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THE EFFECT OF MANAGEMENT ACCOUNTING SYSTEM ON CIRCULAR ECONOMIC: USING AGILE-ADAPTIVE BALANCED SCORECARD AS MEDIATOR

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Abstract: *In recent years, the literature has dealt with the analysis of many studies on the circular economic and in various fields. However, there are many areas that have not yet been explored, for example the study of factors affecting management accounting systems on the recovery of corporate activities. This paper aims to study the impact of the management accounting system (MAS) on the circular economic by adopting the agile-adaptive balanced scorecard (AABSC) as a mediating factor for this relationship. The purpose of this study is to recommend the problems of the circular economy represented in waste of resources and air pollution, in addition to innovation, customer satisfaction, and internal operations problems. A dual approach was applied which are Structured Equation Model (PLS-SEM) and Artificial Neural Network (ANN) approach. The results of this study provide a positive relationship to the impact of the MAS on the circular economy through the implementation of the AABSC as a mediator. A new perspective was presented in this research that may contribute to encouraging the study of the impact of this MAS on the circular economic to increase innovation processes and customer satisfaction that may contribute to improving the competitive advantage of firms in general.*

Keywords: *Management Accounting System (MAS), Agile-Adaptive Balanced Scorecard (AABSC), Circular Economic, Structured Equation Model (PLS-SEM), Artificial Neural Network (ANN).*

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Introduction

Recently, economic problems have become the most common problems due to the phenomenon of the increasing volatility of environments (Fróna et al., 2019). Based on Naradda Gamage et al. (2020) the instability of the environment affects all countries in the developing and developed countries, all sectors, and all businesses, including small and medium enterprises (SMEs). Therefore, in such phenomena, the ability of institutions, especially SMEs, to anticipate and respond to fluctuating environmental phenomena will allow the business of these institutions to continue in the long term (Alkhuzaim et al. (2021)). So far, most studies still focus on how to solve the problems of declines in the public economy and respond to the volatile environmental phenomena caused by waste of resources, using the traditional tools of accounting systems instead of agile tools (Bai et al., 2021).

Where this can lead to internal problems at the level of these systems, for example, decision-making problems, financial reporting, internal control. Besides, it's can also increase the chances of competition with the others through improving decision-making process and improving the internal control operations that lead to controlling waste of resources and pollution of environments (Maki et al., 2020). Therefore, the MAS always to constantly develop themselves, for example when its adoption the integrated tool such as AABSC in their activities. Thus, the MASs can cover all needs and facilitate decision-making processes and the planning process that helps in achieving economic circular targets for these organizations for long term (Fitria,2021).

In this regards, Al-Nasrawi & Thabit (2020) showed that the integrated of the management accounting system with the circular economic is useful in improving the competitiveness of organizations at all levels and sizes. While Fitria (2021) investigated the impact of the application of the management accounting system towards the circular economy on financial and non-financial performance. It was found through their study that any company can thrive and increase its financial viability through the adoption of accounting systems, especially in service companies. Therefore, in volatile economic environments, organizations must rely on this combination of management accounting system implementation and an increasingly circular economy to obtain comprehensive information that helps anticipate management risks before occurring (Bai et al., 2021).

In the developing countries, especially Iraq. The companies still suffering from the failure to continue business for long-term, as what the Iraqi Ministry of Planning (IMP) refer to its official website (Sultan et al.,2021). At the beginning of the period (2005-2007), Iraqi companies, especially the Iraqi SMEs, began to develop their own MASs (Al-Nasrawi & Thabit,2020). The adoption of this MAS led to an improvement in its efficiency and an increase in the number of Iraqi firms in terms of the production and sevices until 2017 (Maki et al., 2020). After that the Iraqi economy deteriorated due to the financial crises caused by the drop in oil prices against foreign currency (Dudic et al., 2020). Hence, this exchange led to the lack of control Companies have to continue in business due to their inability to respond to such sudden crises (Ismael et al.,2021).

