

Structural Equation Modelling for Validating Disruptive Factors in Livestock Supply Chain

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Abstract—The purpose of this paper is to deploy a structural equation modeling approach through the Partial Small Square technique to validate the disruptions factors that affect livestock supply chain performance. The disruption prediction factors were obtained from the analysis of literature studies and data from the Department of Veterinary Services (DSV) and expert evaluation. Factors considered in the study model are Livestock Process, Finance, Breeders, Quality, Facilities, Technology, Demand, Supply, Information Communication, Sales, Transportation, Government Involvement, Disaster and Syariah Compliance. The results of the study found that the factors of Livestock Process, Finance, Breeders, Livestock Quality, Technology, Supply, Sales, Transportation, Government Involvement and Syariah Compliance were accepted as disruptions in the livestock supply chain. The findings of this study will assist farmers and livestock stakeholders to take necessary measures to minimise the disruption and further the government's goal of enlivening small and medium livestock enterprises in Malaysia.

Keywords—Supply chain management; disruption; livestock; structural equation modelling

I. INTRODUCTION

Livestock breeding is an agricultural activity that is one of the most important in the Malaysian agricultural industry [1]. According to United Nations [2], the importance of animal husbandry is seen as the “intensification of animal production as a way to ensure food supply”. The increasing demand for livestock meat supply in developing countries, including Malaysia, is driven by population growth, urbanization, industry, and increasing income. Households, the influx of foreign workers and an increase in the tourism industry [3]. Based on the Department of Statistics Malaysia (JPM), livestock in Malaysia contributed 14.9 percent to Gross Domestic Product (GDP) in 2018. This situation shows the livestock industry is one of the important sub-sectors in agricultural development in the country.

As reported by Institute of Supply Chain Management [4], a supply chain is defined as the smooth design of management, where the value-added process flows smoothly across organisational boundaries to fulfil the real needs of end customers. A supply chain, is an integration activity that occurs between one network and another to obtain raw materials,

transform raw materials into a semi-final product form, and finally become a final product, and then deliver the final product to customers through the distribution system [5].

Fig. 1 is the supply chain of the livestock industry as a whole. The livestock supply chain is generally the same for all livestock animals starting from the feed supplier to the end-user and through different livestock processes [6].

Breeding data is necessary to ensure that breeders have access to the most up-to-date information and can make informed decisions during the breeding process. Preliminary research indicated that farmers have no experience using information systems in livestock management, which is one of the types of disruption. The Department of Veterinary Services has built a system of information and technology exchange channels based on previous studies to ensure information is conveyed swiftly and accurately. Its purpose is to bridge the gap between officers and farmers in terms of communication. However, the study indicated that, with the exception of family support, social interactions, and internal drive, information and communication technology elements have no positive and substantial impact on farmer success [7]. The study also discovered that breeder information systems designed to aid livestock sector stakeholders were underutilized [8]. As a result, the Department of Veterinary Services (DSV) finds it difficult to get data on breeders and animals for data analysis, and the process of recording livestock reports cannot be implemented on time due to the difficulty in obtaining livestock data.

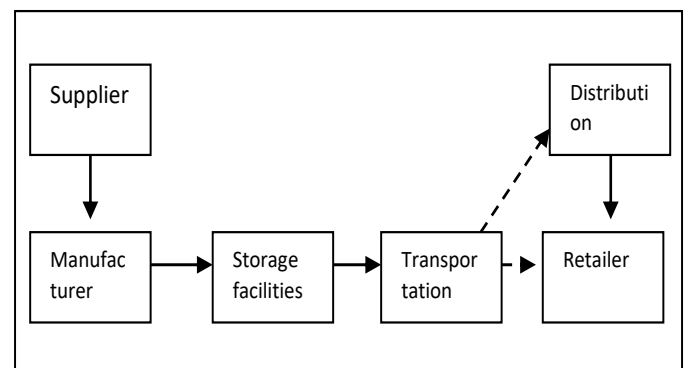


Fig. 1. Livestock Supply Chain.

