International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2019, 9(3), 205-212.

Analyzing the Enablers for Turkish Defence Industry Supply Chains: An Interpretive Structural Modelling Approach

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Received: 10 January 2019 **Accepted:** 28 April 2019 **DOI:** https://doi.org/10.32479/ijefi.8085

ABSTRACT

Defense industry is one of the most important contributors to a country's power in economic and political domain. In this sector, there is always the need for continuous innovation and modernization parallel to the technological developments. In this context, aim is to improve the supply chain management for defense sector with the efforts of providing for it nationally through the life cycle management approach. The purpose of this study is to determine the conceptual enabling factors, the barriers and the targeted dynamics within the supply chain in the context of the Turkish Defense Industry and to create a model that may be useful for it. First, the detailed review of the relevant writings on the concepts affecting the defense industry and supply chain relationship performed. Then, the academic and industrial opinions about the bilateral interaction of these concepts have been obtained and analyzed with the help of interpretive structural modeling (ISM) method, which chosen as the proper decision making methodology for this work. Thus, a general model for the Turkish defense industry supply chain is established. In addition, the academic and the industrial views related to these enablers provided to the users separately and comparatively.

Keywords: Defense Industry Supply Chain, Defense Industry, Supply Chain Management, Interpretive Structural Modelling, Decision Making
JEL Classifications: H56, L10, M10

1. INTRODUCTION

Because of being located in the world's one of the most instable region, Turkey needs a developed defense industry. Beside showing a great improvement as a result of effective defense policies, Turkish defense industry is still not remain as a one of the top level countries. In this direction it is seen that there is a need for industry depth and supply chain management in order to increase domestic defense procurements and exportation (Graham and Hardaker, 1998; Jackson, 2004). Establishing a specialized supply chain which has the ability of sub system design development and creating brand is very important to decrease foreign-source dependence to admissible levels.

Purpose of this work is to determine conceptual enablers and barriers to supply chain targeted to establish within Turkish defense industry dynamics, with literature research and expert opinions in order to give some idea to Turkish defense industry firm managers about the concepts that they have to take care of. Another purpose is to analyze these determined enablers' mutual interactions on the basis of academic and sectoral expert opinions with interpretive structural modelling (ISM). Thus, an ISM based model will be revealed related to the Turkish defense industry supply chain and by means of this model, interaction levels of determined enablers will be specified. In addition, academic and sectoral opinions will be compared additionally for the interaction of these enablers.

2. LITERATURE REVIEW

High importance of *Research and Development (R&D)* Ability because of defense industry's long product life cycles than other sectors and changing customer requirements in this period is indicated by Jakson (Jackson, 2004). Graham and Hardaker stated that firms that having technology development strategies rather than chasing economic advantages will cooperate with their customers more closely and be more competitive in terms of problem solving, cost reduction and quality assurance (Graham and Hardaker, 1998). Instead of just buying and selling action, long-term relations based on information sharing have to establish as Gates stated (Gates, 2004). Likewise also Dowdall indicated the necessity to increase information sharing levels of technology sub-contractors and close “knowledge gaps” when a base-spread supply chain is considered (Dowdall, 2004). Ignoring this interaction means having a limited information sharing will reveal many actions that not creating any value inside supply chain and as a natural result decrease in economic sustainability and competitiveness will rise in front of us.