Since that time, Iraqi companies, especially SMEs, are witnessing a decline in their overall performance in terms of productivity and ability to provide services (Maki et al., 2020). Therefore, this study seeks to rely on modern and integrated tools for the management accounting system, such as the agile-adaptive balanced scorecard (AABSC) instead of the traditional tools of the balanced scorecard. As shown in Figure 1

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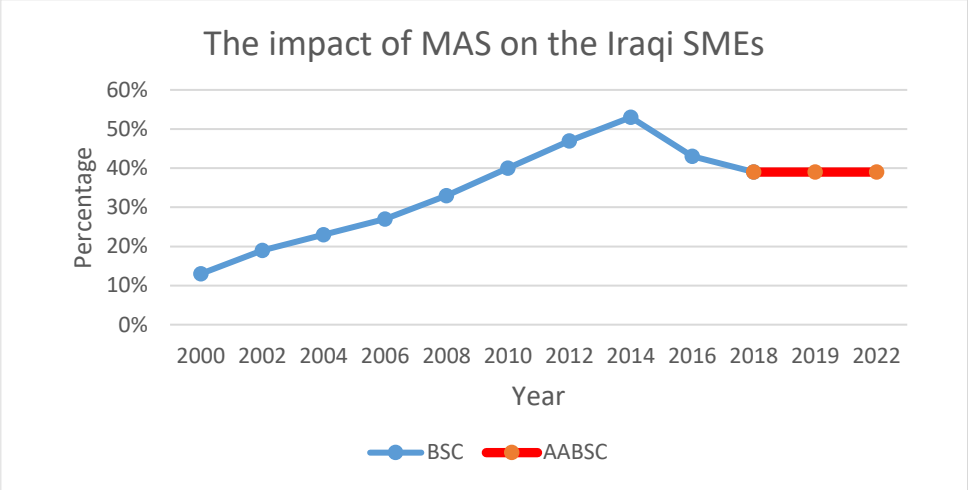

Figure 1: Impact of MAS on the Iraq SMEs

(Source: Author Based on Literature Review Analysis)

Figure 1 explain that the traditional tool of Balanced Scorecard is not good enough to respond to the changing in the environment of firms especially the SMEs (Alobaidy, 2019). Therefore, the literature suggested to use the integrated tools of management accounting system such as AABSC which is found it by Wiraeus & Creelman (2019), to enhance the SMEs to respond to fluctuating environment conditions. Thus, this study will adopt this AABSC as mediating to in improve the MAS of Iraqi SMEs towards solve the economic issues.

The remainder of this paper organised as follows: Section 2 shown the literature review pertaining to implementation of AABSC as mediation towards the relationship between the MAS and circular economic and developed the hypotheses. The methodology employed in the research are presented in the Section 3. Following this, survey findings are presented in Section 4 and discussed this finding in Section 5. lastly, the research is concluded in Section 6.

Literature Review

Management accounting system (MAS)

Management accounting system (MAS) is one of the complex administrative systems that are relied upon by institutions to generate information about users of the internal and external business environment of this system (Ngo,2021). MAS provides services or products to meet clints' needs through enhancing clints' experiences of the services and products' features, uniqueness, functionality, and responsiveness (Falih Chichan & Alabdullah, 2021). MAS also become one of the effective management tools that contribute significantly to support and develop the process of measuring the general performance of small and medium enterprises (SMEs) in various sectors by improving the competitive advantage (Sultan et al.,2021).

In view of the above in the previous studies, the extent of the effect of the traditional tools of MAS on firms, such as traditional BSC has been explained, and this tool has proven its effectiveness in measuring the sustainable performance and has achieved its goal in developed country companies (Ghasemi et al.,2019), but its use in developing countries companies was weak in developing the MAS, especially in SMEs (Abedian et al., 2021). Therefore, resorting to the use of an integrated approach to the balanced scorecard, for example the AABSC can solve the problem in the MAS of these firms, and this is what we will address in the next paragraph.

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Agile-Adaptative Balanced Scorecard (AABSC)

Many leading firms, especially the SMEs, began to adopt the Agile-Adaptive Balanced Scorecard (AABSC) when they verify that it enables them to improve their firms' sustainable performance by linking subunits and members in a substantial effort to increasing the enterprise's common objectives (Zawawi & Hoque, 2020). The resulting tool, denoted as the Dynamic of AABSC, offers high adaptability, comprehensiveness, and unbiased, methodical cause-effect relationship construction for the organizations, especially the SMEs (Mies & Gold,2021).

