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A dynamic modeling for green business development in oil refining industry

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ABSTRACT

A carbon-based industry, such as oil refinery, needs to change its business model to achieve a green business. Considering the existing too much data, the modeling procedure is complex. Therefore, combination of the Fuzzy Delphi method and System Dynamics can be considered to cover this complexity. The starting point in this work is literature review of prior studies on the same common topic and green business, and it relies on a Fuzzy Delphi method to define main parameters. Based on the experts' opinions, management support (0.78), cost (0.77), knowledge management (0.73), quality (0.64), staff training and empowering (0.63) customer satisfaction (0.63), environmental plan (0.61), production and process design (0.58) as well as suppliers (0.35) are the determining parameters in modeling green oil refining industry, respectively. Application of the results of the scenarios proposed based on importance illustrates the increasing share of the green business financial resource in considerable growth (39 %) of applying the green business model by 50% chance. Financial investing in the recycling plan leads up to a positive effect (43%) by almost equal chance of 50%-100%. Investing in staff training and empowerment leads to 37.5 % growth in exploiting the green business model with 50% chance. In conclusion, the oil refining organizations must pay attention to the above-mentioned part of their business to generate income and save environmental resources.

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INTRODUCTION

In the 21th century, concerns about environmental issues have intensified (Ahmad, 2015; Fraccascia *et al.,* 2018). The international environmental protocols head to accept the green strategies and to apply green management in all parts of the organizations. For some reasons, organizations are moving toward greening their systems, such as new carrier opportunities, which lead to innovation and wealthier companies (khan, 2015). Different parts of the business have a leading role in applying green policy to reach green business goals (Paille *et al.,* 2013). A green business emphasizes enduring commitment to advance environmental ideologies and principles in one's business plan of action and operations as well as decreasing and eliminating the environmental drawbacks caused by anything related to the company's products and services. Furthermore, focusing on developing innovative products, services and processes which contribute to sustainable development, minimize resource waste and energy leakage (Wagner, 2009; Geissdoerfer *et al.,* 2017). The concept of green business models was emerged at the end of the 20th century and induced increasing attention to the sustainability of economic development (Čekanavičius, 2014). Statement Green business experts on environmental sustainability emphasizes business sustainability and production and reduces their harmful effects on society as well. In experts' view, competitive advantages stem from the approaches which consider the environment seriously and follow the financial improvement (Hart, 2005; Winston, 2010; Werbach, 2010). Defining a green business model will be a challenging procedure, since providing a unique definition for all businesses which have different conditions is almost impossible. As a result, relying on the provider's viewpoint, such a definition will be varied (Foray, 2014; Fraccascia *et al.,* 2018). In the transitioning phase of a business model, there is a need for the strategy-intensive holistic and deliberate systematic choices (Kanger and Schot, 2019; Schot and Steinmueller, 2018). The effect of company structures including operational parts, internal processes, infrastructures and even intangible assets should be regarded as a factor involved in altering a company's business model. In other words, the main parts will change based on the organization's goal and the effective indicators. This model is supposed to prepare a business to survive in a competitive market during lack of environmental resources. Company's approach in choosing policies leads to competitive sustainability opportunities and values for customers and itself in a competitive atmosphere (Kujala *et al.*, 2010). Business models are often framed in response to particular competitive conditions and outline the way a company generates revenues regarding the structure of their value chain. They also depict how to have constructive interaction with the customers, suppliers and partners with complementary competencies (Leitão *et al.*, 2013). Green business models can be considered as a tool for competitive sustainability because they rest on creation of green value proposition to customers and gain profits and reputation. Henriksen *et al.* (2012) defined green business as: "Green business model innovation is about re-evaluating the business model's components to capture both economic and environmental values and reduces the ecological footprint in a life-cycle perspective". A sustainable and green business includes any organizations which participate in environmentally friendly plans and guarantees all parts of their business. Such a business considers environmental eternity as the main priority in addition to financial profit. In fact, the risk of depriving future generation of their requirement on the cost of meeting the present needs is not taken into account in this business. In manufacturing business, it covers eco-friendly design, raw materials, packaging, distribution, and even reuse/retreatment of products after their useful life (Jabbour, *et al*., 2015; Drohomeretski *et al*., 2014; Rehman *et al*. 2016). The basic problem of different businesses in applying environmentally friendly strategies is not having an accurate definition of greenness in organizations, substantive and procedural details. The side effects of each business on the environment and resources vary dramatically, depending on the company's productions, and are as different as the green plans which are applied. In fact, the green strategies have to be defined differently in each organization, accounting to the organization's variety of activities. Hence, developing green guidelines will be necessary for the organizations to match their performance with environmental needs. These guidelines will be a criterion for evaluation of the company's green performance (Winston, 2010; Dosi *et al*., 2017). Competitive disadvantage will be inevitable unless climate change and sustainability take priority over other issues in a large-sized company. Companies that mitigate their exposure to climate-change risks, without risking their financial recourses, provide a competitive advantage in a carbon-constrained future putting them ahead of their competitors (Lash and Wellington, 2007). The internal proactive approaches adopting eco-deigns influence the environmental performance of the firm (AlKhidir and Zailani, 2009). Hence, there is a need for a future-oriented framework and action guidelines for developed conditions. Thus, this survey attempts to go through these conditions and define a generative, sense-making, learning-oriented process (Miller, 2007; Rohrbeck and Schwarz, 2013). The proposed model includes fuzzy Delphi method (FDM) to ensure that the different views regarding priorities and measures are considered and system dynamics (SD) is provided to allow for foresighting long-term future prospects, assumptions and policies (Miles *et al*., 2016). A summary of reviewed studies has been given in Table 1. As it can be seen, there is a lack of system thinking among the applied methods.