According to works of Sinkovics et al. (2011), it is seen in literature that information technology usage is mostly effect flexibility and trust concepts in supply chains. However, it should not be forgotten that using a new information technology will only provide a temporary competitiveness as Fawcett et al. stated. Here the important thing is to maintain this enabler as an approach (Fawcett et al., 2011). Another important enabler for defense supply chains is economic sustainability. Hoffmann et al., indicated that environmental, social and ethical risks may damage financial structure also economic sustainability in supply chains (Hofmann et al., 2014). In addition, Elrod et al., referred to have a flexible supply understanding for especially duplicate production firms in defense industry supply chains, in order to present quality products while not decreasing profitability means to stay competitive (Elrod et al., 2013). As Middleton et al. Stated, to achieve staying competitive by increasing genuine product development ability, if and only think is to have an adequate design and test infrastructure (Middleton et al., 2006). Planned infrastructure should be absolutely in international level and accredited and meet also commercial and international demands. In additionally Graham and Hardaker indicated that developing trust based relationships would avail much more than establishing value based relationships through long term contracts in supply chains (Graham and Hardaker, 1998). Also trust will be the sole concept for clarity and information sharing as Dowdall stated (Dowdall, 2004). Beside all these Johnsen et al. indicated the importance of planning, acting and controlling with program management understanding while considering the big picture within huge defense projects (Johnsen et al., 2009). Additionally defense firms of the future should have innovative approaches following commercial technology developments closely and plan to develop solution range always. In this direction, it is seen in last years that innovative competitiveness culture has been growing on knowledge developing and speed as Hult et al. stated (Hult et al., 2013). Especially Mavengere indicated the need of high level qualified human resource through defense supply chains that are using and developing high technology products (Mavengere, 2013). At least one remarkable thing is the *Collaboration* of defense industry cluster firms, universities and research centers. Also as Quetlas and Grau indicated, it would be provided to benefit from not only the universities’ and research centers’ fund of knowledge also take advantage of test and experiment opportunity (Quetglás, Ethics, and 2002 n.d.). Thus a safe development environmental will be ensured as spin-off of the commercial products that would be developed previously for defense industry as Bellais and Guichard (2006) indicated. As the result of literature research main enablers of Turkish Defense Industry Supply Chain and related example references are given in Table 1.

3. ANALYZING TURKISH DEFENSE INDUSTRY SUPPLY CHAIN ENABLERS

Mostly used multi criteria consideration methods used in academic researches about Turkish deference industry are goal programming (GP), analytic hierarchical process (AHP) and analytic network process (ANP) (Ersöz and Kabak, n.d.). However, except from these methods, in order to collect multi-dimensional academic and sectoral opinions without using any quantitative data for the research model, interpretive structural model (ISM) method is preferred.

3.1. Interpretive Structural Modelling

Interpretive structural model (ISM) founded by John N. Warfield, is a method that is using to describe and explain the factors and interfacing relations appertaining to a problem by power factors (Aykın et al., 2014). First of the five stages of the method is identifying the concepts related to the problem. After initial conceptual enablers are identified by the expert opinions a

Table 1: Enablers of Turkish defense industry supply chain and related references

Defense industry supply chain related elements		References
E1	R&D ability	Gates, 2004; Graham and Hardaker, 1998; Jackson, 2004.
E2	Information sharing	Datta and Christopher, 2011; Dowdall, 2004; Gates, 2004
E3	Information technology usage	Fawcett et al., 2011; Mavengere, 2013; Sinkovics et al., 2011
E4	Economic sustainability	Gates, 2004; Hofmann et al., 2014; Wahl and Bull, 2014
E5	Flexibility	Dowdall, 2004; Elrod et al., 2004; Graham and Hardaker, 1998
E6	Infrastructure	Elrod et al., 2014; Middleton et al., 2006
E7	Trust	Dowdall, 2004; Graham and Hardaker, 1998; Johnsen et al., 2009
E8	Program management understanding	Dowdall, 2004; Gates, 2004; Johnsen et al., 2009
E9	Competitiveness	Elrod et al., 2014; Hult et al., 2007
E10	Qualified human resource	Gates, 2004; Graham and Hardaker, 1998; Mavengere, 2013
E11	University and research center collaboration	Bellais and Guichard 2006; Quetglás and Grau, 2002

structural self-interaction matrix (SSIM) is developed based upon the contextual supporting relations as the second stage. In the third stage, all enablers which relation structures are defined are arrayed in a holistic frame according to the driving and dependence powers to form a reachability matrix. After the necessary transitivity check in Reachability Matrix, power – dependence graph (MICMAC) is created related to the driving power and dependence of the enablers as the fourth stage. In this graph, enablers are divided in to 4 group as autonomous, dependent, linkage and in depended. At the final fifth stage interpretive structural model (ISM) based model is revealed as arraying enablers related to each other in the same level, ones dependent to others to the lower level and ones driving others to the upper level. Therefore, specific relations of the concepts and holistic structure drawn hierarchically.