Wiraeus & Creelman (2019) confirmed that the AABSC have four perspectives: Business Value, Customer, Operational Excellence, and Future Orientation. Thus, the AABSC focuses on connecting jointly with the SME's dimensions, and it is an attractive and considerably significant strategic workout for these companies towards sustainability goals (Dudic et al., 2020). Therefore, the AABSC provides an excellent basis for the proper, optimal and successful implementation of the organisation's strategy, and creates a practical framework for the individuals to find a new perspective for the organization's activities (Nazari-Shirkouhi et al., 2020).

Circular Economic

Circular economic is one of the modern areas that have been recently focused on in management systems, such as the MAS and many other management systems (Fatimah et al., 2020). Besides, Pearlmutter et al. (2020), proved that the circular economic is one of the solutions that can be adopted in addressing harsh environmental phenomenon such as high temperatures in work sites, emission of toxic gases, air pollution and waste, in addition conditions of increased competition to access resources that are used in the production process (Bag et al., 2020). Thus, the circular economy has a positive impact on green environment in industrial feild in combating the wasting resources and environment challenges (Rehman Khan et al.,2021). Figure 1 show the impact of the circular economy on the environment.

Figure 2: The Life cycle of circular economy

(Source: Rehman Khan et al.,2021)

The circular economic can contribute through modern technological innovations to improving the systems that are adopted in the manufacturing and production processes that help in raising the quality and efficiency of the resources adopted in the manufacturing processes (Vermeșan et al.,2020). Thus, it seeks to reducing the waste in the use of resources, reducing environmental pollution, and improving social responsibility (Negri et al.,2021).

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Hypotheses Development

The Relationship Between Management Accounting System and Agile-Adaptative Balance Scorecard

To address the sustainability issues of companies, especially the sustainability of SMEs, Maheshwari et al. (2021) posits that when established the companies, they need an integrated business framework helps increase the informativeness of management accounting, improve financial reports, and coordinate between firms' departments. Through the adoption of integrated tools for MAS such as AABSC, the study found that the decision-making process has improved significantly, and this reflects a tangible impact on improving innovation and increasing customer satisfaction for companies in general (Zawawi & Hoque, 2020). Thus, this study assumes that:

Hypothesis 1. Management accounting system is positively associated with Agile-Adaptive Balanced Scorecard in Iraqi SMEs.

The Relationship Between Agile-Adaptative Balanced Scorecard and Circular Economic

Based on Ismael et al. (2021), the AABSC can be solving the problems of environmental performance by focusing on green industries, controlling waste of resources, and recycling waste materials. In addition to, the AABSC is not a tool to stimulate the radical transformation of companies only, but it can be a decisive multi-objective strategy during its implementation with the circular economic to establish a production consumption system to support environmental sustainability (Mies & Gold,2021). Thus, the adoption of AABSC will contribute to reducing these problems and therefore the study supposes that:

Hypothesis 2. Agile-Adaptive Balanced Scorecard is positively associated with Circular economic in Iraqi SMEs.

The Mediating Role of Agile-Adaptative Balanced Scorecard

According to Salvioni & Almici (2020), the using of AABSC as mediating tool for the relationship between the MAS and the circular economic will help the firms to consist of an integrated system for environment managerial with the inclusiveness, materiality, to assist an organization in meeting the expectations of its stakeholders. In addition to, the AABSC can help the top management to minimize the consumptions of resources and energy, helps explain positive relationships between organization's performance and customers satisfaction, and helps the firms to improving the learn and growth of internal business (Oliveira et al.,2021). Thus, there is a need to use AABSC as an effective tool of MAS to ensure the achievement of the objectives of the circular economic by creating a business environment away from air pollution and waste of raw resources (Dagilienė et al.,2021). Therefore, this study proposed that:

Hypothesis 3. Agile-Adaptive Balanced Scorecard mediates the effect of the relationship between the Management accounting system and Circular economic in Iraqi SMEs.