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The livestock industry in Malaysia is currently experiencing difficulties and disruptions in managing farms in a systematic manner to produce large-scale meat supplies, particularly to meet the demand of local consumers. Due to poor breeding rates, the cattle industry is experiencing a livestock population shortfall. Unsuitable breeds, high feed costs, and a lack of grazing land all contribute to the disruption. The role of private-sector involvement is also limited due to low-profit returns in the livestock sector, and this has resulted in the involvement of SME breeders still at a moderate level.

In addition, livestock practitioners in Malaysia often experience technical problems such as livestock selection, livestock breed selection, selection and provision of good livestock feed as well as farm management in accordance with the standards set by the government. The situation of livestock practitioners who still breed traditionally leads to unforeseen organizational management problems such as issues of destruction of livestock, management of labour or contract workers, credit loans and repayment methods that cannot be well followed by breeders. The issue of lack of DSV officers in some farming areas is seen to affect efforts to guide and channel accurate, up-to-date and direct information to farmers. Non-compliance of officials involved in financial management as well as lack of skills training also resulted in losses and tarnished the image of the government.

The demand for livestock meat supply in Malaysia is constantly increasing from year to year but the supply of stocks is always insufficient causing Malaysia to rely on import sources. The findings found that in 2017, a total of 167,439.17 metric tons of large ruminant meat were imported into the country [9]. The year 2020 saw the global Covid-19 pandemic had disrupted most of the country's economic activities due to movement control measures, including import sources of meat supply. To address this disruption, DSV is implementing efforts by providing guidance and educational activities to farmers as an incentive to increase meat production. However, the country still imports meat supplies from abroad. Table I refers to the time series statistics of the number of ruminants and pigs issued by the Veterinary Department from 2016 to 2020 in Malaysia.

TABLE I. NUMBER OF LIVESTOCK STATISTICS

Types of Livestock	2016	2017	2018	2019	2020*
Buffalo	59,740	54,632	48,195	47,652	47,266
Cow	654,602	620,521	589,113	581,567	585,597
Goat	350,370	318,032	289,361	256,159	264,922
Sheep	134,057	126,161	122,205	117,921	117,526
Pig	1,370,763	1,412,737	1,448,122	1,468,788	1,463,000
Chicken	-	-	-	138,689,878	145,049,672
Duck	-	-	-	6,971,200	6,481,782

II. LITERATURE REVIEW

Every organization faces supply chain disruption at some point during the manufacturing process. The supply chain is a system consisting of organizations, human resources, technology, activities, information and resources involved in the activity of converting raw materials into finished products and delivered to consumers. Each supply chain activity has a different purpose. The supply chain in each organization is different and depends on the activities as well as the end product produced. Disruptions that occur in the supply chain complicate many parties including suppliers and end-users and expose various risks and disadvantages to all stakeholders in the supply chain [10].

In recent years, the supply chain process has become longer and more complex while the level and frequency of supply chain disruptions have shown an increase [11]. Disruption is defined as an event that disrupts the flow of material in the supply chain that causes the movement of goods to stop abruptly [12]. Disruption occurs due to several factors such as natural disasters, labour disputes, dependence on a single supplier, suppliers experiencing bankruptcy, violence, war and political instability. Transportation accidents, failure of public places and product failure and disruption of disasters after the occurrence of disasters such as haze, water crisis, forest fires and others. Particularly in Malaysia, natural disasters and extreme weather conditions are to some extent a threat to supply chain [13]. According to Pfohl, et al. [11], apart from natural disaster disruptions, other disruption factors identified are production machine failure, quality problems on final products, quality problems at the resource level, system failures, and problems from human resources, suppliers' delays, delays transportation and natural disasters themselves.

