A conceptual framework for after-sales service risk reduction of Chinese agricultural machinery in South Africa

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Abstract After-sales service (ASS) plays a significant role following the agricultural machinery being sold. With the development of trade and economic exchange between South Africa and China. Chinese agricultural machinery has increasingly sold to South African and Africa. After-sales service becomes crucial important to maintenance the machinery. Results found that the people whose age was between 30 and 49 that much involved in the research findings. Comparison between South African and China found to be more males participate (79.2%) in China, and more females (29.2%) in South Africa. It found that South African female engaged more than Chinese females. The staff and directors made up the majority of participants, where staff and directors accounted for 54.2% in South Africa and 70.9% from China's side. The percentage on the degree of high school level of Chinese interviewees showed the highest among these five items, which were 50% compared to the highest degree of South African participants at the college level (37.5%). There was no interviewer who earned a major in engineering in South African-involved in this study and there was an endeavor to employ more engineers in South Africa. The highest point was the value of spare parts factor from the perspective of South African participants, followed by the factors repairing, maintenance, technician and training. The focus group was concerned with the other factors that impacted on the ASS of AM. The focus-group in China showed that except for the factors that influenced the ASS of AM, Sanbao; three Guarantees: repair, replacement and return, and customer's satisfaction played a significant role in the process of ASS of AM. With this, the factors included the revisiting, maintenance, technology assistance, tracking service and customer's satisfaction. The focus-group in South Africa found that after-sales service was faced a crucial effect to ASS of AM.

Keywords: After-sales service, Agricultural machinery, Factor, Risk

Introduction

Qin *et al.* (2019) pointed out that Africa had large arable land throughout the continent, but the agricultural mechanisation of Africa was the lowest in power usage and level of agricultural machinery, compared with Asia and Latin

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America. As the gateway of Africa for South Africa, its agriculture influenced, to a large extent, the whole continent in an extraordinary manner. According to the Forum on China-Africa Cooperation (2018a) and Xinhua (2018), since establishing diplomatic relations in 1998 between South Africa and China, the bilateral relationship had developed comprehensively and rapidly. China had become South African largest trading partner in terms of export market as well as the source of import for eight consecutive years (Ministry of Foreign Affairs of the People's Republic of China, 2018). The collaboration pertaining to agriculture was placed as a prominent and primary position for both countries. Moreover, Chinese President Xi Jinping had visited South Africa three times since he took office and brought around $14 billion to SA for the third time in 2018, including agriculture, which is very significant (Forum on China-Africa Cooperation, 2018b). With the development of trade and economic exchange between South Africa and China, more and more Chinese agricultural machinery has been sold in SA (South Africa) for more than three decades, according to Yituo (Zhang, 2009), Levol (Huo, 2020) and Xintenwei (Tao and Liu, 2013) and so on. Compared to the US, EU and UK agricultural machinery, which is modern, high-technology, expensive and very-developed, Chinese ones are focusing on low-price and dominate in small- and medium marketing of agricultural machinery in South Africa.

One of the main problems for farm machinery is after-sales service (Qin *et al.*, 2021), which is important to Agricultural mechanisation that can reduce hard and physical labour, relieve labour shortages, improve farm labour productivity, increase productivity and timeliness of agricultural operations, enhance the efficient use of resources, ameliorate market access and contribute to mitigating climate-related hazards (Zhou, 2016; Kirui and Braun, 2018). Chinese agricultural machinery in South Africa has faced a problem with after-sales service (Qin *et al.*, 2020b and Qin *et al.*, 2021), which worse more than other AM from different countries. It is helpful and useful if the problem of after-sales service is met by means of identifying the factors that influence after-sales service of AM (agricultural machinery) in South Africa via establishing the conceptual model and analyzing the collected-data via questionnaire and focus-group discussion.

After-sales service of agricultural machinery is necessary for farmers who conduct an operation in the field for grain, vegetables and other agricultural products. There are many researchers whose research is concerning agricultural mechanization in Africa (Sims and Kienzle, 2016; Sims and Kienzle, 2017; Mrema *et al.*, 2018; Kirui and Braun, 2018; Kirui, 2019).