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Methodology

Sample Size

The data was collecting from 500 Iraqi SMEs as sample to this study. Based on Afthanorhan et al. (2021), that the sample size of the study it will be good enough if passed the 200 cases when applying the PLS-SEM Path Model. The data were collected by distributed questionnaires randomly among 757 among top managers and leaders of departments such as (Human resources department, Finance department, procurement department, and HSE department). The respondents' email was obtained through coordination between the IMP and the human resources departments of these firms. A filtering has been made before filling out the questionnaire by respondents to avoid employees and workers which are not managers, because this questionnaire is required to be filled by managers only.

Six hundred and ninety managers have responded to the questionnaires, seven questionnaires excluded because incomplete evidence which determined the set of final data at 690 respondents. Hence, this study gains over 91.15% response rate which are completely acceptable in the quantitative research (Makel et al.,2021). According to Afthanorhan et al. (2021), most research behaviours suffer from common issues of bias and subjectivity. To avoid these issues, confidentiality measures were used in the information through the application of Likert-Scale (Weijters et al.,2021) the five-way represented by (Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree).

The data was collected during the last quarter of 2021. The research sampling included 81% (560) males, 19% (130) females, also included 17% single, 52% married with children, and 31% married without children. The respondents ages ranged from 30 to 70 years, within an average age of 42 years, which their educational levels were divided as follows: (25%) diploma, (55%) bachelor's, (15%) master's, and (5%) PhD. This analysis can be included as part of your findings below.

Measurements

The questionnaire was first prepared in the English language. Then, it was translated into Arabic via a translation and back-translation process (Makel et al.,2021). Two specialist academics undertook that procedure. The first one working as a senior lecturer at the departments of the languages, and the second one holder PhD accountancy. Seven principals were randomly contacted for a preliminary survey to improve the refinement of the questionnaires. Some changes have been made based on their recommendations and feedback. Consequently, the latest version, after modifications, was distributed to respondents within three weeks.

The questionnaire was distributed online due to the difference in the distance between the firms. The following scales were adopted to measure the four main variables in the study. The questionnaire consists of (11) items of three variables, based on the five Likert scales. The first and second section contained four elements, while the third section contained three elements. Where the section on the circular economy included questions that included the objectives of the research in terms of resources recycling and treating air pollution in the environment. After the analysis the study found these elements have a reliability estimate at (a = 0.91). MAS section include four elements which are used to make sure about the role of the MAS in these SMEs of this study. Wherefore, the results of this study found that the MAS have one-dimensional construction and has a reliability estimate at (a = 0.89). Finally, the last section includes three elements of AABSC the study used it to approve important of this AABSC in increasing the

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innovation and customer satisfaction. Hence the findings of this study showed that the AABSC has a reliability estimate at (a = 0.80).

Data Analysis and Results

This analysis summarizes the data collected. When, conducting causal and non-linear relationships, two main axes must be followed. The first is the evaluation of measurement models and the evaluation of structural models. The second is the implementation of non-linear relationships according to the AAN method. This dual combination of (PLS-SEM and ANN) is adopted to enable accurate research results in depth concepts compared to the single PLS-SEM (Abbasi et al.,2021).

Common Method Bias (CMB)

The common bias method is adopted to ensure that the information collected by the respondents is information free from bias. Therefore, two modern methods were adopted for statistical and procedural treatments. The first method was achieved through the contributors or respondents that it is not necessary to disclose their personal identity to obtain frank answers without any pressure (Jordan & Troth,2020). The second, various measures were used at this stage, such as the use of the gender scale using the measures of name, education level, years of experience, and age, in addition to using a categorical scale to measure the Internet skills to the participants. The five-point Likert scale has been adopted. The Harman individual factor which is one of the methods that are adopted to determine the majority of variance in measurements (Kock,2021). In addition to, the common latent factor analyses were also used to ensure that the obtained data were free of common bias (Jordan & Troth,2020). Thus, the individual Harman factor, which was adopted, showed that the rates of variance are less than 50%. Therefore, common bias style of the data was minimized.