Each supply chain is exposed to its own dangers as a result of increased supply chain transit [14]. Each phase of the chain becomes more susceptible to different types of interference as the chain process becomes more efficient. Through the literature review, disruption caused by inefficiency in management, in turn, disrupts organisational activities as well as increases the cost of operating expenses and repairs [15]. A survey conducted on 559 companies representing 62 countries and 14 various the industry sector found that 85 per cent of the companies reported at least one supply chain disruption that occurred in the past 12 months [16]. While a recent study conducted in 2019 by the Business Continuity Institute reported despite the awareness of supply chain risk has increased, most companies remain at high risk of being exposed to disruptions. The study found that 74 per cent of respondents from a survey of 426 organisations had experienced at least one disruption in the supply chain of which 6 to 20 disruptions were reported each year, which is 50 per cent of companies, and experienced financial losses varying from 50 thousand to 500 million euros. While more than 23% of businesses reported losses of at least one million euros as a result of disruptions. Supply chain disruptions not only cause financial loss but potentially damage a company's brand or reputation as a result of third-party failures. According to the study, 27 per cent of businesses suffered a tarnished reputation, 58 per cent lost productivity, and 38 per cent lost

revenue. With a damaged reputation of 11.6 per cent, Asian countries are in fourth place [17].

There's no denying that the Covid-19 pandemic has shifted the country's economic landscape in unexpected ways. The livestock industry is no exception. The pandemic disruption that has hit the world presents a new form of challenge to farmers in Malaysia who are struggling to get the desired results. Farmers and livestock stakeholders face uncertain income and other disruptions in the supply chain and in turn expect assistance from the government for extensive assistance plans and long-term efforts to ensure the welfare of farmers is protected. The impact of the Covid 19 pandemic resulted in the distribution chain being affected due to the closure of operations, the absence of employees and declining cash reserves [18]. Physically disrupted supply chain disruptions have prompted entrepreneurs to take alternative measures by switching to online sales through social media including Facebook and WhatsApp, product delivery through private drivers and downsizing businesses to save operating costs [19].

Referring to the Table II are the sources of research findings past a discussion of the disruption factors identified in the supply chain.

TABLE II. FINDINGS OF POST DISRUPTION STUDIES IN THE SUPPLY CHAIN

Disruption Factors	References Study Findings
Production Facility Failure	[20] [21] [5] [21] [25] [26]
Quality Problems at The Resource Level	[21] [23] [24] [25] [20] [26] [27] [28]
Information Technology System Failure	[20] [21] [30] [29]
Human Resource Issues	[22] [30] [29] [27]
Distribution Network Discontinued	[22] [30] [29] [27]
Demand Fluctuations	[27] [25] [28]
Supplier Delay	[27] [28]
Bankrupt Supplier	[20] [5]
Top Suppliers Bankrupt Suppliers	[22] [30] [29] [27]
Transportation Breakoff	[21] [27] [30] [29] [27]
Port Party Strike	[22] [30] [29] [27]
Natural Disasters	[23] [22] [30] [29] [27]
Security Risk (Terrorist Threat)	[22] [30] [29] [27]
Communication Failure	[30] [29] [27] [22]
Political and Economic Instability	[21] [22] [24][77]
Regulatory and Legal Risks	[20] [25] [21] [23] [22][73]

The study also considered the SCOR Model and PESTLE analysis and the Behzad disruption framework to identify disruption factors according to the livestock industry.

1) *Model SCOR*: The SCOR model was developed in 1996 by Pittiglio Rabin Todd and McGrath and endorsed by

the Supply Chain Management Council as an industry-standard model in supply chain management [31]. Referring to Fig. 2, SCOR is process-oriented consisting of Plan (planning), Source (source), Make (manufacturing), Deliver (delivery) and Return (return) as in Fig. 2. This process encompasses the entire supply chain process from the point of view of suppliers, organizations and customers. The organizations involved are internal and external organizations.

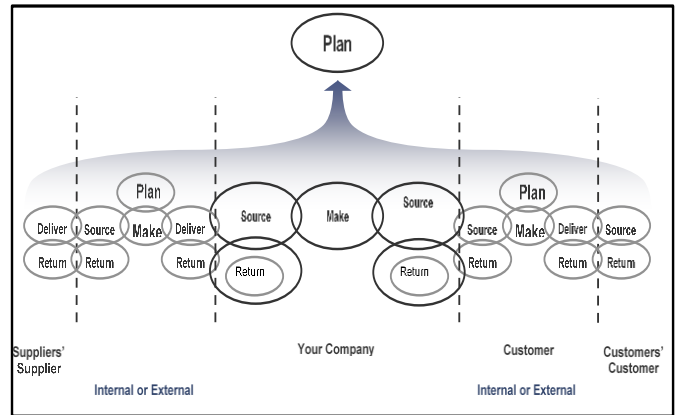


Fig. 2. SCOR Model.

