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Review Paper

Interpretive structural modeling of factors representing potential of M-Commerce in agrochemical marketing

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Abstract

Present research focuses on investigating the dimensions of services provided by m-commerce in agricultural input marketing considering the opinions of the farmers in the present marketing field. What is to be studied in this research work is to know how worthily it is to use the mobile phone in the agri-input marketing platform for the farmers based in the rural parts of our country. In the present work, interpretive structural modeling (ISM) of factors representing potential of m-commerce in agrochemical industries is accomplished. For this purpose, first of all a systematically designed questionnaire was sent to 152 customers of agrochemical industries and with the help of responses and the principal component analysis, seven factors were investigated. The identified factors were aesthetics, user friendliness, and curiosity for new discovery, ease of use, suitability, reliability and cost. In next step, another systematically designed questionnaire was framed by using interpretive structural modeling approach to find the relationships of the factors.

Keywords: Mobile (M)-commerce, agrochemical marketing, interpretive structural modeling.

Introduction

Any transaction having a monetary worth is M-commerce which may be conducted with the help of a mobile telecommunications network[1]. According to Sadeh *et al.* m-commerce mainly is the upcoming applications and services both together used by all of us from our mobile devices which are Internet-enabled[2]. This can be considered, according to the statistics as a logical step for the purchasers and Indian businessmen. In the present scenario where the mobile handsets and smart phones are growing and developing tremendously and use of debit and credit cards has increased, there are chances of strong growth in mobile commerce. Mobile technology also offers the edge over competitors. M-Commerce can be seen as a part of E-Commerce.

Following are few of the benefits of M-Commerce in comparison to E-commerce: i. Consumers can access the service in M-commerce at any place which is not possible in E-Commerce; ii. M-Commerce is more securing than E-Commerce as users have authentication number; iii. M-Commerce is more convenient than E-Commerce in terms of using, carrying and handling the mobile devices; iv. Internet connectivity is always needed in e-commerce but m-commerce does not have such boundaries; v. Video conferencing can also be done through m-commerce but it is not possible in e-commerce; vi. Electricity is also one of the factors of necessity which is not in m-commerce; vii. M-commerce is costlier than e-commerce; and viii. M-commerce is much easier than e-commerce.

In our country, m-commerce has influenced many conventional fields, out of which its contribution to agriculture cannot be overlooked. As per the estimates of Central Statistics Office agriculture contributes 15.35% of the country's Gross Domestic Product (GDP) which is a considerable figure and so the Indian agriculture sector is still the backbone of the nation's economy as earlier time. In agriculture m-commerce is used by farmers and associated personnel in the marketing of agro-chemicals. Agrochemicals are the chemicals used in agriculture, including chemical fertilizers, herbicides, and insecticides. For the improvement and protection of the crops and livestock, agro-chemicals are used around the globe since many years. Good yields from crops are obtained by applying fertilizers as the crops are protected from insects and diseases by using the pesticides at the right time. By veterinary treatment such as vaccination, oral dosing or immersion dipping the animals are similarly protected from parasites and diseases.

In present research work, investigations about the relationships of factors representing potential of m-commerce in agrochemical industries are made. The research work is of *four fold* types, and includes literature on agrochemical marketing in India, interpretive structural modelling, case study, and concludes with conclusion and future implications of the research.

Agrochemical marketing in India

The agrochemical markets are established in India and it is considered as one of the best in the world. As our total

consumption amounts to about five hundred million tones India stands at tenth position in the world in pesticide consumption. Among the South Asian and African countries, with the exception of Japan, India is presently the largest manufacturer of basic pesticides. The Indian pesticides market which is 1.6% of the worldwide market pie ranks the twelfth largest in the world with a worth of US$0.6 Billion. India, with a total capacity installed of technical grade pesticides having an enormous and moderate scale and four hundred pesticide formulators (of all sectors) spread all through the country to be used in agriculture and farming, public health of the people, household and plant protection is one amongst the foremost dynamic generic pesticide industries within the world. Overall, it may be said that there is a bright future for agro-chemical firms in Bharat in the post-patent era.

The generic products having 80th of molecules or more than that which are non-patented forms the dominating part of the Indian crop protection trade. And this is the reason for a very low entry and makes it a barrier for the trade. Hence, the number of the important factors for firms to succeed includes robust distribution network, acceptable evaluation, and complete recall and dealer margins. Technical grades are used to manufacture the crop protection chemicals and later on converted into formulations for agricultural use.

