65	0.05	1392.61	162.280
DFSME	Number	0.914	0	1	0.281

Notes: Y = output; K = capital; L = labour; K/L = ratio of capital labour; II = intermediate input value; TRE = employee training expenses; SED = ratio of employees trained at diploma level and Malaysian Higher School Certificate or equivalent; TIER = ratio of employees trained at a higher level including advanced degree or equivalent; W = wage rate; ICT = communication cost; R&D = research & development cost; DFSME = dummy for small medium firms size

4.2 Technical Efficiency Analysis

Table 2 displays the frequency and the index distribution of technical efficiency in the soft drink manufacturing firms in Malaysia in 2015. This finding describes the contribution of technical efficiency of a firm in soft drink manufacturing industry. The soft drink manufacturing industry consists of 118 firms.

If scrutinized closely, the frequency and index distribution of technical efficiency between 0.91 and 1.00 were the highest range of the overall industry, i.e. 61.02 percent, followed by index distribution of technical efficiency between 0.81 and 0.90 which was 32.20 percent. These results were driven by higher demand due to the rapid economic growth of between 0.8 percent to 6 percent per annum and increase in purchasing power. Thus, firms have increased the level of efficiency using modern technology and improving the skills of employees.

Table 2: Frequency and index distribution of technical efficiency based on industry of soft drink manufacturing firms in Malaysia

Percent	Firms	Technical Efficiency Range
≤ 0.20	0	0
0.21 - 0.30	0	0
0.31 - 0.40	0	0
0.41 - 0.50	0	0
0.51 - 0.60	0	0
0.61 - 0.70	1	0.847
0.71 - 0.80	7	5.932
0.81 - 0.90	38	32.203
0.91 - 100	72	61.017

4.3 Determinants of Technical Inefficiency

Table 3 illustrates the results of parameter estimator of stochastic frontier production model 2015 using FRONTIER 4.1, which was developed by [54]. The results of the analysis show that the most input parameter estimator in soft drink manufacturing industry is significant at 1 percent significant level. Each input can be explained by the significant output. When there was an increase of 1 percent in the number of labour, total output increased by 0.6 percent. At the same time, when there was an increase of 1 percent in the total input value of intermediate, the total output increased by 0.4 percent.

The gamma value based on the analysis conducted is 0.02. The significant technical inefficiencies had a significant impact on the level and production change of soft drink manufacturing firms in this study. Apart from that, parameter sigma-squared is also significant in implying that firms operated in an inefficient manner, and budgeting of stochastic frontier production model is better than the average production model in analysing industrial production processes.

Table 3. Parameter estimation of stochastic frontier production model

Variable	Coefficient	t-ratio
Constants β_0	2.065	2.854***
Ln Capital β_1	0.056	0.771
Ln Labour β_2	0.596	3.480***
Ln Intermediate Input β_3	0.412	2.569***
0.5(LnK*LnK) β_4	0.027	2.858***
0.5(LnL*LnL) β_5	0.194	4.541***
0.5(LnII*LnII) β_6	0.099	3.562***
LnK*LnL β_7	-0.026	-1.179
LnK*LnII β_8	-0.01	-0.877
LnL*LnII β_9	-0.112	-4.141
Sigma-Squared	0.033	7.426***
Gamma γ	0.02	4.054***
Log likelihood function	34.142	

Note: *, ** and *** significant at 10%, 5% and 1% levels respectively

Based on Table 4, several variables of technical inefficiency are significant except for employee training expenses, ratio of highly qualified employees, ratio of employees with secondary education, communication expenses and research & development expenses. The negative sign indicates that an increase in the variable will decrease the technical inefficiency while the positive sign indicates otherwise. Wage rates play a pivotal role with real coefficients of -0.104 and significant at 10 percent significance level. This shows that when employees' wages increase by 1 unit, the technical inefficiency will decrease at 0.10 points. This shows an increase in wages to employees can motivate employees to improve their productivity and ultimately increase the amount of production output at an optimal level. According to [56], [30] and [57], by minimizing the salary or wages to all employees can increase the work attitude as it fair for all workers to increase the productivity and efficiency. It shows that wage is important to reduce inefficiency in this industry. In fact, the level of technical efficiency of a firm will also increase. This can be attributed to [33], [57] and [58] where it says that an increase in wage increases can increase employee motivation to further increase productivity and efficiency.