This study shows the business implications of green business implementation in oil refining companies. The first step consists of literature review on parameters and components of green business model. In the second step, FDM identifies the importance grade of each case stated in the previous section. Finally, the System dynamics model and descriptions are present in the third. The scenarios derived from literature, experts' opinions and the defined model are discussed to choose the practical one. The results are mentioned in the final section. To the best of the authors' knowledge, a few studies yet have been done concerning model development in the green business context by system dynamics (SD) approach in the oil refining industry to better fill the research gap. The fundamental components which affect the green business resulted from literature review's content analysis have been used to form the base parameters of the model (Table 2). The main contributions of this study are: 1) Introducing a practical business model considering both environmental and financial values at the same time; 2) FDM and SD approach are proposed as two strong methods for developing complex systems; 3) A comprehensive sensitivity analysis is considered as the stepping stone of the stimulated model; and 4) The key step toward developing experimental approaches, as a result, can lead to saving environmental resources. This study has been carried out in Isfahan oil refinery in Iran in 2018.

Table 1: Some of the major reviews under consideration

Paradigm	Reference
Mixed methods, multiple case study	Mezger (2014)
Qualitative, action research	Heikkilä *et al.,* (2015)
Artificial neural network	Rehman (2016)
Quantitative, discourse analysis	Kasztelana (2017)
Fuzzy Delphi method	Yazdimoghaddam (2018)
Portfolio of directionality	Kanger and Schot (2019)

MATERIALS AND METHODS

The FDM and SD approach were employed as the survey methodology to gather data and to construct a green business model in the oil refining industry. Researches have revealed that FDM is a useful tool to gather information and SD is a noteworthy model builder.

Step 1: Literature review

A carefully organized research in journals highlighted the study goals and facilitated searching for GB modeling by SD in oil industries. The bibliographic databases used in the literature consist of Web of Science and Scopus, Science Direct, Google Scholar, Emerald, Taylor and Francis, Springer and John Wiley publications. According to the literature, the industrial criteria of the green business model in prior researches and other related areas as well as the experts' oil refining experiences were combined to generalize nine important parameters to make the building block of the simulation (Table 2).

The existing approaches for modeling green business exhibit a wide range of goals and domains to be fulfilled. Due to the lack of direct methodology to be utilized in green business modeling, both FDM and SD approach are combined as a good tool to cover the complexity of the systematic viewpoint and take a wide number of objectives into consideration. Thus, combination of these tools to consider all aspects of the subject was followed as a methodology in this study. The model has been described in the following sections.

Step 2: Fuzzy Delphi method

The FDM can be applied to group decision can solve the fuzziness of common understanding of

Table 2: The main factors affecting the green business

Factors	Reference
Management commitment	Azzone *et al.* (1998); Lin *et al.* (2001); Bose (2004); Boyle (2004); Gosselin and Haddock (2005); Jaju and Mohanty (2008); Daily *et al.* (2012); Koo and Chung (2014); Dubey *et al.* (2015); Thomas *et al.* (2016); Kasztelana. (2017); Shivangi and Santosh (2018).
Knowledge management	Bose (2004); Haddock (2005); Fenwick (2007); Jaju and Mohanty (2008); Meythi and Martusa (2013).
Employees	Azzone *et al.* (1998); Bose (2004); Boyle (2004); Fenwick (2007); Daily *et al.* (2012); Zailani *et al.* (2012); Koo and Chung (2014); Thomas *et al.* (2016); Ahmed *et al.* (2017).
Designed production process	Azzone and Noci (1998); Lin *et al.* (2001); Boyle (2004); Gosselin (2005); Simpson *et al.* (2007); Brown (2008; Koo and Chung (2014); Dubey *et al.* (2015); Thomas *et al.* (2016).
Supplier	Azzone *et al.* (1998); Boyle (2004); Simpson *et al.* (2007); Brown, *et al.* (2008); Dubey *et al.* (2015); Thomas *et al.* (2016); Ahmed *et al.* (2017); Shivangi and Santosh (2018).
Quality	Lin *et al.* (2001); Beheshti (2004); Gosselin (2005); Simpson *et al.* (2007); Sakao (2009); Nunes and Bennett (2010); Kasztelana (2017).
Cost	Lin *et al.* (2001); Beheshti (2004); Rusinko (2007); Brown (2008).
Environment	Azzone *et al.* (1998); Lin *et al.* (2001); Boyle (2004); Rusinko (2007); Brown (2008); Nunes and Bennett (2010); Daily *et al.* (2012); Kasztelana (2017).
Customer	Azzone *et al.* (1998); Lin *et al.* (2001); Beheshti (2004); Rusinko (2007); Jaju and Mohanty (2008); Nunes and Bennett (2010); Daily *et al.* (2012); Shivangi and Santosh (2018).

expert opinions (Farmad pour, 2016). It is helpful to demonstrate the qualitative values to quantitative values (Hsu *et al*., 2015). Actually, insufficiency of the crisp numbered to simulate real-world systems is problematic due to uncertainty, obfuscation and individuals' priorities (Kannan *et al*., 2014). To overcome the above problem, the FDM was proposed by Zadeh (1965) and (Shen *et al*., 2013). This study takes advantage of the FDM to cover the determinative parameters properly. The steps of the mentioned method are as following (Cheng *et al.*, 2002; Yazdimoghaddam *et al., 2018*):

1) Discovering the possible parameters recognized through the detailed literature review (Table 2).