Nearly 75-80% of the market share in India is controlled by the top 10 corporations. The portfolio of the product and the presentation and introduction of recent molecules plays an important role in the market share of huge players. Different types of mergers, amalgamations and acquisitions with giant players purchasing out little producers have been observed in the market. And later for further expansion in markets firms also are searching for strategic alliances and partnerships.

Pesticides dominate the Indian crop protection market and which makes almost 60 percentage of the domestic crop protection chemicals market. The rice and cotton crops are the most important crops where theses pesticides are applied. Of the total crop protection chemicals market respectively, fungicides and herbicides are the biggest growing segments accounting for 18 and 16% respectively. The sale of herbicides is seasonal as the weeds grow in damp and warm weather and die in cold seasons. The main crops are rice and wheat where the herbicides are used intensively. The key growth drivers for herbicides are the increasing labor costs and labor shortage. The fungicides are usually used in fruits, vegetables and rice. The fungicides embrace a shift in agriculture from cash crops to fruits and vegetables due to the key growth drivers and government support for exports of fruits and vegetables. All biological materials organisms, which might be used to control pests, form Bio-pesticides which are used to control pests. At present bio- pesticides represent only 3rd of Indian crop protection market; however there are chances of significant growth opportunities for this product phase if we increase our considerations towards safety and toxicity of pesticides, strict and tight rules and the government support. Andhra Pradesh and the surrounding geographic region are prime 3 states contributing to 45th of pesticide consumption in India. The leading consumer with 21st share is no other but Andhra Pradesh. The top seven states account for quite seventieth of crop protection chemicals usage in India.

Agricultural production and protection of technology ought to play an important role in order to satisfy the requirements of a growing population. Insects, pests, weeds, rodents, nematodes damages substantial food production during storage. Pesticides are currently basic needs for agriculture productions. All the countries in the world use pesticides. In spite of various hazards pesticides trade has been enjoying an important role in green revolution. Due to insects, pests, plant pathogens, weeds, rodents, birds an appreciable quantity of food is lost as a result in storage. Insecticides, fungicides, herbicides, rodenticides, nematicide form pesticides at completely different stages of agricultural production.

Pesticides which embrace fungicides, herbicides, rodenticides, miticide, nematicide are primarily derived from numerous chemicals that are initially manufactured as technical grade product and later they are converted into approved formulations (powder, emulsions, concentrates). Low capacity utilization has been observed in the Indian pesticide trade. At present we are using 146,000 tonnes which has low capacity utilization of <60%. The high inventory attributable to seasonal and irregular demand on account of monsoons affects the trade. The consumption pattern of pesticides in Bharat compared to the remainder of the planet creates a marked distinction. But on the other hand herbicides and fungicides have a considerably higher share within the world market and they account for seventy six % of the entire domestic market. Seventieth of total agrochemical consumption is only used by crops like cotton, wheat and rice alone. As compared to different countries the consumption of chemical is low.

Interpretive Structure Modeling (ISM)

A set of different direct and indirect related elements are structured into a comprehensive systemic model and an interactive learning process is formed known as ISM. The structure of the system is complicated by the presence of directly or indirectly related elements which may or may not be articulated in a clear fashion. Where the structure is not clearly defined, it becomes difficult to deal with such a system. Hence, *interpretive structural modeling* (ISM) is such a methodology which aids in the identification of a structure within a system. Order and direction on the complexity of relationships amongst the elements of a system is done with the help of ISM methodology[3]. ISM is a powerful technique, which can be applied in various fields[4-6]. The ISM technique has the different steps involved like[7-10]: i. Identification of elements which are affects the problem or issues-survey can be done, ii. A contextual relationship must be established between elements