However, the ratio of capital-labour indicates an increase in technical inefficiency. The result shows that when the ratio of capital-labour increases by 1 unit, the inefficiency will increase by 0.06 percent. This result is inconsistent with those from past studies which claimed that the ratio of capital-labour has a positive relationship with the determinants of efficiency and inefficiency, such as in [59] and [58] Besides, another significant that increase inefficiency was firms size which increase by 0.002 percent at 5 percent significant when 1 unit is increase. [38] stated that there is have positive and significant that appear at certain industry that will able effect on productivity and increase inefficiency. [30] noted that the reduction in capital and the increase in the number of labor could not impair the firm's productivity and thus increase inefficiencies.

Table 4. Determinants of technical inefficiency

Variable and parameter	Translog	t-value
Constants	0.094	-0.349
LnRatio of capital-labour	0.057	1.796*
LnEmployee training expenses	0.001	0.082
LnRatio of TIER	-0.089	-0.209
LnRatio of SED	-0.071	-0.321
LnWages	-0.104	-1.932*
LnICT	-0.01	-0.46
LnR&D	-0.015	-1.377
Dummy firms size	0.033	2.443**

5. Conclusion and Implications

This study aims to measure the level of efficiency and analyses the determinants of the technical inefficiency of soft drink manufacturing industry in Malaysia. The analysis was based on data gathered from the DOS comprises of 118 firms of soft drink manufacturing firms in Malaysia. The findings were obtained through function of translog production to investigate the efficiency level and determinants of firms' inefficiency. The level of technical efficiency of the soft drink manufacturing industry is at high efficient which is 0.92 range.

The following findings indicate that 118 firms participated in this study. The regression result reveals that determinants such as employees wage rates is significant in reducing firms' inefficiency. It shows that wages rates able to give the good impact in future in reducing the inefficiency at all firms. The firms are advised to enhance the rate of wage to make sure that employees may work efficiently in soft drink manufacturing industry. Meanwhile, the ratio of capital-labour and firm sizes was found to have a negative relationship since the result shows its increase causes firm inefficiency. The use of capital must be in line with the use of labour as it able to reduce the inefficiency in future. The capital must be under the number of labour as it can be saving the cost and able to use more workforce to improve productivity and efficiency. The firm sizes play an important role in soft drink production as it can recognise how much quantity of product able to produce every month at that year. The result of this research shows that small firms in this industry was most participated in soft drink ma manufacturing and it show the high efficiency in this industry. In conclusion, soft drink manufacturing firms in Malaysia should take initiatives to improve employees wage rates for the purposes of improving employees' productivity and motivation which will eventually increase the amount of production in the future. Besides, the firm size also has a negative relationship which is increase the inefficiency. The SME firms should be take attention by government by do some development and help in term of financial or investment to raise SME production and productivity growth.

The study, however, has a limitation. It is difficult to have access to firm's data. Most of the employers were reluctant to cooperate in answering the questionnaires submitted by the DOS. This has caused difficulties in obtaining extensive firm's data which is valuable for this study. Based on the limitations that have been encountered in this study's, the following are some recommendations for further research. First, increasing the number of existing firms to obtain the results of a more comprehensive technical competence. Second, additional variables that affect technical inefficiency can be investigated such as research and development, exports and imports. Third, a further research to identify and compare the results of using two different approaches in modelling the SFA and DEA (data envelopment analysis). The comparisons of the results can indicate whether there are differences or similarities in the obtained results.

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