2) *PESTLE Analysis*: There are six factors in the PESTLE framework. The factors are political, economic, social, technology, legal and environmental. PESTLE analysis is a method of analyzing the external environment to identify factors that contribute to the success or failure of an organization or industry. PESTLE analysis has a different structure from previous studies such as PEST and STEPE [32].

- **Political factors**: Politics plays an important role in business. In the livestock industry, politics plays a role in the effort to grow the industry through government involvement in assisting farmers by aiding further expand the livestock industry. For example, assistance from Majlis Amanah Rakyat to invest in industrial and commercial programs in the agriculture and food-based livestock sector is seriously and comprehensively needed to ensure that farmers rise up in the supply chain as well as increase the participation of Muslims in controlling the country's food supply meat industry.
- **Economic Factors**: Economic factors are measuring measures that are used to assess an organization's financial success. It is common that economic conditions often change over the life of an organization through comparisons of current levels of inflation, unemployment, economic growth and international trade. In the breeding process, financial difficulties are a huge and crucial issue. Farmers frequently complain about a lack of capital, which prevents them from increasing the number of farm animals. Only enough profit is made to be used as working capital.

- **Social Factors:** In a given situation or problem, social factors are used to assess the mentality of an individual or user. Demographic variables are also known as social factors. Indicators of social measurements are such as age distribution, population growth rate, employment level, income statistics, education level, religion, culture and social interaction. Apart from the aforementioned factors, the measurement of social factors also takes into account health and environmental concerns. At both the national and global levels, a variety of social and communication factors play a critical role. Among the several social sub-factors that can be considered to determine the measurement of social performance for an organization are social mobility, ethics and religion, lifestyle, level of education, historical issues, identity and beliefs, demographics and two-way cultural communication. The breeding process is influenced by the involvement of breeders who are 45 years old and older on average. The level of acceptance and openness in the breeding process makes the breeding field either a failure or a success and it results in a loss of cost and no return on capital that has been issued or vice versa. Similarly, the level of low or higher education among farmers affects the level of knowledge of the latest technology, and this can result in a lack of production of livestock products in the country or vice versa.
 - **Technology Factors:** When it comes to accurately assessing organisational performance, technology plays a big role. Technology advancements can improve internal efficiencies and prevent products or services from becoming obsolete. Every year the role of technology in the industry is increasing and technology in every chain is increasingly required to keep the process running effectively. Barn housing technology is one of the innovations that have been introduced into the livestock process [33]. Among other findings, livestock owners at present do not have to worry about the health of livestock because there is livestock automation technology based on the Internet of Things (IoT) that can monitor livestock remotely using drones and wireless network technology and able to collect data from sensors installed on livestock as well as water quality sensors in several water sources around livestock areas [34]. Among the technology sub-factors that can be considered to determine the measurement of technology performance for an organization are an information management system, quality and price, information change rate, minimize information retrieval problems, intellectual property, outsourcing, network coverage, patents and licenses, research and development, production efficiency and government legislative activities.
 - **Environmental Factors:** Environmental factors today are often seen as a threat to the environment. The livestock industry is no exception to environmental issues. Livestock activities, especially cattle breeding is carried out on the oil palm and rubber plantation lands that offer the potential to be cultivated in an integrated manner [9]. However, there are cases of livestock deaths recorded due to wild animal attacks, poisoning, negligence and deaths due to floods as well as accidents.
 - **Legal Factors:** The legal element is the final component of the PESTLE analysis. In this factor, the knowledge of laws and regulations needs to be known and learned importantly to prevent the occurrence of unnecessary legal costs. In carrying out livestock practices, there are guidelines that need to be followed through the Livestock Farm Practice Scheme to ensure good livestock practices to ensure the production of quality livestock and safe to eat. Good Livestock Practices (GAHP) MS 2027: 2006 includes livestock health management programs, biosecurity programs, sanitary and phytosanitary programs and farm waste and pollution management programs [9]. These farming practices cover all types of ruminant and non-ruminant livestock.
- Finally, PESTLE analysis is utilised to evaluate external factors that have an impact on an industry. The PESTLE analysis is an excellent starting point for developing the study framework [35]. Organizational owners need to identify the risks to be faced and use all of these factors and knowledge to make decisions to improve organisational performance. PESTLE can comprehensively understand the environmental picture of an organisation and can maximise opportunities as well as reduce the threat of disruption to the organisation [36].
- Political factors can determine how the direction of political parties affects business development and growth in animal husbandry. Economic factors are used to assess the impact of interest rates, taxes, stock markets, consumer confidence and other economic metrics. Breeders and livestock stakeholders need to be more competitive in line with current changes to withstand the challenges of lifting the livestock industry towards high-income economic transformation. Social factors affect lifestyle changes, advertising targets, ethics, demographics and culture. Technology factors are seen to help industry performance and ensure organizations use the latest technology in business. New high-tech approaches in the production of the livestock industry can help double the revenue from the livestock industry. Legal factors are expected to help regulate new laws and regulations that affect the operation of the industry and environmental factors can identify accidents and weaknesses that occur as well as solutions that can be considered, especially in the livestock industry.