Assessment of the PLS-SEM Path Model Results

PLS-SEM approach has been adopted to exam the causal relationships in this research. Besides, the discriminant validity and convergent validity were examined to evaluate the measurement. Where the convergent validity can be measured by means of factor loading and average extracted variance (AVE), also by the composite reliability (CR). Table 1 explains the convergent validation results

Table 1: Results of Measurement Model

No.	Items	Loading	Cronbach's Alpha	CR	AVE
	Circular economic		0.821	0.809	0.650
1	My firm have consulted stakeholders about an environmental management issue	0.709			
2	My firm recycle and/or recover material	0.798			
3	My firm sell up-recycled products	0.771			
4	My company refurbish goods and/or parts	0.892			
	Managerial accounting system		0.752	0.804	0.653
1	Enable the organization to focus on critical success factors	0.796			
2	Enable discussion in meetings	0.779			
3	Enable continual challenge and debate	0.815			
4	New ideas at work get me going	0.773			
	Agile-adoptive balance scorecard		0.876	0.886	0.509

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No.	Items	Loading	Cronbach's Alpha	CR	AVE
1	My firm have adopted agile-adaptive balanced scorecard to improve financial performance	0.751			
2	My firm have adopted agile-adaptive balanced scorecard to achievement of strategic Goals	0.868			
3	My firm have adopted agile-adaptive balanced scorecard to improved efficiency in operations	0.928			

Table 1 shows the reliability of the elements used in the current scan because all the extracted load factors are greater than 0.7. Moreover, the AVE and CR are greater than 0.5 and 0.70, respectively. Thus, there is no concern about convergent validity. This study adopts Fornell-Larker method for measuring and checking discriminative validity. Table 2 describes the Fornell-Larker method for measuring discriminative validity. The discriminant validity method is estimated by comparing the acquired variance and covariance with other constructs. Accordingly, it was found that the square root of AVE is more than the relevant degree of cross-correlation.

Table 2: Discriminant Validity of Constructs

	1	2	3
1. Circular economic	0.864		
2. Managerial accounting system	0.214	0.784	
3. Agile-adoptive balance scorecard	0.257	0.093	0.937

The results extracted from the analysis process indicates that all the extracted measures have discriminatory validity, because the extracted AVE value is greater than the correlation value for each of the variables that measure its distinct sub-concept as shown in table 2 for example the AVE value of circular economic is 0.864, the AVE value of MAS is 0.784, and the AVE value of AABSC is 0.937. All values mentioned are above 0.7, and these are acceptable and can be relied upon to obtain the required results.

Assessment of Structural Model

This study had developed three hypotheses to uncovering the role of MAS towards the circular economic through AABSC. To evaluate the structural model adopted in this study, causal relationships were used in all structures. According to the hypotheses identified in this research, the bootstrapping method was adopted on PLS-SEM to determine the statistical significance by implementing 1000 (340 case data: one-tailed, 0.05) by adopting the bootstrap sampling (Valdez-Juárez & Castillo-Vergara,2021). When the significance level is 0.05, the t-value for a one-tailed should be equal to or higher than the value 1.645 (Shahin et al.,2020). As shown in Table 3.

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Table 3: Path Coefficients and Hypotheses Testing

	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values	Result
Agile-adoptive balance scorecard -> Circular economy	0.179	0.25	0.066	2.712	0	Supported
Managerial accounting system -> Agile -adoptive balance scorecard	0.147	0.193	0.05	2.940	0	Supported

Mediating effect	Path a	Path b	Indirect Effect	SE	t-value	95% UL	Result
Managerial accounting system -> Agile adoptive balance scorecard -> Circular economic	0.347	0.232	0.058	0.1	3.774	0.072	Supported

In Table 3, the t-values of the relationship between AABSC and the circular economy and between the MAS and the circular economy are higher than 1.645, and this indicates that there is a positive relationship between these variables (Shahin et al.,2020). Also, the t-values of the mediator AABSC towards the MAS and circular economic is higher than 1.645, which indicates a positive relationship between the median and the other variables of this study (Kassim et al.,2021).

Artificial Neural Network (ANN)

An artificial neural network (ANN) is like computing systems that have been extracted from biological neural networks that are analogous to the human brain in terms of acquiring learning and knowledge (Hasson et al.,2020). Thus, faults can be reduced, and prediction accuracy improved, and this will reflect its impact on examining the hypotheses of this study with high quality. ANN is through which errors that occur between the real results and the required results are identified and handled in opposite and different ways to achieve the desired results (Shaikh et al.,2019). ANN has been used in many research fields, including studies related to construction, services, furnishing, hotel, and tourism, as well as manufacturing companies (Niu & Silva,2021).