Nevertheless, there are few scholars focusing on after-sales service of farm machinery, which can reduce repetitive work and increase productivity

and timeliness of agricultural operations. It is significant to establish the factors that impact the risk of ASS of agricultural machinery and set up a model or framework regarding risk reduction of ASS of agricultural machinery. This research is concentrating on establishing the framework by means of a literature review and explanatory method.

This study aimed to facilitate a conceptual framework of risk reduction of after-sales service on Chinese agricultural machinery in South Africa.

Materials and methods

Literature review and an exploratory/descriptive approach of research have been adopted for a literature review of academic resources in this research finding on the after-sales service of agricultural machinery, mainly focusing on China's agricultural equipment in South Africa.

The six factors that impact the after-sales service on agricultural machinery are summarized by Qin *et al.* (2019) which consisted of the technician, spare part, timing repairing, maintenance, training, as well as a customer information system and service centre as shown in Table 1.

Table 1. Factors that influence the after-sales service of agricultural machinery (Qin e*t al.*, 2019)

Item	The factors that influence the after-sales service of agricultural machinery
B-1	Technician
B-2	Spare parts
B-3	Timing repairing
B-4	Maintenance
B-5	Training course
B-6	Farm machinery user database or information management system and service centre

By means of literature review and an exploratory method, firstly, the factors with after-sales and agricultural machinery as the keywords are identified. Secondly, the most important factors that affect after-sales service on agricultural machinery are identified from the peer-reviewed journal papers. This is followed by extracting the relevant views or opinions related to the distinct factors affecting after-sales. Finally, a potential conceptual framework on risk reduction of after-sales service is drawn for the upcoming data

collection and analysis. The basis of this framework is the identified literature combined with the initial elements of a design science research approach (Venable *et al.*, 2016).

Research design

The study was applied a concurrent mixed-method design (Halcomb & Hickman, 2015) to collect both quantitative and qualitative data at the same time. The research method was collected the data from quantitative and qualitative processes which analyzed in the same period to be consistent and validated. In the quantitative process, the relevant participants were divided into four groups, in which there were six contributors. They completed the close-ended questionnaire before focusing on group discussion of other factors that influenced agricultural machinery's after-sales service. In the qualitative design, the focus group interview was conducted with each group by the presider to discuss and get the result of other factors impacting the after-sales service of farm equipment. This type of activity was conducted in South Africa and China, respectively.

The questionnaires were collected from the relevant personnel at the two distinct stages of quantitative and qualitative data gathering. The collected data were analyzed quantitative and qualitative data. Each group was expected to develop the factors that impacted the after-sales service of farm equipment thereof. Each group submitted their decisions and results to the presider. The resolutions, and the results were used to provide more explanation on the factors that were evaluated by way of statistical technology as part of a quantitative approach (Saunders *et al.*, 2016).

Research population and sample strategy

The population was an aggregate or totality of all the objects, subjects or members that conformed to a set of specification and the target population which were followed Polit & Hungler and Mugenda & Mugenda (cited by Warsame, 2016). The research population included staff, workers, managers, directors, CEOs working in the agricultural machinery enterprises, farmers and users who used the farm machinery in China and South Africa.

Data collecting from samples were represented the entire population. The sampling techniques were divided into two types, namely probability samples (including simple random, systematic, stratified random and cluster samples) and non-probability samples (quota sampling, purposive sampling, snowball,