3) *Behzad disruption framework*: Referring to Table III, the Behzad disruption framework is divided into three parts namely the organizational level, the network level consisting of demand, supply and transport and the environment level.

At the organizational level, there are several disorders identified like production machine failure, the occurrence of quality problems on the final product, the failure of information technology systems and the occurrence of problems from human resources due to the strike. While environmental disruptions are broken down into demand, supply, and transportation sub-factors. At the network level, disruptions at the demand level stem from the distribution network being stalled in the chain due to disruptions occurring in one of the chains and demand fluctuations in livestock supply. Disruption at the supply level is due to quality problems at the source level and the occurrence of some problems from the suppliers like delays and suppliers who suddenly experience losses (bankruptcy). Disruptions at the transportation level were identified as being caused by suppliers experiencing bankruptcy situations, transportation delays and strikes from employees. Meanwhile, disruption at the environmental level is caused by natural disasters, security risks like threats from terrorists, communication failures between several chains, political and economic instability and regulatory and legal risks. Findings from the study of [11] also found disruption factors also stem from natural disasters, security risks such as terrorist threats, the occurrence of communication failures between several chains, political and economic instability and regulatory and legal risks occurring at the chain network-level causing chain movements to pause.

TABLE III. BEHZAD FRAMEWORK

	Disruption Factors	
Organizational Level		Production machine failure
		Quality problems with the final product
		Information technology system failure
		Problems from human resources (strike)
Network Level	Demand	Network distribution disruption
		Demand fluctuates
	Supply	Quality problems at the resource level
		Supplier delays
		Supplier incurs losses (bankruptcy)
	Transportation	Bankruptcy of third-party logistics
		Transportation delays
		Strike
Environmental Level		Natural disaster
		Security risk (terrorist threat)
		Communication failure between several chains
		Political and economic instability
		Regulatory and legal risks

In total, this study presents 18 constructs of livestock disruption in the first circulation as in Table IV.

TABLE IV. LIST OF LIVESTOCK DISRUPTION CONSTRUCTS

No.		Factors	References
1	Organizational Level	Operating Process (Management)	[31][32] [37]
2		ICT Management Failure	[32][71]
3		Information Communication Disruption	[11] [38]
4		Livestock Process	[9] [39] [40] 41] [42] [43]
5		Problems of human development (Breeders)	[31][11][72]
6		Farm worker	[38] [9] [11] [39] [41] [42] [43]
7		Quality	[11][38]
8	Network Level	Supplies	[31][32][38]
9		Sales	[32]
10		Financial Assistance (External)	[11][37]
11		Finance (Internal)	[11][37][71][75]
12		Facilities (Facilities)	[31] [9] [42] [43]
13		Request	[11][72]
14	Environmental Level	Transportation	[11][37][38][31]
15		Flexible	[9][44] [46] [11] [45]
16		Natural disaster	[11][38]
17		Government Involvement	[32][38][76]
18		Security	[11][38][37]