with respect to which examination of the pairs of elements would be done; iii. Pair-wise relationship between elements of the system is indicated by developing a structural self-interaction matrix (SSIM) of elements. To denote the direction of relationship between barriers (i and j) we have used the following four symbols: V – To get barrier j, Barrier i helps; A – To get barrier i, Barrier j helps; X – To get each other Barriers i and j will help; and O - Barriers i and j are unrelated. iv. A Reach ability matrix is developed from the SSIM, and transitivity is checked – the basic assumption in ISM is the transitivity of the contextual relation which states that if element A is related to B and B is related to C, then A is related to C. Binary matrix is used in the SSIM called the initial Reachability matrix by substituting V, A, X and O by 1 and 0 as per given case. The substitution of 1s and 0s are as per the following rules: (a) If the (i, j) entry in the SSIM is V, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0; (b) If the (i, j) entry in the SSIM is A, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1; (c) If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1; and (d) If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0. v. Dividing of the reachability matrix into different classes; vi. Depending on the relationships given from the division in the reachability matrix, a directed graph (digraph) is drawn, and the transitive links are removed; vii. By replacing element nodes with the statements an ISM-based model is converted; and viii. To check for conceptual inconsistency and making the necessary alterations the model is reviewed.

Case Study

In present research work, first of all, with the help of principal component analysis factors representing potential of m-commerce to the agrochemical marketing industries were determined. For this purpose, again, a systematically designed questionnaire was given to 152 customers of agrochemicals. Different abbreviated factors are presented in Table-1.

Table-1: Different Factors representing Potential of M-commerce in Agrochemical Marketing.

S. No.	Factors	Abbreviation
1.	Aesthetics	F_1
2.	User friendliness	F_2
3.	Curiosity for new discovery	F_3
4.	Ease of use	F_4
5.	Suitability	F_5
6.	Reliability	F_6
7.	Cost	F_7

After getting the responses, as a next step, Structural self-interaction matrix was finalized by the candidate, which was simply the collection of responses. Table-2 shows the Structural Self –Interaction Matrix.

In the next step, SSIM is converted into the initial reachability. The initial rechability matrix is shown in Table-3.

Next step is to calculate driving and dependence powers for factors. Table-3 also shows the driving and dependence powers of the factors. Each factor's driving power is the total number of factors (along with the factor), which may help in getting. The total number of factors is dependence (along with the factor), which may help in getting it.

Table-2: Structural Self Interaction Matrix (SSIM).

Factors	F_7	F_6	F_5	F_4	F_3	F_2	F_1
F_1	V	V	V	X	X	X	
F_2	X	V	V	O	X		
F_3	X	V	V	V			
F_4	A	V	O				
F_5	A	V					
F_6	A						
F_7							

Next step was targeted to identify the levels of factors. For this purpose, first driving and dependence powers of factors was identified. The factors will be found eligible for leveling for which intersection set and Reachability set will be equal. This is shown from Table-4 to Table-7. Finally, levels of all the factors were obtained, as shown in Table-8.

Table-3: Initial Reachability Matrix.

Factors	F1	F2	F3	F4	F5	F6	F7	Driving Power
F_1	1	1	1	1	1	1	1	7
F_2	1	1	1	0	1	1	1	6
F_3	1	1	1	1	1	1	1	7
F_4	1	0	0	1	0	1	0	3
F_5	0	0	0	0	1	1	0	2
F_6	0	0	0	0	0	1	0	1
F_7	0	1	1	1	1	1	1	6
Dependence Power	4	4	4	4	5	7	4	

Table-4: Iteration for Level I.

Factors	Rechability set (Factors No.)	Antecedent set (Factors No.)	Intersection (Factors No.)	Level
F1	1,2,3,4,5,6,7	1,2,3,4	1,2,3,4	
F2	1,2,3,5,6,7	1,2,3,7	1,2,3,7	
F3	1,2,3,4,5,6,7	1,2,3,7	1,2,3,7	
F4	1,4,6	1,3,4,7	1,4	
F5	5,6	1,2,3,5,7	5	
F6	6	1,2,3,4,5,6,7	6	Level-I
F7	2,3,4,5,6,7	1,2,3,7	2,3,7	

Table-5: Iteration for Level II.

Factors	Rechability set (Factors No.)	Antecedent set (Factors No.)	Intersection (Factors No.)	Level
F1	1,2,3,4,5, 7	1,2,3,4	1,2,3,4	
F2	1,2,3,5, 7	1,2,3,7	1,2,3,7	
F3	1,2,3,4,5,7	1,2,3,7	1,2,3,7	
F4	1,4	1,3,4,7	1,4	Level-II
F5	5	1,2,3,5,7	5	Level-II
F7	2,3,4,5, 7	1,2,3,7	2,3,7	

In the next step a conical matrix was developed by clubbing together the factors in the same level, across the rows and columns of the reach ability matrix, as shown in Table-9. By totaling the number of ones in the rows the driver power of a barrier is derived, and by totaling up the number of ones in the columns the dependence power is derived. This analysis is also called as MICMAC Analysis.