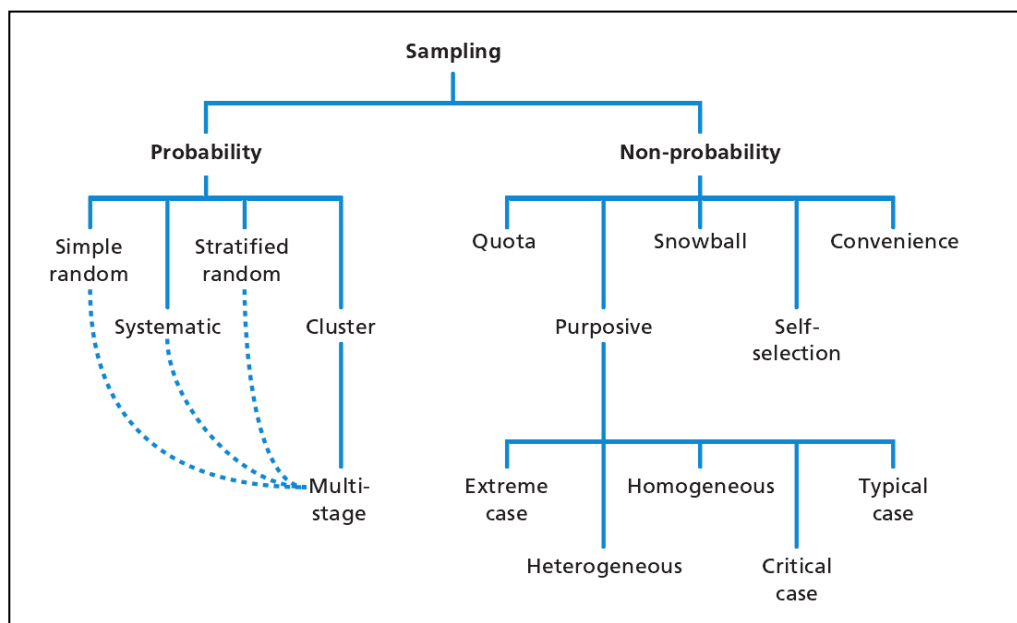self-selection sampling as well as convenience sampling) as illustrated in Figure 1 (Saunders *et al.*, 2016).

Figure 1. Sampling techniques (Saunders *et al.*, 2016)

The probability sampling was used and a simple randomized probability sampling strategies were employed to devise sampling to represent the sample population. The samples consisted of the population from staff, works, directors, managers, CEOs, and presidents who had worked at agricultural machinery enterprises and small-holder farmers or users using the farm machinery in both South Africa and China. The samples were randomly chosen at the first stage from the population mentioned above, followed by group discussion which formulated by means of employing the principles of non-probability sampling techniques such as snowball and purposive sampling.

The samples from both the South African side (24 valid collected questionnaires from 4 groups) and the Chinese side (24 valid collected questionnaires from 4 groups) were mainly collected the data. The total number of participants was 48. Moreover, we identified the first six participants via the simple random method. Furthermore, the sampling method of snowball and purposive sampling were employed to collect the left questionnaires and undertake the focus group discussion.

Research participants

The interviewed group consisted of 48 valid participants including the relevant personnel from agricultural machinery enterprises, sales facilities, after-sales centre, repairing shops and households of small-holder farmers who were using agricultural machinery in both China and South Africa.

Data collection method

Data collection methods were used the primary and secondary data through observation by using semi-structured, in-depth and group interviews, and questionnaires according to Saunders *et al.* (2016). The data collection was completed by using both quantitative and qualitative research methods and focus group interviews were conducted in four South African groups and other four Chinese groups. Each group had six relevant participants. There were two stages in the same procedure for each group. In the first part, the participants were completed the close-ended questionnaire to gather the quantitative data. At the second stage, focus group discussion was collected the qualitative data on other factors influencing the after-sales service of agricultural machinery, except for the factors found in the literature review cited. The deliberations and the objectives of the focus group interview were used to complement the information of the quantitative data to provide more explanation of quantitative data as well as verify those results. The four focus groups in China are named as C1, C2, C3 and C4 (in which C represents the Chinese focus group), comparing them to the groups from South African labelled as SA1, SA2, SA3 and SA4 (in which SA means South African focus group) respectively.

Data analysis method

The descriptive analysis was evaluated the characteristics of a population in the samples that essentially summarized the research data (Christensen *et al.*, 2015). The analysis included the means, standard deviation, percentages and frequencies of primary data.