III. METHODOLOGY

This study adopts the study design proposed by Marakas [47]. The research methodology includes six main phases namely the problem analysis phase, the initial study phase, the model development phase, the instrument development phase, the model validation phase and lastly the model feasibility phase. The evaluation in each phase is using the Mini Delphi method for the rounds that are required as in the Model Development Phase. Conforming to the Reffi et al. [73] Mini Delphi is a technique that uses a discussion-based approach between moderators and involved experts. This study used a four-round Mini Delphi approach formally through face-to-face and email methods. In accord with Azizah et al. [74] panel responses were analyzed to identify the mean value for each construct.

The first phase of our research was to identify concerns and questions. Then the objective of the study was identified based on the issues and questions of the study, background and previous studies. This step of research results in a conceptual disruptor. The second phase includes a survey questionnaire as well as interviews with experts and stakeholders. Other factors

that lead to disruption other than those listed in the literature review are identified at this stage. Third phase: Assessment and selection of disruptive variables using a checklist tool. Data gathering based on the specified questionnaire in the fourth step. Model validation based on statistical analysis is the fifth phase. The Partial Small Square method was used to assess validation using the Structured Equation Modelling approach. The sixth phase entails creating a prototype of an information system based on the validated model.

IV. ANALYSIS

The data was analyzed using the Structured Equation Modelling (SEM) through Partial Least Squares Method. Structural Equation Modelling is a second-generation data multivariate analysis method used to test linear theory and causal augmentation models [48],[49],[50]. Analysis through Partial Least Squares Method approach was implemented through two levels of analysis. The first step involves examining the validity and reliability of the measurement model while the second step involves the evaluation and interpretation of the structural (theoretical) model [51]. The following is an explanation related to the analysis.

A. Convergence Validity

Convergent validity is defined as the degree to which some indicator can measure a given concept [50]. [52] proposed several criteria to measure the validity of convergence, which are factor loading, Cronbach Alpha (CA), Composite Reliability (CR) and Mean Variable Extraction (AVE). He also suggested that the load factor of the items should be greater than 0.7. The second criterion for convergent validity to convergence is composite reliability which refers to the degree to which a set of items consistently measures latent variables [52].

Through analysis, the Cronbach Alpha value and composite reliability were checked. The Cronbach Alpha value ranged from 0.8 to 0.873 while the composite reliability ranged from 0.873 to 0.902, which is significantly higher than the recommended level of 0.7 [53],[52]. Therefore, this result confirms that the validity of the convergent model has been tested. In addition, the average variance extracted (AVE) values were corrected to confirm the convergent validity of the external model. AVE is the mean-variance taken from several items related to the variance shared by the measurement error. In other words, AVE measures the variance shared by the metrics against the measurement error. If the AVE value is at least 0.5, then a latent variable can be inferred [52]. In this study, the AVE values ranged from 0.511 to 0.728, indicating that the study design constructs were validated [52].

B. Discriminant Validity

Discriminant validity has been used to measure the extent to which the constructs in the model differ from one another [50]. This validity is important because it ensures that the constructs in the model are unique and do not have high affinity for each other. In other words, items that measure the proposed construction should have high load, while items that do not measure the proposed construction will have low load. In the study, the validity of discrimination was measured using three criteria: Fornell Lacker, Cross Loading and HTMT.

1) *Fornell lacker*: The result of the square root of the AVE for the model's structures is placed on the diagonal of the correlation matrix. The model will be declared discriminant if the value of the square root AVE of each structure is greater than the elements in the column and row of each structure. The results of the study showed that the validity of the discriminant was confirmed because the squared value of AVE for each structure was greater than the mutual correlation of the columns and rows of the structure.

2) *Cross loading*: Cross-loading is the second approach to measuring the validity of discrimination. In this method items that are matched to the proposed constructs will have a high factor load while items matched to the proposed constructs will have a low load.