3.2. Data Collection Method

After enablers of Turkish Defense industry supply chain have identified, dual relationship of these enablers is collected by an online survey based questionnaire. One choose among given options as indicated in next section is requested for every two of enablers by relevant 7 academician and 7 persons having sectoral experience. Therefore, total of 57 questions for 11 enablers are answered.

3.3. Data Collection and Structural Self-interaction Matrix

After identifying and enlisting the 11 enablers through literature review and expert opinion, the next step is to analyze these enablers. For this purpose, a contextual relationship of "reaches to" type is chosen. This means that one enabler reaches to another chosen enabler. Based on this principle, a contextual relationship is developed. Some experts, both from industry and academia, have surveyed in developing the contextual relationship among the enablers. Keeping in mind the contextual relationship for each enabler, the existence of a relation between any two enablers (i and j) and the associated direction of this relation has been decided. The following four symbols have been used to denote the direction of the relationship between two enablers (i and j):

- V is used for the relation from enabler i to enabler j (i.e. if enabler i influences or reaches to enabler j).
- A is used for the relation from enabler j to enabler i (i.e. if enabler j reaches to enabler i).
- X is used for both direction relations (i.e. if enablers i and j reach to each other).
- 0 is used for no relation between two enablers (i.e. if enablers i and j are unrelated) (Table 2).

3.4. Reachability Matrix

The next step is to develop the reachability matrix from structural self-interaction matrix (SSIM). This is obtained in two sub-steps. In the first sub-step, the SSIM format is converted into the initial reachability matrix format by transforming the information of each cell of SSIM into binary digits (i.e. ones or zeros) in the initial reachability matrix. This transformation has done with the following rules:

1. If the cell (i, j) is assigned with symbol V in the SSIM, then, this cell (i, j) entry becomes 1 and the cell (j, i) entry becomes 0 in the initial reachability matrix.
2. If the cell (i, j) is assigned with symbol A in the SSIM, then, this cell (i, j) entry becomes 0 and the cell (j, i) entry becomes 1 in the initial reachability matrix.
3. If the cell (i, j) is assigned with symbol X in the SSIM, then, this cell (i, j) entry becomes 1 and the cell (j, i) entry also becomes 1 in the initial reachability matrix.
4. If the cell (i, j) is assigned with symbol O in the SSIM, then, this cell (i, j) entry becomes 0 and the cell (j, i) entry also becomes 0 in the initial reachability matrix.

As a result, raw reachability matrix, which indicates the driving and dependence power of each enabler on others, is obtained as Table 3 below.

In the second sub-step, final reachability matrix is prepared. For this purpose, the concept of transitivity is introduced so that some of the cells of the initial reachability matrix are filled by inference. The final reachability matrix will then consist of some entries from the pair-wise comparisons and some inferred entries. The transitivity concept, which states that if a variable "A" is related to "B" and "B" is related to "C", then "A" is necessarily related to "C," is used to fill the gap, if any, in the opinions collected during the development of SSIM.

After incorporating the transitivity concept as described above, the final refined reachability matrix is obtained and is presented in Table 4.

3.5. Leveling Partitions

The reachability and antecedent set for each variable are obtained from final reachability matrix. The reachability set for a particular

Table 2: Structural Self-interaction matrix

		E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11
E1	R&D Ability											
E2	Information Sharing	A										
E3	Information Technology Usage	A	A									
E4	Economic Sustainability	X	X	V								
E5	Flexibility	A	X	X	A							
E6	Infrastructure	A	X	A	X	X						
E7	Trust	0	A	X	X	X	0					
E8	Program Management Understanding	A	X	X	A	A	0	X				
E9	Competitiveness	V	X	V	A	V	X	X	V			
E10	Qualified Human Resource	A	X	A	A	X	X	A	A	A		
E11	University and Research Center Collaboration	X	X	X	X	X	0	V	X	X	X	

variable consists of the variable itself and the other variables, which it may help to achieve. The antecedent set consists of the variable itself and the other variables, which may help in achieving them. Subsequently, the intersection of these sets is derived for all variables. The variable for which the reachability and the intersection sets are the same, is assigned as the top-level variable in the ISM hierarchy as it would not help to achieve any other variable above their own level. After the identification of the top-level element, it is discarded from the list of remaining variables. From Table 5, it is seen that the green economic sustainability and university and research center collaboration are found at level I. Thus, it would be positioned at the top of the ISM hierarchy. This iteration is repeated until the levels of each variable are found out. The identified levels aids in building the digraph and the final model of ISM. Fallowing six iterations are also given in Table 6.