Table-6: Iteration for Level III.

Factors	Rechability set (Factors No.)	Antecedent set (Factors No.)	Intersection (Factors No.)	Level
F1	1,2,3, 7	1,2,3	1,2,3	
F2	1,2,3, 7	1,2,3,7	1,2,3,7	Level III
F3	1,2,3, 7	1,2,3,7	1,2,3,7	Level III
F7	2,3, 7	1,2,3,7	2,3,7	Level III

Table-7: Iteration for Level IV.

Factors	Rechability set (Factors No.)	Antecedent set (Factors No.)	Intersection (Factors No.)	Level
F1	1	1	1	Level-IV

Table-8: Levels of Factors.

Factors	Rechability set (Factor No.)	Antecedent set (Factors No.)	Intersection	Level
F6	6	1,2,3,4,5,6,7	6	Level-I
F4	1,4	1,3,4,7	1,4	Level-II
F5	5	1,2,3,5,7	5	Level-II
F2	1,2,3, 7	1,2,3,7	1,2,3,7	Level-III
F3	1,2,3, 7	1,2,3,7	1,2,3,7	Level-III
F7	2,3, 7	1,2,3,7	2,3,7	Level-III
F1	1	1	1	Level-IV

Table-9: Conical form of Reachability Matrix.

Factors	F6	F4	F5	F2	F3	F7	F1	Driving Power
F6	1	0	0	0	0	0	0	1
F4	1	1	0	0	0	0	1	3
F5	1	0	1	0	0	0	0	2
F2	1	0	1	1	1	1	1	6
F3	1	1	1	1	1	1	1	7
F7	1	1	1	1	1	1	0	6
F1	1	1	1	1	1	1	1	7
Dependence power	7	4	5	4	4	4	4	

On the basis of Table-9, a graph showing all the factors plotted against driving and dependence powers obtained, which is shown in Figure-1. In Figure-1, there are four quadrants, showing the nature of factors falling under.

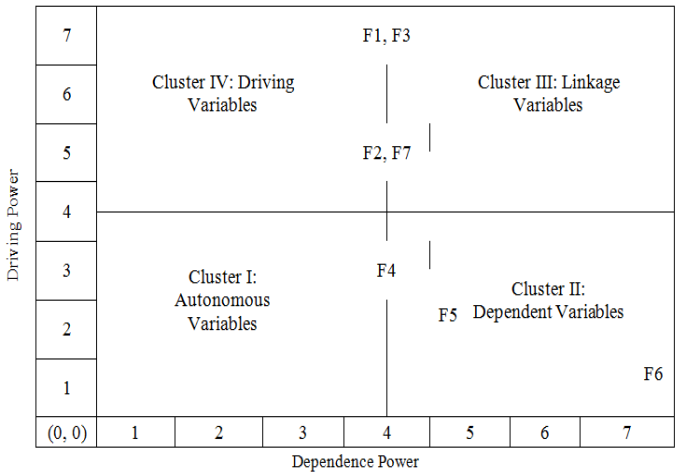

Figure-1: Cluster wise distribution of factors.

From cluster wise distribution of factors shown in Figure-1, one can investigate the levels and types of variables. In next step, diagraph preparation is accomplished with the help of SSIM. After analysis of opinions given by industry experts, candidate draws the diagraph, shown in Figure-2.