3) *Heteroit Monotrait (HTMT)*: Heterotope-monomer correlation ratio (HTMT) was used to assess the validity of the discrimination considered to be more accurate than other methods [54]. HTMT is recommended because it achieves higher specificity and sensitivity compared to cross criteria. An HTMT value close to 1 indicates invalid discrimination. Some authors recommend a cutoff of 0.85 [55], while others suggest a value of 0.90 [56]. If the value of HTMT is greater than this threshold, then selectivity is not valid. Result shows the HTMT clearly indicating that the HTMT value is less than 0.90 and further validates the validity of the discrimination.

C. Structural Model Assessment

Structural Model Evaluation will be carried out once the validation model has been validated. Generally, there are several approaches to measuring the structural model of multicollinearity, R-square, relevant and predictive coefficient routes.

1) *Multicollinearity*: Multicollinearity exists when two or more exogenous variables have a very high correlation [57]. It shows that some exogenous variables can be explained by other exogenous variables. Multicollinearity may result in inflationary problems of standard regression coefficients, which results in significant reduction in inflation [58]. Multicollinearity is said to occur when the correlation coefficient value is greater than 0.90 [52]. Additionally, collinearity issues can also be examined with reference to VIF values and tolerance. The author in [59] states that the VIF value should not exceed 5 to confirm that the structural model has no multicollinearity problem. The Fig. 3 shows the results of the alignment statistic (inner VIF) for each element. Each factor falls within the mean value from 1.102 to 2.812, which is within an acceptable range of less than 5.

2) *R-Square*: R-square is a measure of the predictive accuracy of a model and it is also considered as the combined effect of exogenous variables on endogenousness [60]. In other words, R-square provides the number of variants of endogenous variables that can be described by endogenous variables. In the PLS-SEM model, the R-square coefficient values of 0.67, 0.33 and 0.19 are classified according to three force levels, respectively, as medium and low [61]. According

to Henseler et al. [62], when structural models are explained by one or two modest exogenous variables, the R-square value is acceptable, and if the endogenous latent variables depend on some exogenous variable, the value of R-square is acceptable. The Fig. 4 shows the R-square value has significant level.

3) *F Square*: The F-square assesses the relative impact of each predictor construct on endogenous constructs [63]. Specifically, it measures the strength of an exogenous variable that impacts the endogenous variable in the R-square. According to the guidelines developed by [64], F-square values 0.02, 0.15 and 0.35 are considered as small, medium and strong [65]. The Fig. 5 shows the effect of the size of each exogenous variable on the endogenous variable.

Factor	Disruption
Transport	1.429
Supply	2.812
Disaster	1.889
Sales	1.701
Infrastructure	1.157
Government	1.991
Financial	1.902
Communication	1.932
Quality	1.559
Breeder	1.927
Demand	2.749
Livestock process	1.579
Syariah	1.102
Technology	2.179

Fig. 3. Multicollinearity.

Construct	R Square	R Square Adjusted
Disruption	0.795	0.785

Fig. 4. R-square Test Results.

Factor	Disruption
Transport	0.027
Supply	0.088
Disaster	0.001
Sales	0.017
Infrastructure	0.007
Government	0.069
Financial	0.045
Communication	0.035
Quality	0.038
Breeder	0.067
Demand	0.022
Livestock process	0.098
Syariah	0.03
Technology	0.228

Fig. 5. F-Square Test Results.

4) *Predictive relevance or blindfolding*: Q-Square analysis was performed to measure the relevance of exogenous constructs in predicting endogenous constructs [66],[67],[50]. When the Q-square value is higher than zero, this means that the model has a prediction relation, and if the value is zero and below, it indicates a lack of predicted prediction [68]. Based on result, the value of Q2 obtained by 0.415 is greater than the value of 0 which means that some exogenous variables can predict endogenous variables.