3.6. Building the ISM Based Structure

For complex problems such as the one under consideration, a number of enablers may be affecting the Turkish defense industry supply chain. However, the direct and indirect relationships between the enablers describe the situation far more accurately than any individual factor taken in isolation. ISM is an appropriate methodology in such circumstances because on the basis of relationship between the variables, an overall structure can be extracted for the system under consideration. The ISM process transforms unclear, poorly articulated mental models of systems into a visible, well-defined overall structure portrayed by a graphical model.

From the final reachability matrix (Table 4), the structural model is generated by means of vertices or nodes and lines of edges. This can be depicted in a graph called a directed graph or digraph. After accounting for the transitivities as described in the ISM

Table 3: Raw reachability matrix

		E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	Dep. P
E1	R&D ability	1	1	1	1	1	1	0	1	0	1	1	9
E2	Information sharing	0	1	1	1	1	1	1	1	1	1	1	10
E3	Information technology usage	0	0	1	0	1	1	1	1	0	1	1	7
E4	Economic sustainability	1	1	1	1	1	1	1	1	1	1	1	11
E5	Flexibility	0	1	1	0	1	1	1	1	0	1	1	8
E6	Infrastructure	0	1	0	1	1	1	0	0	1	1	0	6
E7	Trust	0	0	1	1	1	0	1	1	1	1	0	7
E8	Program management understanding	0	1	1	0	0	0	1	1	0	1	1	6
E9	Competitiveness	1	1	1	0	1	1	1	1	1	1	1	10
E10	Qualified human resource	0	1	0	0	1	1	0	0	0	1	1	5
E11	University and research center collaboration	1	1	1	1	1	0	1	1	1	1	1	10
Drv. P		4	9	9	6	10	8	8	9	6	11	9	

Table 4: Refined reachability matrix

		E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	Dep. P
E1	R&D ability	1	1	1	1	1	1	1	1	0	1	1	10
E2	Information sharing	0	1	1	1	1	1	1	1	1	1	1	10
E3	Information technology usage	0	0	1	0	1	1	1	1	0	1	1	7
E4	Economic sustainability	1	1	1	1	1	1	1	1	1	1	1	11
E5	Flexibility	0	1	1	0	1	1	1	1	0	1	1	8
E6	Infrastructure	0	1	0	1	1	1	1	1	1	1	1	9
E7	Trust	1	0	1	1	1	1	1	1	1	1	0	9
E8	Program management Understanding	0	1	1	0	0	1	1	1	0	1	1	7
E9	Competitiveness	1	1	1	0	1	1	1	1	1	1	1	10
E10	Qualified human resource	0	1	0	0	1	1	0	0	0	1	1	5
E11	University and research center collaboration	1	1	1	1	1	1	1	1	1	1	1	11
Drv. P		5	9	9	6	10	11	10	10	6	11	10	

Table 5: First iteration for leveling partitions

Iteration 1					
Enablers		**Reachability set**	**Antecedent set**	**Intersection set**	**Level**
E1	R&D ability	1,4,7,9,11	1,2,3,4,5,6,7,8,10,11	1,4,7,11	
E2	Information sharing	1,2,4,5,6,8,9,10,11	2,3,4,5,6,7,8,9,10,11	2,4,5,6,8,9,10,11	
E3	Information technology usage	1,2,3,4,5,7,8,9,11	3,5,6,7,8,10,11	3,5,7,8,11	
E4	Economic sustainability	1,2,4,6,7,11	1,2,3,4,5,6,7,8,9,10,11	1,2,4,6,7,11	1
E5	Flexibility	1,2,3,4,5,6,7,9,10,11	2,3,5,6,7,8,10,11	2,3,5,6,7,10,11	
E6	Infrastructure	1,2,3,4,5,6,7,8,9,10,11	2,4,5,6,7,8,9,10,11	2,4,5,6,7,8,9,10,11	
E7	Trust	2,3,4,5,7,8,9,11	3,4,5,7,8,9,10	3,4,5,7,8,9	
E8	Program management understanding	1,2,3,4,5,7,8,9,11	2,3,7,8,10,11	2,3,7,8,11	
E9	Competitiveness	2,4,6,7,9,11	1,2,3,5,6,7,8,9,10,11	2,6,7,9,11	
E10	Qualified human resource	1,2,3,4,5,6,7,8,9,10,11	2,5,6,10,11	2,5,6,10,11	
E11	University and research center collaboration	1,2,3,4,5,8,9,10,11	1,2,3,4,5,7,8,9,10,11	1,2,3,4,5,8,9,10,11	1