2) Devising the questionnaire related to the FDM, aiming to get the experts' opinions about whether they agree to the components and dimensions. All the experts expressed their satisfaction in the Likert five-part spectrum using the linguistic variables as very low, low, medium, high, and very high. Triangular fuzzy numbers were used to define the aforementioned variables. The crisp values of fuzzy numbers are presented in Table 3.

Table 3: Linguistic variables

Linguistic scales	Fuzzy number
Very high	(1, 1, 0.75)
High	(1, 0.75, 0.5)
Medium	(0.25, 0.5, 0.75)
Low	(0, 0.25, 0.5)
Very low	(0, 0, 0.25)

1. Re-devising the questionnaire based on the factors extracted from the literature and the new components proposed by the specialists. The questionnaire handed out to 20 experts and they were requested to write their opinions about each component in the form of the mentioned linguistic variables. The fuzzy mean of each component was calculated based on the results of the questionnaire and Eq. 1. Moreover, the defuzzification operation was calculated according to Eq. 2.

$$A_m = (a_{m1}, a_{m2}, a_{m3}) = \left(\frac{1}{n}\sum_{i=1}^{n} a_1^i, \frac{1}{n}\sum_{i=1}^{n} a_2^i, \frac{1}{n}\sum_{i=1}^{n} a_3^i\right) \quad (1)$$

$$\text{Crisp number} = z^* = \frac{1}{6}(a_{mi} + a_{mi+2} + 4\, a_{mi+1}) \quad (2)$$

2. Identifying the final surveys by distributing the comments presented in each step and measuring them. After the variation of the components was less

than the threshold of 0.2, the poll was stopped.

Based on the defuzzified averages, the components with the score of less than the median of gray interval were excluded. In this stage, three components which had a loos score were excluded. Finally, after three surveys, 34 components affecting the green business model in the oil refining industry were specified (Table 4).

Table 4: Final results of the fuzzy delphi method

Parameter	Cronbach alpha	Component	Fuzzy averages	Defuzzified averages	Factor analysis
1. Management commitment	0.892	1. Strategic planning with respect to environmental issues	(0.55 ,0.81 ,0.98)	0.79	0.763
		2. Follow-up and continuous engagement of environmental-related activities	(0.53,0.8,0.98)	0.79	0.889
		3. Allocation of resources to environmental projects	(0.5 ,0.78 ,0.93)	0.77	0.833
2. Knowledge management	0.733	1. The process of accessing information resources	(0.46 ,0.71 ,0.9)	0.7	0.999
		2. Information Sharing policy in Organization	(0.46 ,0.71 ,0.9)	0.7	0.871
		3. integrated technology and information systems for green design	(0.37 ,0.65 ,0.88)	0.65	0.808
		4. Financial Allocation to environmental education	(0.35 ,0.58 ,0.81)	0.59	0.746
		5. Personnel incentive programs to receive eco-friendly offers	(0.51 ,0.78 ,0.93)	0.76	0.924
3. Training Staff	0.843	1. Resource allocation for education	(0.35 ,0.59 ,0.8)	0.8	0.990
		2. R and D teams to protect environmental interests	(0.10 ,0.35 ,0.61)	0.33	0.819
		3. Continuity training and education	(0.13 ,0.37 ,0.92)	0.76	0.896
4. Production design and process	0.618	1. Introduction of a new environmentally friendly product/ process	(0.38 ,0.62 ,0.82)	0.61	0.533
		2. Life cycle analysis to assess environmental impacts	(0.16 ,0.34 ,0.59)	0.36	0.780
		3. Considering production processes to reduce waste, energy consumption and pollution	(0.3 ,0.55 ,0.77)	0.55	0.584
		4. Number of inspections at the beginning, during and after the production	(0.39 ,0.64 ,0.87)	0.64	0.547
		5. Number of recycling / reuse plans	(0.42 ,0.67 ,0.86)	0.66	0.715
		6. Applying the optimal use of resources approach	(0.33 ,0.59 ,0.81)	0.59	0.495
		7. Applying the preventive approach to environmental protection at the design stage of the product	(0.45 ,0.7 ,0.91)	0.69	0.659
5. Environment	0.782	1. The amount of solid, liquid and gaseous waste generation	(0.58 ,0.83 ,0.96)	0.81	0.990
		2. The rate of use of recyclable material(recycling)	(0.38 ,0.63 ,0.87)	0.66	0.819
		3. The extent of employee participation in environmental activities	(0.1 ,0.25 ,0.50)	0.24	0.428
		4. financial allocation	(0.66 ,0.91 ,0.98)	0.76	0.460
		5. The percentage of human mistakes	(0.68 ,0.93 ,1)	0.91	0.412
		6. Environmental Binding Policies	(0.11 ,0.31 ,0.56)	0.30	0.570
6. Supplier	0.636	1.Reduce need of raw material and supplier	(0.10 ,0.35 ,0.61)	0.35	0.835
7. cost	0.889	1. The cost of training	(0.34 ,0.59 ,0.84)	0.59	0.896
		2. Reduce production costs by recycling	(0.64 ,0.87 ,1)	0.86	0.870
		3. Reduce the cost of raw material through R and D project	(0.64 ,0.87 ,1)	0.86	0.945
8. Customer	0.722	1. Growth number of customers	(0.63 ,0.88 ,0.9)	0.86	0.519
		2. Growth share market share	(0.30 ,0.56 ,0.86)	0.56	0.540
		3. The growth in the number of sale	(0.27 ,0.48 ,0.75)	0.48	0.460
9. Quality	0.631	1. Encourage the organization to respond to green strategies and commitment to improving quality to satisfy costumers	(0.17 ,0.38 ,0.63)	0.67	0.923
		2. Environmental policies and systems development	(0.38 ,0.63 ,0.85)	0.63	0.796
		3. Effective system for identifying hazardous products	(0.38 ,0.63 ,0.87)	0.63	0.548