Furthermore, there were several statistical methods and software were conducted to examine the empirically factors that affected the after-sales service of agricultural machinery as illustrated in Figure 2.
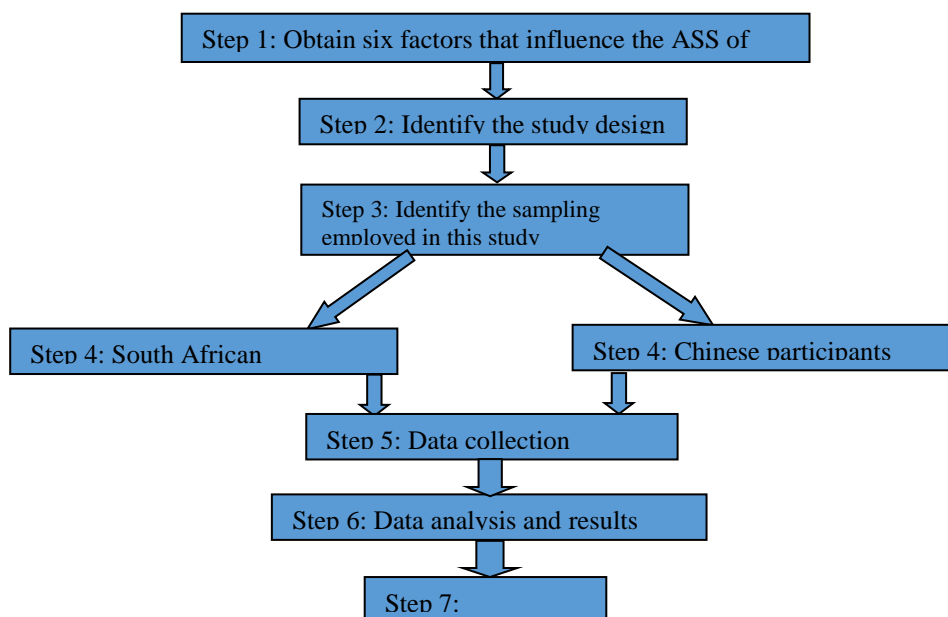
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            │ Step 2: Identify the study design │
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│ Step 4: South African   │   │ Step 4: Chinese participants │
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Figure 2. Research design and methodological layout

Results

The demographic profiles of the study showed that the participants included six items, which were age, gender, position in the company, degree of education, educational background or major, as well as working years. Four groups had six participants each, and the total was 48 participants who involved in this research from both China and South African sides. The age and working years had five and four scale variables, respectively. Gender is measured by frequency and percentage and consisted of two categorical variables, which were male and female. Position, degree of education and major were measured in terms of six, five and six nominal categorical variables gauged in percentages and frequency.

Result illustrated the essential characteristics of participants involved in this study is shown in Table 2. It showed that the majority of participants' age was 30-39 (33.3%) and 40-19 (33.3%) from China's side, comparing 30-39 (58.3%) from the South African side. The age of more than 50 years old in South Africa was lower than in China. The results found that the people whose age was between 30 and 49 that much involved in the research findings. Comparison between South African and China found to be more males participate (79.2%) in China, and more females (29.2%) in South Africa joined in this topic. It resulted that South African female engaged more than Chinese females. The analyzed data showed that staff and directors made up the

majority of participants, where staff and directors accounted for 54.2% in South Africa and 70.9% from China's side. Moreover, from the same outcome, the percentage on the degree of high school level of Chinese interviewees showed the highest among these five items, which were 50% compared to the highest degree of South African participants at the college level (37.5%).