In this research, the integrated approach of PLS-SEM and ANN was adopted to identify problems in the circular economy and business sustainability for companies, especially Iraqi SMEs. Where, the adoption of this dual approach will contribute to predicting risks and thus will contribute to obtaining accurate information that can help in making decisions easily. On the other hand, the purpose of integrating ANN with PLS-SEM is to clarify non-compensated and non-linear relationships with the constraints used. Moreover, the ANN approach can find the axis of linear and non-linear correlations among all the variables used in addition to providing high-value and high-quality extracts.

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ANN analysis helps each neuron which are MAS, AABSC, and circular economic to calculate its output according to the number of stimulus factors acquired through the input vector, *x. Wji*, which determines the weights that associate the input component-*i*, with the hidden neuron-*j*, while *Vkj* indicates the weights that associate the neuron-*j*, with the output neuron-*k*. And then the real neurons that were entered are collected and calculated with the weighted sum of the outputs and inputs of the neurons *(yi)*by more proportional to the hidden cells (Shaikh et al.,2019).

$$\boldsymbol{net_j^h = \sum_{i=1}^{N} Wji\, x_i \; and \; Y_i = f\,(net_j^h)} \quad \textbf{(1)}$$

For the k-th output neuron,

$$\boldsymbol{net_k^0 = \sum_{j=1}^{J+1} V_{kj} y_j \; and \; o_k = f\,(net_k^0)} \quad \textbf{(2)}$$

The third equation seeks to show the interaction of the sigmoid function with parameter λ to control the slope of the function. Then, through the training procedure for the specific input patterns, the outputs which is o_k will be produced to match the desired response of each neuron d_k. Through this, the following patterns will be redirected by correcting the weights that lead to less errors. Also, the outputs of the weight of the layer *V* will be calculated using (Equation 4, 5) the weighting syntax through which the weight of the hidden layer *W* will be determined and calculated. On the other hand, the o_{pk} refers to the outputs due from the work of the neurons, as the o_{pk} seeks. Also, to get the actual output of neuron-k for input pattern-p. Then all required weights will be processed or corrected in the same way to reduce the size of the sum square errors by activating Equation 6 (Arhin & Gatiba,2019).

$$f\,(net) = \frac{1}{1+e^{-\lambda net}} \quad (3)$$

$$V_{kj}(t+1) = v_{kj}(t) + c\lambda(d_k - o_k)o_k(1-o_k)y_i(t) \quad (4)$$

$$W_{ji}(t+1) = W_{ji}(t) + c\lambda^2 y_j(1-y_j)x_i(t)\left(\sum_{k=1}^{k}(d_k - o_k)o_k(1-o_k)V_{kj}\right) \quad (5)$$

$$SSE = \frac{1}{2P}\sum_{p=1}^{p}\sum_{k=1}^{k}(d_{pk} - o_{pk})^2 \quad (6)$$

In this paper, the authors relied on a multi-layered perceptual pattern with "feed-forward towards back-propagation" algorithm and this is done by applying predictors by analyzing "PLS" for each input neuron, also the outputs and hidden layers were supported by implementing the sigmoid function. Table 4 shows the magnitude of the RMSE value according to ten-fold.

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Table 4: RMSE Values

Neural Network	Input neurons					
	Output nodes: Circular economic					
	Training			Testing		
	N	SSE	RMSE	N	SSE	RMSE
1	523	185.64	0.816	167	11.63	0.85
2	512	125.57	0.647	178	11.75	0.94
3	512	103.79	0.5741	178	12.95	0.61
4	504	124.06	0.501	186	14.84	0.69
5	522	158.34	0.5579	168	8.93	0.79
6	511	122.50	0.6368	179	15.83	0.78
7	596	125.56	0.636	94	17.94	0.72
8	512	138.76	0.34567	178	13.58	0.74
9	503	194.66	0.589	187	12.78	0.76
10	514	144.56	0.5986	176	17.47	0.76
Mean		142.34	0.59		13.77	0.76
SD		29.18	0.12		2.79	0.09

The result of sensitivity analysis shows 80% of the variance in circular economy is predicted by the input neurons. Based on the sensitivity analysis (Table 4) calculates the normalized importance (NI) of all input neurons by dividing the mean importance with the highest importance and expressed in percentage. Table 5. Shown the normalized importance.