Step 3: System dynamics (SD)

SD is a thinking model and simulation methodology specifically developed to support the study of dynamic behavior in complex systems over the last decades. Explanation of four constituents of SD is as follows (Forrester, 1976):

1. The emphasis of conceptualization is on purpose, boundary and identifying key variables and their modes and feedback loops of the model. This step provides the parameters and their effects on the model. 2. Formulation emphasizes the level, the rate equations and the parameter values. Based on the experts' opinions, the relationship among the components turned into mathematical equation.

3. Simulation includes testing the dynamic hypothesis, assumptions and sensitivity analysis through the Theil index.

4. Implementation is examining the different scenarios and stem an accessible insight.

RESULTS AND DISCUSSION

Conceptualization

After literature review, the effect of parameters on green business in oil refining industry was analyzed via FDM. Three parameters (Environmental education for suppliers, environmental audits on suppliers and customers' information system were excluded. After implementing three surveys according to FDM, three parameters were excluded, and finally, 34 out of 37 effective factors were specified. The final result of the FDM process emphasizes Iran's context. The final output of the FDM process covers the SD conceptualization and forms the inputs of the model simulation (Table 4).

Cronbach's alpha demonstrates the level of reliability for each parameter. It is above the 0.60 for all parameters, confirming that all of them are qualified and reliable. The factor analysis illustrates the contribution of the components and the result has to be more than 0.4 (means that all components have contributed) (Table 4).

Simulating and formulating the model

Parameters that attain higher defuzzified averages are more effective. These parameters have been selected to be applied in modeling by SD and their values have been used as impact factor in the formulation step of SD. Feedbacks are regarded as a reason which make SD. Green business loops of the stock-flow diagram of oil refining business are explained in this section. Vensim is used for drawing the loops and formulating. The boxes indicate levels (or state variables) that integrate the flows and the valves represent rates. These together generate the corresponding set of differential equations analogous to mass balance in actual flow processes. The curved arrows describe the causal information system. This type of modeling help to predict real-world behavior under complex circumstances (Fig. 1), (Lee and Tunzelmann, 2005).

The SD model contains 3 main reinforcing feedback loops as:

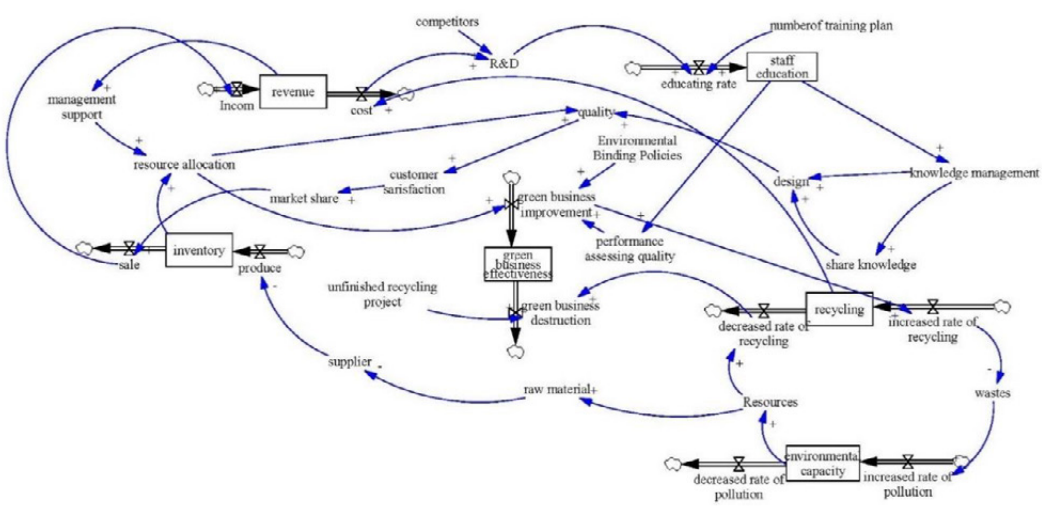

Fig. 1: Workflow diagram of green business model

1) Management's commitment and support: As illustrated, the higher the management's support and commitment, the greater resources allocation. This leads to amelioration of raw material quality, customer satisfaction and market share, and thereby boosting sales, revenue and benefits. Benefit growth will charge the improvement in green business finance allocation. This reinforcing feedback drives growth in green business applied in an organization.

2) Staff's educating: The more effective the staff's educating, the greater knowledge management. This leads to creative product, product attractiveness, boosting customer satisfaction, extending market share and increasing sales as well as revenue. In this way, not only the financial and environmental values augment, but also the company is known as a green one and a leader in the market.

3) Environment: Two interrelated feedback loops are main parts of this section of SD model. First, the more the green business budget share of the greater implementation of the green business plan, the more increase in recycling to generate more raw material, which results in less need to utilize environmental resources.

4) Second feedback loop: Higher amount of waste causes more pollution and reduces environmental biodiversity and reduction in ecosystem carrying capacity. Therefore, further reduction of environmental resources will lead to more shortage of raw material.