Table 6: Next iterations for leveling partitions

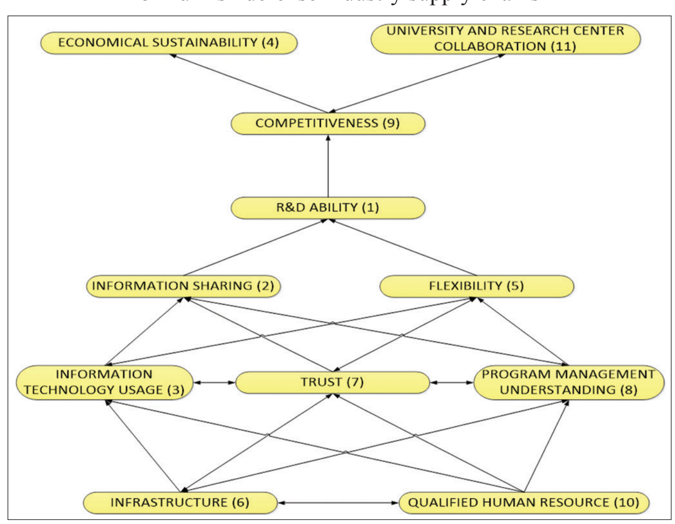
Enablers		Reachability set	Antecedent set	Intersection set	Level
Iteration 2					
E1	R&D abilit	1,7,9	1,2,3,5,6,7,8,10	1,7	
E2	Information sharing	1,2,5,6,8,9,10	2,3,5,6,7,8,9,10	2,5,6,8,9,10	
E3	Information technology usage	1,2,3,5,7,8,9	3,5,6,7,8,10	3,5,7,8	
E5	Flexibility	1,2,3,5,6,7,9,10	2,3,5,6,7,8,10	2,3,5,6,7,10	
E6	Infrastructure	1,2,3,5,6,7,8,9,10	2,5,6,7,8,9,10	2,5,6,7,8,9,10	
E7	Trust	2,3,5,7,8,9	3,5,7,8,9,10	3,5,7,8,9	
E8	Program management understanding	1,2,3,5,7,8,9	2,3,7,8,10	2,3,7,8	
E9	Competitiveness	2,6,7,9	1,2,3,5,6,7,8,9,10	2,6,7,9	2
E10	Qualified human resource	1,2,3,5,6,7,8,9,10	2,5,6,10	2,5,6,10	
Iteration 3					
E1	R&D ability	1,7	1,2,3,5,6,7,8,10	1,7	3
E2	Information sharing	1,2,5,6,8,10	2,3,5,6,7,8,10	2,5,6,8,10	
E3	Information technology usage	1,2,3,5,7,8	3,5,6,7,8,10	3,5,7,8	
E5	Flexibility	1,2,3,5,6,7,10	2,3,5,6,7,8,10	2,3,5,6,7,10	
E6	Infrastructure	1,2,3,5,6,7,8,10	2,5,6,7,8,10	2,5,6,7,8,10	
E7	Trust	2,3,5,7,8	3 5 7 8 10	3 5 7 8	
E8	Program management understanding	1,2,3,5,7,8	2,3,7,8,10	2,3,7,8	
E10	Qualified human resource	1,2,3,5,6,7,8,10	2,5,6,10	2,5,6,10	
Iteration 4					
E2	Information sharing	2,5,6,8,10	2,3,5,6,7,8,10	2,5,6,8,10	4
E3	Information Technology usage	2,3,5,7,8	3,5,6,7,8,10	3,5,7,8	
E5	Flexibility	2,3,5,6,7,10	2,3,5,6,7,8,10	2,3,5,6,7,10	4
E6	Infrastructure	2,3,5,6,7,8,10	2,5,6,7,8,10	2,5,6,7,8,10	
E7	Trust	2,3,5,7,8	3,5,7,8,10	3,5,7,8	
E8	Program management understanding	2,3,5,7,8	2,3,7,8,10	2,3,7,8	
E10	Qualified human resource	2,3,5,6,7,8,10	2,5,6,10	2,5,6,10	
Iteration 5					
E3	Information technology usage	3,7,8	3,6,7,8,10	3,7,8	5
E6	Infrastructure	3,6,7,8,10	6,7,8,10	6,7,8,10	
E7	Trust	3,7,8	3,7,8,10	3,7,8	5
E8	Program management Understanding	3,7,8	3,7,8,10	3,7,8	5
E10	Qualified human resource	3,6,7,8,10	6,10	6,10	
Iteration 6					
E6	Infrastructure	6,10	6,10	6,10	6
E10	Qualified human resource	6,10	6,10	6,10	6