Table 2. Descriptive analysis of the participants

		China				South Africa	
Description		Frequency	Per cent	Description		Frequency	Per cent
Age	20-29	5	20.8	*Age*	20-29	3	12.5
	30-39	8	33.3		30-39	14	58.3
	40-49	8	33.3		40-49	6	25.0
	≥ 50	3	12.5		≥ 50	1	4.2
	Total	24	100.0		Total	24	100.0
Gender	Male	19	79.2	*Gender*	Male	17	70.8
	Female	5	20.8		Female	7	29.2
	Total	24	100.0		Total	24	100.0
Position	CEO	1	4.2	*Position*	CEO	1	4.2
	Manager	4	16.7		Manager	2	8.3
	Director	7	29.2		Director	6	25.0
	Staff	10	41.7		Staff	7	29.2
	Farmer	3	12.5		Farmer	4	16.7
	Total	24	100.0		Others	4	16.7
Degree	High school	12	50.0	*Degree*	High school	6	25.0
	College	6	25.0		College	9	37.5
	Bachelor	4	16.7		Bachelor	4	16.7
	Postgraduate	1	4.2		Postgraduate	1	4.2
	Others	1	4.2		Others	4	16.7
	Total	24	100.0		Total	24	100.0
Major	Agriculture	7	29.2	*Major*	Agriculture	7	29.2
	Economic	5	20.8		Economic	3	12.5
	Management	3	12.5		Management	3	12.5
	Engineering	1	4.2		Engineering	0	0
	Mechanical	5	20.8		Mechanical	7	29.2
	Others	3	12.5		Others	4	16.7
	Total	24	100.0		Total	24	100.0
Working Years	0-10	7	29.2	*Working Years*	0-10	5	20.8
	11-20	8	33.3		11-20	11	45.8
	21-30	8	33.3		21-30	7	29.2
	>30	1	4.2		>30	1	4.2
	Total	24	100.0		Total	24	100.0

However, from both South Africa and China perspective, agriculture was proved to be the educational background of the participant to make up the majority in these six items, which both were reached 29.2%. Interestingly, there

was no interviewee who earned a major in engineering in South African involved in this study. In the following data collection, there was more endeavor that should be employed to invite more engineers from South Africa involving in this project who possibly get fair data for analysis. From the South African perspective, involver who's major in agriculture and mechanics or electromechanics were the same (29.2%). The working experience of 11-20 years and 21-30 years accounted for 66.6% and 75% in China and South Africa. The working-age of more than 30 years was lower on both sides in this research findings.

According to the result in Table 3, from the factors B1 to B6 (B represented the factors that influenced the after-sales services of agricultural machinery in this research), the analyzed empirical data mean values of all variables were above 3. For all factors that influenced the after-sales service of AM, these revealed to cover the spectrum of after-sales service of AM. The mean value of the spare part factor was the highest of 4.6, followed by the maintenance factor (4.1) and training factor (4.0). The mean value of the technician factor is measured as the lowest one by Chinese participants in this study at 3.4 points.

Table 3. The result of Chinese participants

	N	Minimum	Maximum	Mean	Std. Deviation
B1-Technician	24	2.00	5.00	3.4167	.77553
B2-Spare parts	24	4.00	5.00	4.5833	.50361
B3-Repair	24	3.00	5.00	3.9167	.77553
B4-Maintenance	24	3.00	5.00	4.0833	.71728
B5-Training	24	2.00	5.00	4.0000	.83406
B6-UD-ISC	24	2.00	5.00	3.9167	.77553
Valid N (listwise)	24				

Note: UD-ISC is an abbreviation of User Database and Information System Centre

On the other hand, South Africa participants indicated the point of more than three as the mean for the empirical data collected. This means all of the identified six factors belonged to the after-sales service of agricultural machinery in the light of the data collected and analyzed in Table 4. The highest point was the value of spare parts factor from the perspective of South African participants, followed by the factors repairing (4.4), maintenance (4.4),

technician (4.3) and training (4.2). The factor, user database and information system centre are considered less important than other factors by South African participants, as indicated in Table 4.

Table 4. The result of South African participants

	N	Minimum	Maximum	Mean	Std. Deviation
B1-Technician	24	3.00	5.00	4.2917	.80645
B2-Spare parts	24	3.00	5.00	4.4583	.77903
B3-Repair	24	3.00	5.00	4.3750	.76967
B4-Maintenance	24	3.00	5.00	4.4167	.77553
B5-Training	24	3.00	5.00	4.2083	.65801
B6-UD-ISC	24	3.00	5.00	3.8750	.79741
Valid N (listwise)	24				

Note: UD-ISC is an abbreviation of User Database and Information System Centre

An interesting point that should be emphasised is that both South African participants and Chinese participants considered the factor user database and information system centre as less significant compared to other factors in this study, as shown in Table 3 and Table 4. The average scores obtained from data collected and demonstrated all factors summarized from the literature review seem to cover the spectrum of the after-sales service of agricultural machinery.