Testing the model

Theil index is a criterion used to compare the performance of forecasting models with reality. The Theil index, which is scale-invariant, is between zero and one. If the parameters values decrease, the better forecast will be possible. The correlation is demonstrated as a result, and 95% is shown as the overlap rate. However, error analysis and Theil's statistics show the mean difference (U_M) of 31%, indicating the ability of the model to show the true behavior of the model. The variance difference (U_S) represents 14%, indicating a negligible difference between the actual and simulated values. The covariance difference (U_C) of 49% is noticeable, which is driven from fluctuations in real values. The workflow model was applied to simulate the behavior of the main factors. This simulation covers 20 years. The proposed scenarios were established on the changes that appeared in the three stock parameters. Furthermore, they depend on increase of the green business budget, in this case recycling budget, and human resource education to identify their effects on the green business objectives.

Scenario analysis

Initially, the base case scenario was run as an extrapolation of past behavior to find out if the model's behavior is as similar as the existing system. The result approves that the model's behavior and all random combination of variables impact are in the range of 0 to 100%. The analysis was conducted based on three-level variables of revenue share of green business plan budget, recycling and staff training. Fig. 2 shows the budget allocation effect on the green business performance. Four percentages of occurrence have been assigned to each factor (yellow, green, blue and gray parts indicate 50%, 75%, 95% and 100% occurrence respectively). The green business effectiveness is evaluated based on financial resource allocation and the number of training plan and recycling project is discussed as below. The formulated relation has been shown in Table 5.

In the first scenario illustrate the green business budget increase effect, the share of the budget increases by 12%. Initially, the company encounters a new condition. Consequently, the graph trend has a slow growth, but later, a triple growth is observed. The result shows that budget has a positive impact (39%) on green business by 50% chance which is a valuable risk to take (Fig. 2). This can be due to exogenous variables affecting performance accomplishment. Thus, albeit budget raise can be influential, it will not address all the problems.

The second scenario illustrates the recycling

Table 5: Green business effectiveness relation

Specification	Relation
Green business effectiveness	INTEGRAL (Green business improvement - Green business destruction ,15)
Green business improvement	DELAY1(performance assessing quality Look up, 2)*.161+ resource allocation Look up*.77+ Environmental Binding Policies Look up*.069
Green business destruction	Number of recycling / reuse plans Look up*.66 + The rate un recycling Look up*.37

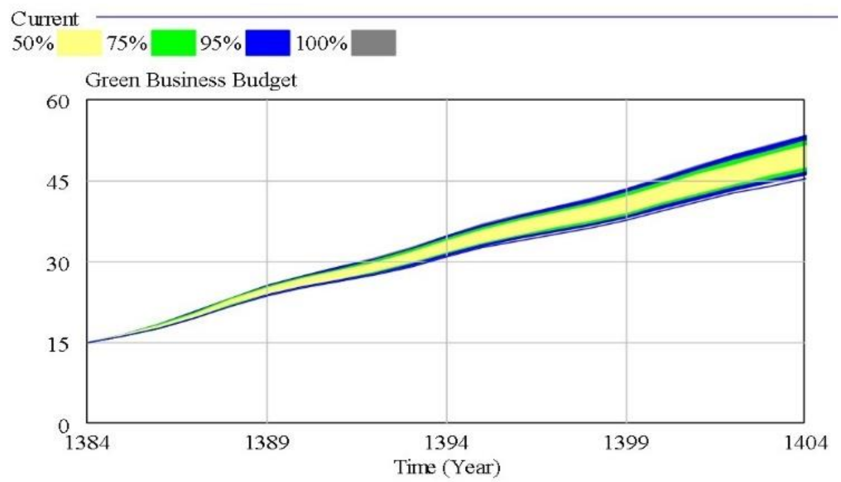

Fig. 2: The green business budget

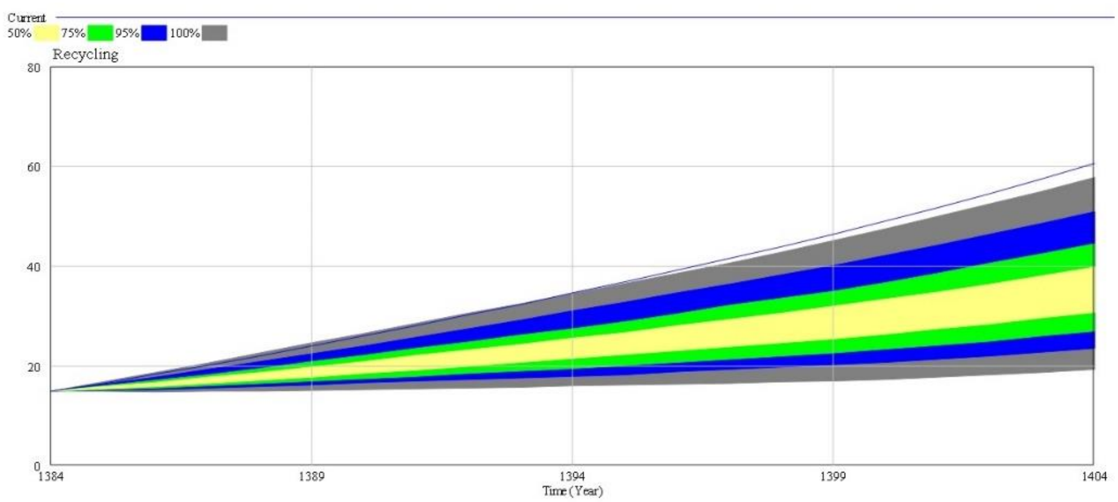

Fig. 3: Recycling budget

budget effects on applying the green business. Budgeting on different recycling plans rests on green business goals. As it can be seen from the result, enhancement in wastes recycling, wastes reduction and recycled output are exploited in production line of the refineries as raw materials. The percentage of the trends similarity between simulation and reality confirms the validity of the simulated model. Fig. 3 indicates that the greatest impact would be about 40%. Depending on the company's condition, it might be even 100% chance to develope.