Table 5: Sensitivity Analysis with Normalized Importance

Neural Network	Relative importance	
	MAS	AABS
1	0.27	0.25
2	0.29	0.23
3	0.33	0.34
4	0.18	0.39
5	0.13	0.28
6	0.28	0.25
7	0.24	0.35
8	0.23	0.27
9	0.13	0.37
10	0.25	0.38
Mean relative importance	0.25	0.30
Normalized importance (%)	87.90%	100.00%

Hence, normalized importance was indicated AABS is the most powerful predictor for circular economic (NI = 100%), following by MAS (NI = 87.9%). This is further supported by the total contribution of the input neurons (Table 6). Please further explain in simple language what does this Table 5 means?

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Table 6: Parameter Estimates

Parameter Estimates					
Predictor		Predicted			
		Hidden Layer 1		Output Layer	Total contribution
		H (1:1)	H (1:2)	CE	
Input Layer	(Bias)	1.26	-1.25		0.33
	MAS	0.09	0.89		0.28
	AABS	-0.31	0.13		0.39
Hidden Layer 1	(Bias)			-0.57	
	H (1:1)			-1.65	
	H (1:2)			1.68	

In Table 6, the resistance of the AABSC as a mediator is one of the main and contributing factors in predicting managerial risks that improve the decision-making process. H (1:2) neurons are the primary contributing cells, which are the most influential cells, followed by H (1:1) cells in terms of influence. Thus, these extracted ratios indicate the efficiency of the mediator AABSC on the circular economic.

Discussion

This section will discuss the findings from the study based on its objectives. First, the impact of MAS on the circular economy is examined directly. Second. Examine the impact of MAS on the circular economy by adopting AABS as a mediator to achieve these goals. These relationships were examined by applying two hybrid stations, PLS-SEM and ANN, to solve the problems of resource waste, environmental pollution, innovation, and customer satisfaction. The current study confirmed that there is a direct relationship between the MAS and the circular economy, but this relationship would be more effective and active if the AABSC was approved as a mediator for this relationship between the MAS and the circular economy in such type of companies that suffer from environmental disturbances.

The current results are similar to Oliveira et al. (2021) study, which included that the activities related to the circular economy show an improvement in the overall performance of the MAS in general. However, the results of Mies & Gold (2021, indicate a contradiction with the results of the current study, as their results indicate that MAS does not affect the circular economy in Chinese SMEs. Therefore, it can be said that the basis of the work of the MAS depends on a set of work strategies for each organization and each work environment towards achieving the requirements of the circular economy.

Companies, especially the SMEs, seek to develop the MAS and make it an integrated system through the application of modern and integrated tools such as AABSC to overcome the sudden environmental disturbances that have recently caused the failure of most companies due to the inability of these companies to address these risks. Accordingly, the focus of MAS on the circular economy will greatly contribute to supporting these companies and increasing their activities through the efficient use of resources to reduce the level of waste during manufacturing and production processes. Therefore, this study recommends the adoption of the variables of this research, not only to control waste of resources and air pollution, but extends to include focusing on competitive advantage, and increasing market share to meet the

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demands of the masses of stakeholders and customers. Thus, these institutions, especially the SMEs, must realize the economic and environmental importance and try to limit or reduce their negative effects on society in general.

On the other hand, the aim of the current survey is to measure the effect of the mediating role of the AABSC on the relationship between the MAS and the circular economy. In this content, the results of the statistical survey demonstrate the role of the AABSC as a mediator of the relationship between the MAS and the circular economy. In addition, the current research confirmed that the adoption of MAS and AABSC as a cooperation element helps organizations, especially SMEs, in avoiding individual decisions of some managers that may reflect their negative effects on the overall performance. The current study demonstrated the effectiveness of the AABSC in enhancing the role of the circular economy in waste recycling processes and reducing air pollution, in addition to enhancing its roles in innovation and increasing customer satisfaction to improve the competitive advantage. Thus, the current study proved the AABSC as a mediator to improve the relationship between the MAS and the circular economy according to the current results of the survey.