The focus group discussion was employed to work out whether there were other factors that impacted on the ASS of AM. On the one hand, the focus-group discussion in China showed that except for the factors that influenced the ASS of AM, Sanbao (Three Guarantees: repair, replacement and return), customer's satisfaction played a significant role in the process of ASS of AM. Meanwhile, the factors also included the revisiting, maintenance, technology assistance, tracking service and customer's satisfaction, as illustrated in Table 5.

On the other hand, the focus-group discussion in South Africa presented that the after-sales service interview and unexpected downtime were also crucial to ASS of AM. In addition, users' satisfaction, timely communication and sufficient accessories were key elements of ASS of AM (see Table 6).

Table 5. The focus-group discussion in China

Group 1 China	Result of discussion
C1	1, Sanbao is an important factor that impacts after-sales service in China
	2, Downtime caused adverse effects
C2	1, customer's satisfaction
	2, Sanbao policy
	3, Re-visiting
C3	1, Maintenance
	2, Sanbao in two years for free
	3, timely training
	4, Technology assistance
C4	1, Tracking service
	2, Sanbao Policy

Table 6. The focus-group discussion in South Africa

Group 2 South Africa	Result of discussion
SA1	1, After-sales service interview
	2, Unexpected downtime
SA 2	No
SA 3	1, Users' satisfaction regarding after-sales service of agricultural machinery
	2, timely communication with farmers and users
SA 4	Sufficient accessories and availability

Discussion

Quantitative data discussion

The factors that influenced the after-sale service of agricultural machinery were elucidated. From the reviewed literature, the factors that impacted the after-sales service of agricultural machinery was also summarized in the same trends from the prior researchers' study (Qin *et al.*, 2020a). Those factors revealed variables in this research which were technicians, spare parts, timely repairing, maintenance, training, and users involved in AM (Agricultural Machinery) information management system and service centre.

In this study, the measured means were the extent of the after-sales service of agricultural machinery. If the value of means in this factor was more than three data collected, it is considered this factor belongs to the component of the after-sales service of agricultural machinery. According to Chinse participants' response, the mean of spare parts was the highest one (4.58),

followed by maintenance (4.08) and training (4.00). All means of these factors were above three, which implied they met the standard as the factor of ASS of AM in this study. Jalil (2011) supported that the spare parts were an extremely significant element to ASS. Meanwhile, Palmarini *et al.* (2018) and Man *et al.* (2016) agreed with this outcome that maintenance and training played a pivotal role in the process of ASS. Carr (2017) argued that timely repair was also very important to ASS of AM. On the other hand, according to Chinse participants' answer, all means of the first five factors were above 4. They were spare parts (4.45), maintenance (4.41), timely repair (4.37), technician (4.29) and training course (4.20). These elements were also testified to be very significant and supported by Jalil (2011), Man *et al.* (2016) and Palmarini *et al.* (2018).

Qualitative data discussion

From the focus group discussion of four separate groups in China, C1 indicated that Sanbao which means contract repairing, refund guarantee and replacement guarantee was an important factor for after-sales service in the Chinese agricultural machinery industry. According to them, downtime was another factor impacting on after-sales service of AM. Three Guarantees (Sanbao) is the abbreviation of "repair, replacement and return" for the distinct kind of retail products as stated by Zhu *et al.* (2019). In this study, Sanbao is distributed to B3-Repair and B6-UD-ISC. This was also reported by Zhu *et al.* (2019). Down-time is assigned to a group of B3-Repair and B6-UD-ISC. C2 concluded three factors, including customers' satisfaction, Sanbao policy and Re-visiting in which customers' satisfaction is assorted to the spectrum of B6-UD-ISC. Ngo and Nguyen (2016) and Zhu *et al*. (2019) confirmed that the Sanbo and customers' satisfaction were a significant part of after-sales service. Sanbao policy was in the range of B3-Repair and B6-UD-ISC; meanwhile, revisiting belongs to B6-UD-ISC. C4 figured out that Maintenance, Sanbao, in two years for free, timely training and technology assistance related to four factors that influenced the after-sales service of AM. Finally, the group of C4 resulted that tracking service and Sanbao policy were two other factors that affected after-sales service. According to our study, those two are divided into B6-UD-ISC. Furthermore, those two elements were also determined and testified by Cao *et al.* (2018) and Zhu *et al.* (2019), and they were in the field of ASS.