methodology, the digraph is finally converted into the ISM model as shown in Figure 1.

3.7. MIC-MAC Analysis

The objective of MIC–MAC analysis is to analyze the driver power and the dependence of the variables. The variables are classified into four clusters (Figure 2). The first cluster consists of the "autonomous enablers" that have weak driver power and weak dependence. These enablers are relatively disconnected from the system, with which they have only few links, although these may be strong. The second cluster consists of the "dependent enablers" that have weak driver power but strong dependence. The third cluster contains the "linkage enablers" that have strong driving power and also strong dependence. These barriers are unstable in the sense that any action on these barriers will have an effect on others and also a feedback on themselves. The fourth cluster includes the "independent enablers" having strong driving power but weak dependence. It is observed that a variable with a very strong driving power (called a key variable) falls into either the "independent" or "linkage" categories. The driving power and the dependence of each of these enablers are shown in Table 4. In this table, an entry of "1" along the columns and rows indicates the dependence and driving power, respectively.

Figure 1: Interpretive structural modeling based model for the enablers of Turkish defense industry supply chains



When we examine MICMAC analyze, Information Technology Usage (E3), Program Management Understanding (E8) and Qualified Human Resource (E10) enablers seem the independent variables of the model. In addition, dependent variables appear as R&D Ability (E1), Economic Sustainability (E4) and Competitiveness (E9). In MICMAC analyzes, linkage enablers represent intermediate variables. In this point, we may assume nearby nodes to the path along the dependent variables to the independent variables as Mediator variables for their closer driver and dependence powers. Also relatively distant nodes to the path along the dependent variables to the independent variables may be assumed as Moderator variables because of their relatively high driver and dependence powers. Therefore, Information Sharing (E2), Trust (E7) and Flexibility (E5) enablers may be accepted as Mediator variables while Infrastructure (E6) and University and Research Center Collaboration (E11) enablers are Moderator variables.

4. DISCUSSION

4.1. Analysis and Literature Relation

In the MICMAC Analysis in Figure 2, first we see that there is no Autonomous Enabler in our chart. This means that all the selected concepts are acutely related to the Turkish Defense Industry Supply Chain and all of them should have taken in consideration. In our model, it is show up that R&D Ability, Economic Sustainability and Competitiveness concepts are the targeted abilities for Turkish Defense Industry Supply Chain. Although R&D Ability is stated as an important primer enabler for especially Economic Sustainability and Competitiveness of defense industry firms (Gates, 2004; Graham and Hardaker, 1998; Jackson, 2004); R&D Ability (E1) is qualified much more like a goal for our collected perspective. Infrastructure and university and research center collaboration are seem to be important effective factors for Turkish defense industry supply chain as parallel to the literature (Middleton et al., 2006). While Infrastructure has the highest driving power and university and research center collaboration seems to have superlative dependence power, both of them are the Moderator variables for ISM model. Especially the dependent character of University and research center collaboration among other Turkish defense industry supply chain enablers should be verified and the reason of this should be further searched. Also information sharing, trust and flexibility are indicated as intermediate variables for Turkish defense industry supply chain confirming related literature (Elrod et al., 2013; Gates, 2004; Hult et al., 2013).