The third scenario demonstrates that investing in human resource's training and educating would be effective on green business. This means that education has enough value to increase the budget of the organization. To specify the models 'subject, the parameter's values are randomly changed (50–600). Even if the number of targets becomes more, there will not be any remarkable drop in the success rate of the process by raising the number of targets. The parameter's value in all the randomly combined situations shows that the model's behavior is under control and the fluctuation remains in the range of 0-1. In 50% of the situation, there is hope for a successful application (37.5% growth) of the plan (Fig. 4).

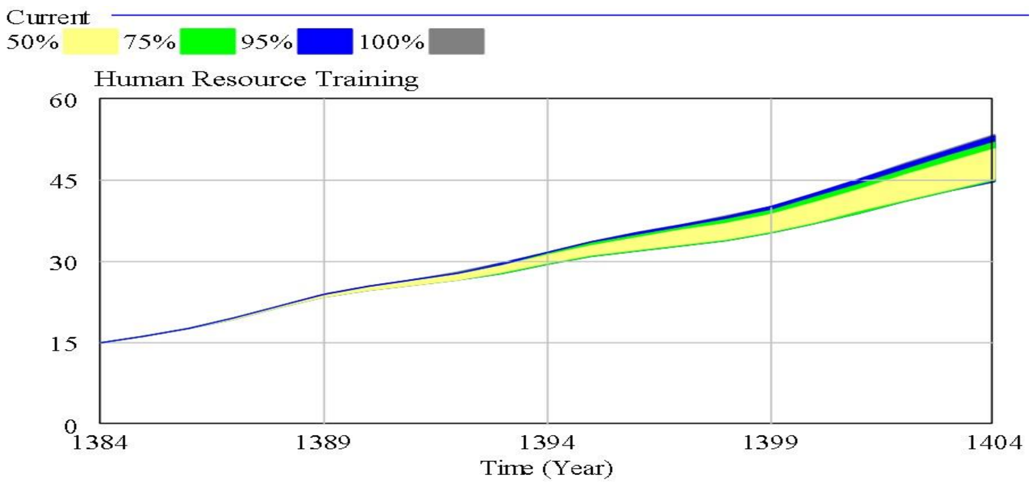

Fig. 4: Human resource training budget

CONCLUSION

The conducted study demonstrates that a practical green business model requires management commitment to support and to allocate resources to green business plans; knowledge management and staff's training to improve organizational knowledge about new methods of being green; and re-designing process of production considering environmental concerns such as wastes, suppliers, cost of changes, customers concerns and products quality. The empirical results of this study illustrate that the recognized parameters are reliable and valid to build a model based on them. The proposed scenarios evaluated three strategies for building a green oil refining company and the results consisted of the chance of investing in business model, staff training and recycling. The simulation results depict that the efficiency of green business is affected by the green business budget share of revenue (39% growth, 50% chance), financial investing in the recycling plan (43% growth, 50-100% chance) and staff training investment (37.5% growth, 50% chance). The conducted studies have developed a model focusing on either business or environment, but the present study has adopted a systematic vision from starting point to the end. The results obtained in this study were argued to pay dividends for oil and gas and petrochemical industries, and the smart systems and software can take the advantages of them. What analysis should do is to develop the current combined method with other novel outlooks to reinforce the simulated model. The effectiveness of change scenarios can be measured using the net present value method in further analysis. Future studies can pursue the forecast of the green strategies implementation in the business model in the form of a forecast graph for a short, medium, long period under 3 scenarios: pessimistic, realistic and optimistic. The models potential can be exploited by experts to prognosticate the output of applying new methods, ideas and their policies using the simulated model. In this way, managers can enter into an overtly green business sector. Alternately, a green business can provide their goods or services through an environmentally friendly process.

AUTHOR CONTRIBUTIONS

N. Barforoush performed the literature review, experimental design, analyzed and interpreted the data, prepared the manuscript text and manuscript edition. A. Etebarian performed the experiments and literature review, compiled the data and manuscript preparation. A. Naghsh helped in the literature review and manuscript preparation. A. Shahin performed some of the remained experiments.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS

%	Percentage
∑	Sum
/	Divide
+	Plus
-	Minus
***	Multiple
a_j^i	No. j element given by No. i expert
A_m	Mean of experts' opinions
am^i	Mean of experts' opinions (stage i)
Eq.	Equation
Fig.	Figure
FDM	Fuzzy Delphi method
n	Number of experts
R and D	Research and development
SD	System dynamics
U_M	Mean difference
U_s	Variance difference
U_c	Covariance difference
*z**	Crisp number

REFERENCES

Ahmad, S., (2015). Green human resource management: Policies and practices. Cogent Bus. Manage., 2(1): 1-13 **(13 pages).**

Ahmed, H.; Ahmed, M., (2017). Developing a greenometer for green Manufacturing assessment. J. Cleaner Prod. 154: 413-423 **(11 pages).**

AlKhidir, T.; Zailani, S., (2009). Going green in supply chain towards environmental sustainability. Global J. Environ. Res., 3(3): 246-251 **(6 pages).**

Azzone, G.; Noci, G., (1998). Identifying effective PMSs for the deployment of green manufacturing

Strategies. Int. J. Operations Prod. Manage. 18(4): 308-335 **(28 pages)**.