5) *Route coefficient*: Route coefficient is the standard version of the linear regression used to assess whether the proposed hypothesis is statistically significant or not significant. Each hypothesis proposed by the model is determined whether it is significant by means of path coefficient analysis. PLS-SEM uses a 5000-sample bootstrapping approach for hypothesis testing. A 95% confidence level with alpha 0.05 was used for hypothesis testing. The hypotheses show that a p value less than 0.05 is significant while a p value greater than 0.05 is not significant.

The Table V analysis results showed that 10 out of 14 hypotheses showed a significant value of $p < 0.05$. Significant results mean that there is significant impact of exogenous constructs on endogenous constructs.

TABLE V. HYPOTHESIS RESULTS

Hypotheses	Relation	O. S.	S. M.	S. D.	Nilai t	p values
H ₁	Trasport -> Disruption	0.089	0.087	0.031	2.892	0.0040
H ₂	Supply -> Disruption	0.225	0.228	0.059	3.833	0.0000
H ₃	Disaster -> Disruption	0.021	0.024	0.039	0.538	0.5910
H ₄	Sales -> Disruption	0.077	0.075	0.038	2.01	0.0450
H ₅	Infrastructure -> Disruption	-0.04	0.039	0.025	1.607	0.1090
H ₆	Government-> Disruption	0.167	0.164	0.039	4.242	0.0000
H ₇	Financial -> Disruption	0.132	0.13	0.037	3.603	0.0000
H ₈	Communication -> Disruption	0.006	0.006	0.039	0.152	0.8790
H ₉	Quality -> Disruption	0.107	0.108	0.035	3.02	0.0030
H ₁₀	Breeder -> Disruption	0.122	0.12	0.036	3.418	0.0010
H ₁₁	Demand -> Disruption	0.006	0.008	0.046	0.126	0.9000
H ₁₂	Livestock process -> Disruption	0.147	0.148	0.035	4.201	0.0000
H ₁₃	Syariah -> Disruption	0.071	0.073	0.029	2.431	0.0150
H ₁₄	Technology -> Disruption	0.21	0.207	0.048	4.384	0.0000
<i>OS=Original Sample/SM=Sample Mean/SD=Standard Deviation</i>						

Thus, the ten constructs accepted in this study explain the disruptions in the livestock supply chain that occur and impact the livestock sector. The construct of this disruption needs to be emphasized so that the competitiveness and sustainability of the livestock sector can be enhanced from time to time.

V. CONCLUSION

Positive results are presented for H1, H2, H4, H6, H7, H9, H10, H12, H13 and H14 where the constructs of transport, supply, sales, government involvement, finance, quality, livestock, livestock processes, syariah and technology have a strong relationship positive to the disorder. The results obtained are in line with the disorder statement presented by Behzad [11] and Park et al. [69] which is found that disruptions factor consist of internal, external, supplier and end-user interference. The results of hypotheses H1, H2, H4, H6, H7, H9, H10, H12, H13 and H14 indicate disruptions occur and are accepted at the levels described by Park et al. [69]. This statement is also expressed by Gunasekaran et al. [38].

Meanwhile for H3, H5, H8 and H11 where the construct of disaster, facilities, communication and demand, the p value > 0.05. This indicates the construct did not have an impact as a disruption in the study. This result contradicts the Martha [12] statement that disruption can be caused by natural disasters, labour disputes, dependence on a sole supplier, suppliers experiencing bankruptcy situations, violence, war and political instability. Similarly, according to Fu et al. [70], communication in the supply chain is the latest advancement in information technology and scientific management that allows most industries to obtain and share information but communication is rejected as a distraction in this analysis. The demand construct was also rejected as a disruption in this study. The results of the demand hypothesis show that the supply-demand whether high or low has no role as a disruption although the study shows that the demand for livestock meat supply in Malaysia is constantly increasing from year to year and still unable meet the demand. This is because Malaysia has the option of relying on imported goods [9].

The future studies consider increasing the number of respondents, respondents with breeder status as well as expanding the sampling of the study to produce more accurate and comprehensive analytical results. In keeping with the next studies also need to consider external constructs like livestock management skills, livestock management experience, current planning and economics, social relationships, networking and marketing as well to be evaluated and given due attention in the livestock disruption model.

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