On the other hand, from the South African focus group discussion, SA1 concluded that after-sales service interviewed and unexpected downtime were other factors impacting the after-sales service of AM. In this study, they are arranged into B3-Repair and B6-UD-ISC separately. SA2 agreed that the

factors impacting agricultural machinery are technician, timing repair, spare parts, maintenance, training course and user management system and service centre without adding any other factors. Moreover, the group SA3 concluded that two other factors were users' satisfaction regarding after-sales service of agricultural machinery and timely communication with farmers and users described as B6-UD-ISC. This is also in conformity with Dombrowski and Malorny (2016) in their research that customer's satisfaction and timely communication were the two elements of ASS. The last group, SA4 explained that sufficient accessories and availability were very significant for after-sales service. This factor is incorporated in B2-Spare parts. Ashburner and Kienzie (2011) stated that sufficient accessories and availability played a crucial role in the ASS and agricultural mechanization.

In light of the group discussions, the factors obtaining from the literature review are confirmed further and explicitly as the main factors affecting the after-sales service of farm machinery in this study. Moreover, the results getting from focus-group discussion and questionnaires presented a conceptual framework that may be designed for the further study of the ASS on agricultural machinery.

Conceptual framework of risk reduction of after-sales service on agricultural machinery

Previous studies reported by Sims and Kienzle (2016); Sims and Kienzle, (2017); Mrema *et al.* (2018); Beuchelt and Nischalke (2018); Kirui (2019); and Qin *et al.* (2019) confirmed that the concentrated on issues regarding agricultural mechanization as well as small-holder farmers in Africa and South Africa. Nevertheless, few researchers have explained the different factors that influence after-sales service of agricultural machinery (Qin *et al.*, 2019). Moreover, few researchers explained a more holistic blueprint of factors that impact on after-sales service of agricultural machinery. The authors then formulated an emerging or novel model of after-sales service of agricultural machinery which also stated by Qin *et al.* (2019). By means of the factors abstracted from the literature review as well as being identified further via focus group discussion and questionnaires, the conceptual framework of after-sales service on agricultural machinery are intended to fill the gap on how to reduce the risk of after-sales service on Chinese agricultural machinery in South Africa.
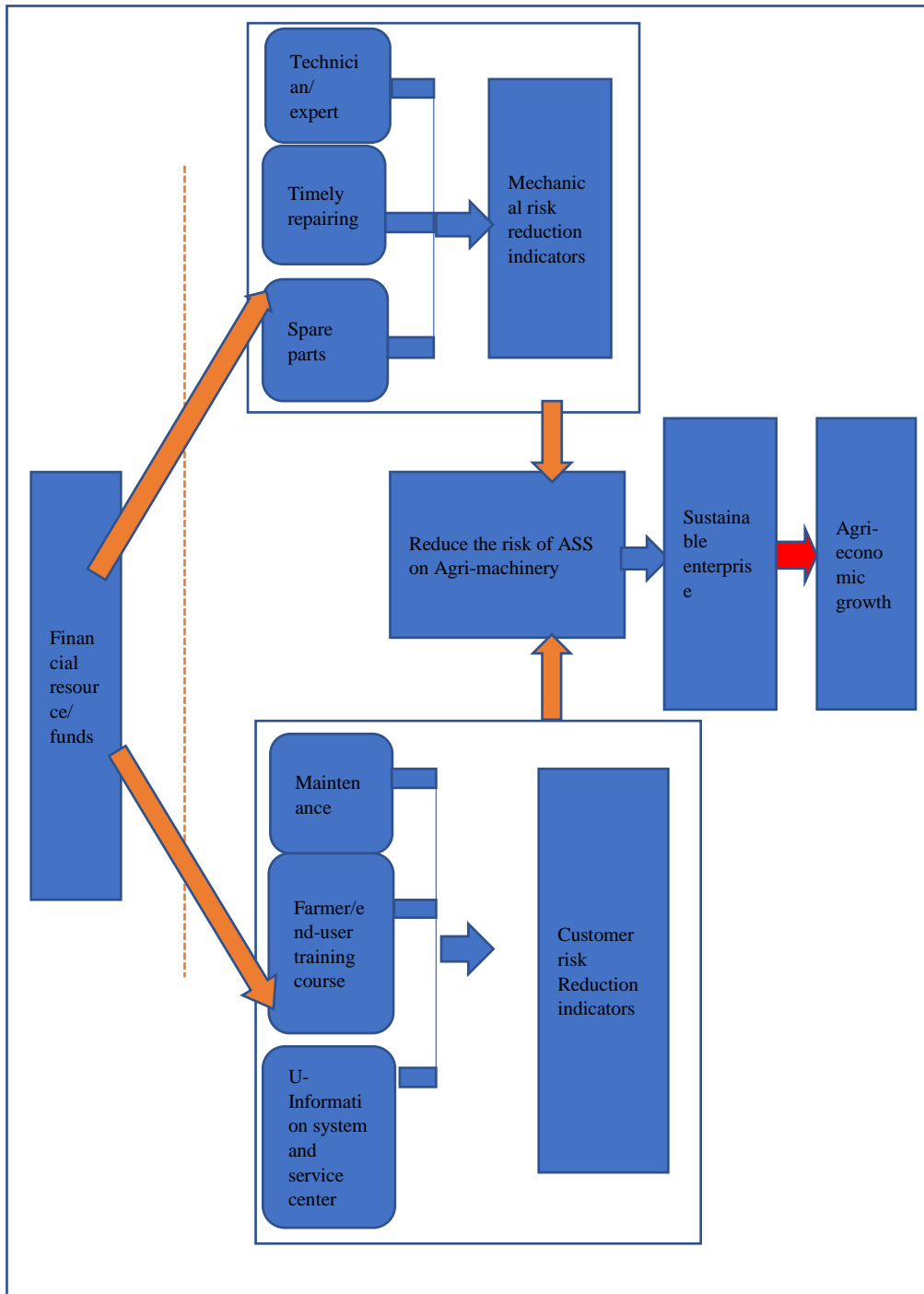
Figure 3. Conceptual framework of risk reduction of ASS on AM (Qin *et al.*, 2019)