Research Implications

Findings of this research going to assisted and provide guides that can help the owners of institutions, especially small and medium enterprises, in addition to managers and researchers in the social sciences, which will be addressed through the sub-discussions below.

Theoretical implications

This study seeks to support the literature and future studies by measuring the extent of the impact of the MAS on the circular economic directly. As well as by implementing of the AABSC as a mediator between the MAS and the circular economic. In addition, this study is the first to adopt the implementation of the integrated tools of the management accounting system, such as the use of the AABSC instead of the traditional tool of the Balanced Scorecard. This was proven by adopting the quantitative method on a group of Iraqi SMEs that were randomly identified to test the effectiveness of this study in achieving the goals. Thus, researchers will have opportunities to adopt these variables to address waste of resource issues in the literature by adopting the implementation of the circular economic with this combination of variables that were referred to above.

Practical implications

In this section, this study suggests that the firms, especially the Iraq SMEs, must pay attention to raw resources, which are one of the important elements in building these firms and their continuity of performance in the long term. In addition to improving its competitive advantage that keeps it in the market. This is done by focusing on recycling and reusing resources to control the waste of resources that have negative effects on firms, especially the Iraqi SMEs, also creating an appropriate environmental climate free of air pollution. Thus, this study will contribute to building and developing the competitive advantage that leads to continued performance of firms, also help to reduce unemployment, reduce environmental pollution, maintaining resource waste. In addition to, this study can improve the innovation and increasing customer satisfaction, hence achieving competitive advantage for long-term.

Limitations and Future Direction

The current research has several limitations that could provide opportunities for further studies. First, the context of the current research relied on one country (Iraq), due to the difficulty of obtaining approvals to implement the study, and this in turn affects the generalization of the

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results. Therefore, this paper recommended in future studies to adopt other countries such as (Syria, Yemen, Palestine, Iran, Libya, and Sudan), which are similar with Iraq's environment in terms of sudden economic fluctuations and administrative risks and compare their results with the current study. Secondly, the study was conducted on the SMEs only, while the family firms suffer from low levels of business and a lack of general performance. Therefore, addressing this type of companies will be a good research focus for the future studies due to the presence of a huge number of these companies in the competitive markets. Third, this study relied on the quantitative approach to understand the role of the AABSC, which is a modern tool that has never been implemented in previous studies. Therefore, the quantitative survey was not sufficient to know the basic mechanism of action of this tool. Accordingly, future studies should address a qualitative approach to explore the essential roles of AABSC, because this approach is described with accuracy and depth. Finally, both PLS-SEM and ANN approaches were adopted in this paper to measure causal and nonlinear relationships. While the future studies have been recommended to adopt the same approach (PLS-SEM with ANN) to explore the similarities and differences in the implementation of the circular economy on other countries.

Conclusion

This research adopts a hybrid of two phases, namely, structural equation modeling and a neural network approach to enhance the circular economic in Iraqi's firms. A quantitative survey was conducted for many managers and leaders in the Iraqi SMEs. The research community consisted of managers and leaders in the SMEs who had the skills and managerial experience of the MAS. The sample of the study was obtained from five Iraqi cities (Basra, Dhi Qar, Maysan, Erbil and Dohuk) because these cities contain raw materials such as oil and other minerals that helped in the spread of SMEs on a large scale. PLS-SEM technology has demonstrated an interrelationship between MAS, AABSC, and circular economic. When perceived technology was high, the relationship between MAS and AABSC on a circular economy was a significant influence. Moreover, there is another important relationship between AABSC and circular economy. The AABSC mediates the relationship between the MAS and the circular economy. Besides, the ANN approach revealed that the adoption of AABSC is one of the very important and modern indicators that can enhance the MASs towards the circular economic by solving the problems of air pollution, recycling of waste, in addition to solving the problems of innovation, customer satisfaction and internal operations of these firms.

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