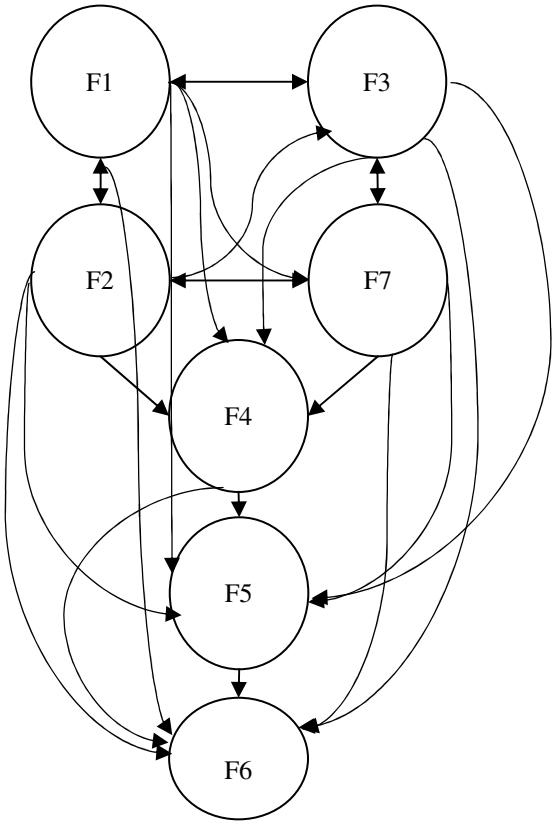

Figure-2: Diagraph (without transitivity removal).

After removal of transitivities following diagraph was obtained.

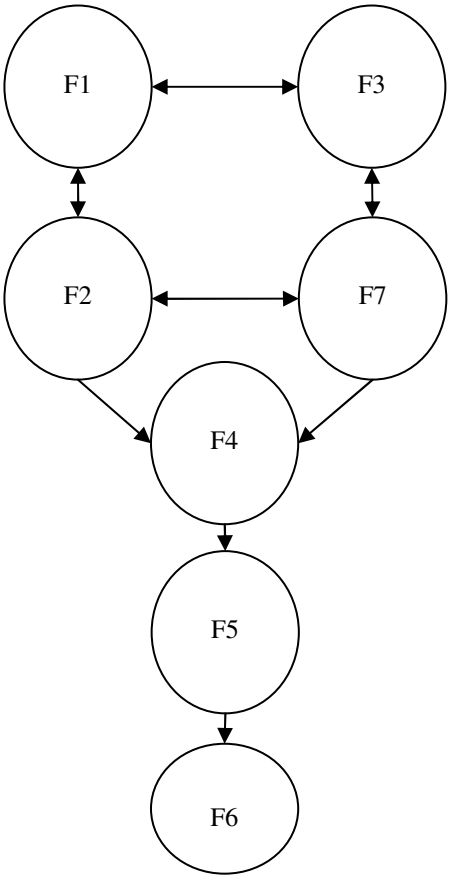

Figure-3: Diagraph (with transitivity removal).

On replacing abbreviations F_1, F_2, etc with factors following relationship tree was obtained.

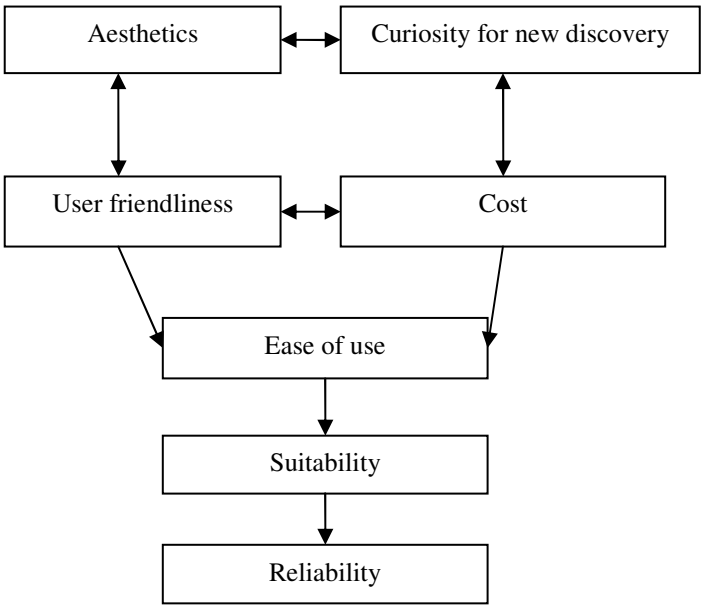

Figure-4: Relationships between Factors.

Conclusion

Figure-4 shows that aesthetics, curiosity for new discovery, user friendliness, and cost are independent variables, however all of them are mutually related. Similarly ease of use, suitability and reliability are dependent variables, which depend on above four. In this manner in present research work, relationship among different factors governing potential of m-commerce in agrochemical marketing in the country is investigated.

Future Implications of Research: Following points represent the future implications of the research. i. Relationships among the factors can be used for further research; ii. Similar research in some other field can be conducted; and iii. A vast research on a broader set of factors can be initiated.

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