Beheshti, H., (2004). Gaining and sustaining competitive advantage with activity based cost management system. Ind. Manage. Data Syst., 104(5): 377-383 **(7 pages).**

Bose, R., (2004). Knowledge management metrics. Ind. Manage. Data Syst., 104(6): 457-468 **(12 pages).**

Boyle, C., (2004). Considerations on educating engineers in sustainability. Int. J. sustainability higher Educ., 5(20): 147-155 **(9 pages).**

Brown, D., (2008). It is good to be green environmentally friendly credentials are influencing business outsourcing decisions. J. Global Oper. Strategic Sources. 1(1): 87-95 **(9 pages).**

Cheng, C.H.; Ching, H.; Lin, Y., (2002). Evaluating the best main battle tank using fuzzy decision theory with linguistic criteria evaluation". Eur. J. Oper. Res., 142: 174-186 **(13 pages).**

Čekanavičius,L.; bazte,R.; Dičmonaitė,A., (2014). Green business: challenges and practices. J. Econ. Cyprus Soc. 93(1): 74-88 **(15 pages).**

Daily, B.F.; Bishop, J.W.; Massound, J.A., (2012). The role of training and empowerment in Environmental performance: a study of Mexican maquiladora industry. Int. J. Oper. Prod. Manage., 32(5): 631-647 **(17 pages).**

Dosi, G.; Marengo, L.; Paraskevopoulou, E.; Valente, M., (2017). A model of cognitive and operational memory of organizations in changing worlds. Cambridge J. Econ, 41(3): 775–806 **(32 pages).**

Drohomeretski, E.; Gouvea da Costa, S.; PinheirodeLima, E., (2014). Green supply chain management: drivers, barriers and practices within the Brazilian automotive industry. J. Manuf. Tech. Manage., 25(8): 1105-1134 **(30 pages).**

Farnadpour,A.(2016). The application of fuzzy delphi method (FDM) for evaluating the factors affecting sustainable tourism in order to develop a model for sustainable tourism. Int. J. Bus. Manage. , 18(9):23-29**(7 pages).**

Fenwick, T. (2007). Developing organizational practices of ecological sustainability: A learning perspective. Leadersh. Organ. J. Dev., 28(7): 632-645 **(14 pages).**

Foray, D., (2014). From smart specialization to smart specialization policy. Eur. J. Innovation Manage., 17(4): 492-507 **(16 pages).**

Forrester, J.W., (1997). Industrial dynamics. J. Oper. Res. Soc., 48(10): 1037-1043 **(7 pages).**

Fraccascia,L. ; Giannoccaro,I. ;Albino,V. (2018). Green product development: What does the country product space imply? J. Cleaner Prod., 170: 1076-1088**(13 pages).**

Gosselin, M., (2005). An empirical study of performance measurement in manufacturing firms. Int. J. Prod. Perform. Manage. , 54(5): 419-437 **(19 pages).**

Geissdoerfer, M.; Savaget, P.; Bocken, N.M.P.; Hultink, E.J., (2017). The circular economy: a new sustainability paradigm. J. Cleaner Prod., 143: 757–768 **(12 pages).**

Haddock,J., (2005). Consumer influence on internet-based corporate communication of environmental activities: the UK food sector. Br. Food J., 107(10): 792-805 **(14 pages).**

Hart, S.L., (2005). Capitalism at the crossroads: The unlimited business opportunities in solving the world's most difficult problems. 3: 57-80 **(24 pages).**

laimani,S.,Soudunsaari,A.,Hakanen,M.,Kuivaniemi,L.,Suoranta,M. (2015). Performance estimation of networked business models: case study on a Finnish eHealth Service Project. J. Bus. Mod. 2(1), 71-88**(18 pages).**

Henriksen,K., Bjerre,M., Almasi,A.M., Damgaard-Grann,E.,(2012), green business model innovation: conceptualization report.

Nordic innovation Public. 2: 18-30 **(13 pages).**

Hsu, D.W.L.; Shen, Y.C.; Yuan, B.J.C.; Chou, C.J., (2015).Toward successful commercialization of university technology: Performance drivers of university technology transfer in Taiwan. Technol. Forecast. Soc., 92: 25-39 **(15 pages).**

Jabbour, C.J.C.; de Freitas, T.P.; Soubihia, D.F.; Gunasekaran, A.; Jabbour, A.B.L.D.S., (2015). Green and competitive: empirical evidence from ISO 9001 certified Brazilian companies. Total Qual. Manage. J., 27(1): 22-41 **(20 pages).**

Jaju, S.B.; Mohanty, R.P., (2008). Economics of environment management system: a quality cost perspective. First International Conference on Emerging Trends in Engineering and Technology Conference. Inst. Electr. Electron. Eng. India: Nagpur, Maharashtra. 16-18 July.