The factors affected the risk reduction on after-sales service agricultural machinery, including mainly two parts, namely mechanical and customer risk reduction indicators. The first part involved technicians, timely repairing and spare parts, while the second section comprises maintenance, training courses, and a user information management system, as also reported by Qin *et al.* (2019).

After our questionnaires and focus group data were analyzed. It was further identified that the factors influencing the after-sales service of agricultural machinery collected from the literature review were determined as the factors employed in this study. However, reducing the risk of after-sale service of Chinese farm machinery in South Africa can lead to or facilitate farm equipment enterprises being sustainable, including Chinese farm machinery enterprises, South African farmers, South African retailers, South African wholesalers, repairing workshop and South African manufacturers etc. Furthermore, all of these results related to agricultural economic growth. South African farmers are more demanded especially small-holder farmers that preferred Chinese farm equipment, which was affordable and high-quality. This can be further beneficial to improving productivity which also stated by Qin *et al.* (2020a), employment increasing (Mmbengwa *et al.*, 2020) and poverty-reducing (Mmbengwa and Qin, 2020 and Zhang and Qin, 2020).

Through our previous research, the conceptual framework on risk reduction of after-sales service of AM is conceptualized using some initial elements of the scientific research design approach. The secondary data were employed to summarize the factors that impacted the after-sales service of AM. Furthermore, the descriptive analysis presented the characteristics of the participants in the sample using frequency and percentage analysis. The mean was employed to identify all the factors from empirical data with mean values above 3. The qualitative data analysis indicated other factors obtained from a focus group discussion. Finally, it is concluded that all factors summarized from the literature review are identified as the elements that impacted on after-sales service of AM. In a future study, more data collection and analysis, including more than 700 questionnaires and a case study or focus group discussion, would be conducted to test further the risk reduction model of after-sales service of agricultural machinery.

Acknowledgements

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