Kanger, L.; Schot, J., (2019) deep transition: theorizing the long term pattern of socio-technical change. Environ. Innovation Societal Transitions, 32: 7-21 (**15 Pages).**

Kasztelana, A., (2017). Green growth, green economy and sustainable development: terminological and relational discourse. Prague Economics Papers. (4): 487–499 **(13 pages).**

Kannan, D.; Jabbour, A.B.L.; Jabbour, C.J.C., (2014). Selecting green suppliers based on GSCM practices: Using Fuzzy TOPSIS applied to a Brazilian electronics company, Eur. J. Oper. Res., 233(2): 432-447 **(16 pages).**

Khan, M., (2015). Green human resource management: a prerequisite for sustainable environment. Prog. Sci. Eng. Res. J., 18(03): 2-6 **(5 pages).**

Koo, H.; Chung, N.,(2014). Examining the eco-technological knowledge of smart green IT adoption behavior: A self-determination perspective. Technol. Forecast. Soc. Change. 88:140-155 **(16 pages).**

Kujala, S.; Artto, K.; Aaltonen, P.; Turkulainen, V., (2010). Business models in project-based firms towards a typology of solution-specific business models. Int. J. Project Manage. 28(2): 96-106 **(11 pages).**

Lash, J.; Wellington, F., (2007). Competitive advantage on a warming climate. Harvard Bus. Rev., 85(3): 94-103 **(10 pages).**

Lee, T.L.; Tunzelmann, N., (2005). A Dynamic Analytic Approach to National Innovation Systems: The IC industry in Taiwan. Res. Policy. 34:425–440 **(16 pages).**

Leitão, A.; Cunha, P.; Valente, F.; Marques, P., (2013). Roadmap for business models definition in manufacturing companies. Int. Acad. Prod. Eng., 7: 383-388 **(6 pages).**

Lin, B.; Jones, C.; Hsieh, C., (2001).Environmental practices and assessment: a process perspective. Ind. Mange. Data Syst., 101(2): 71-80 **(10 pages).**

Mezger, F. (2014). Toward a capability-based conceptualization of business model innovation: insights from an explorative study. R.D. Mange. 44(5): 429-449 **(21 pages).**

Meythi, l.; Martusa, M.R., (2013). Green supply chain management: strategy to gain competitive advantage. Int. J. Energy Technol. Policy. 3(11): 334-341 **(8 pages).**

Miles, I.; Saritas, O.; Sokolov, A., (2016). Foresight for science, technology and innovation. Springer Int. Publ., 6: 95-129 **(35 pages).**

Miller, R., (2007)," Futures literacy: A hybrid strategic scenario method. J. Policy Plann. Future Stud. , 39(4): 341–362 **(22 pages).**

Nunes, B.; Bennett, D., (2010). Green operations initiatives in the automotive industry an environmental reports analysis and benchmarking study. Benchmark Int. J., 17(3): 396-420 **(25 pages).**

Paille, P.; Chen, Y.; Boiral, O.; Jin, J., (2013). The impact of human resource management on environmental performance: an employee-level study. J. Bus. Ethics, 121(3): 1-16 **(16 pages).**

Rehman, M.A.; Seth, D.; Shrivastava, R.L., (2016). Impact of green manufacturing practices on organizational performance in Indian context: An empirical study. J. Cleaner Prod., 137: 427-448 **(22 pages).**

Rohrbeck, R.; Schwarz, J.O., (2013). The value contribution of strategic foresight: Insights from an empirical study of large European companies. Technol. Forecast. Soc. Change, 80: 1593–1606 **(14 pages).**

Rusinko, C.A., (2007). Green manufacturing: an evaluation of environmentally sustainable manufacturing practices and their Impact on competitive outcomes. IEEE Eng. Manage. Rev., 54(3): 445-455 **(11 pages).**

Sakao, T., (2009). Quality engineering for early stage of environmentally conscious design. Total Qual. Manage. J., 21(2): 182-193 **(12 pages).**

Schot, J.; Steinmueller, W.E., (2018). Three frames for innovation policy: R and D, systems of innovation and transformative change. Res. Policy, 47: 1554–1567 **(14 pages).**

Shen, L.; Olfat, L.; Govindan, K.; Khodaverdi, R.; Diabat, A., (2013). A fuzzy multicriteria approach for evaluating green supplier's performance in green supply chain with linguistic preferences. Resour. Conserv. Recycl., 74: 170–179 **(10 pages).**

Shivangi, V.; Santosh, B., (2018), Implementation of green supplier development process model in Indian automobile industry, Manage. Environ. Qual. Int. J., 29(5) 5: 938-960 **(23 pages).**

Simpson, D.; Power, D.; Samson, D., (2007). Greening the automotive supply chain: a relationship perspective. Int. J. Oper. Prod. Manage. , 27(1): 28-48 **(21 pages).**

Thomas, M.; Costa, D.; Oliviera, T., (2016). Assessing the role of IT-enabled process virtualization on green IT adoption. Inf. Syst. Front., 18(4): 693-710 **(18 pages).**

Wagner, M., (2009). Innovation and competitive advantages from the integration of strategic aspects with social and environmental management in European firms, Bus. Strategy Environ., 18(5): 291-306 **(16 pages).**

Werbach, A., (2010). Strategy for sustainability: a business manifesto. Harvard Bus. School Public. 3: 53-84 **(32 pages).**

Winston, A.S., (2010). Green Recovery, Harvard Bus. Press, 2: 60-88 **(29 pages).**

Yazdimoghaddam, J., Salehowlia, M., Bandarian, R., (2018). Developing a fuzzy expert system to predict technology commercialization success. J. Ind. Syst. Eng., 11(2): 228-250 **(23 pages).**

Zailani, S.H.M.; Eltyeb, T.K.; Hsu, C.C.; Tan, K.C., (2012). The impact of external institutional drivers and internal strategy on environmental performance. Int. J. Oper. Prod. Manage., 32(6): 721-745 **(25 pages).**

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