One of the most important implication of ISM model and the MICMAC Analysis is to determine the basic concepts of the targeted Turkish Defense Industry Supply Chain. According to our ISM work, Information Technology Usage (Quetglás, Ethics, and 2002 n.d.), program management understanding (Gates, 2004) and Qualified human resource (Graham and Hardaker, 1998) are stated as main concepts as parallel to the literature. Turkish defense industry must consider gathering more qualified employees aimed at defense technologies with relevant trainings, workshops, etc. In addition, favorable information technologies and program management approach must be used in order to handle comprehensive interrelated defense projects expeditiously. Accordingly, Turkish Government may enhance defense industry regulations and subsidies to have an outstanding defense industry supply chain.

Figure 2: MICMAC analysis chart

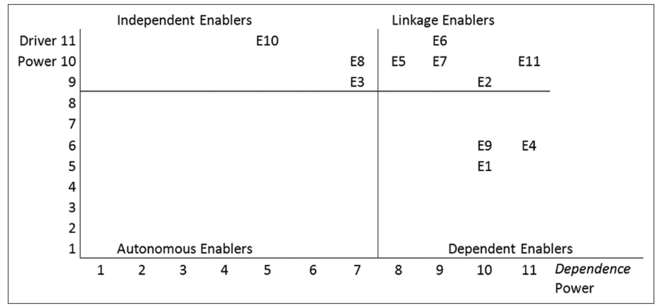


Figure 3: Academic view MIC-MAC analysis chart

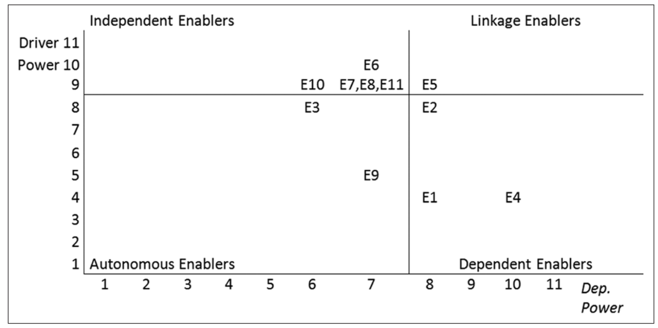
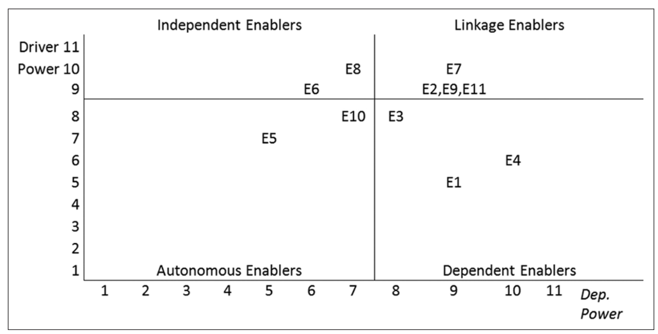


Figure 4: Industrial view MIC-MAC analysis chart



4.2. Comparison of Academic and Industrial Views

According to academic point of view MICMAC Analysis given in Figure 3, Infrastructure (E6), Trust (E7), Program Management Understanding (E8), Qualified Human Resource (E10), University, and Research Collaboration (E11) accepted as key concepts to reach R&D Ability (E1), Information Sharing (E2) and Economic Sustainability (E4) in Turkish Defense Industry Supply Chain. In addition, Information Technology Usage (E3) and Competitiveness (E9) have relatively low interaction among other supply chain concepts while Flexibility (E5) accepted as a sole intermediate variable.

On the other hand, according to industrial point of view MICMAC Analysis given in Figure 4, Infrastructure (E6) and Program Management Understanding (E8) accepted as key concepts to reach R&D Ability (E1), Information Technology Usage (E3) and Economic Sustainability (E4) in Turkish Defense Industry Supply Chain. Also Flexibility (E5) and Qualified Human Resource (E10) have relatively low interaction among other supply chain concepts while remaining concepts are accepted intermediate variables.

When we evaluate academic and industrial point of views separately for designated 11 concepts related with Turkish Defense Industry Supply Chain, some different perspectives about some concepts seen. For example while academic point of view states that Information Sharing and Flexibility have strong relation, industrial view sees no relation among these concepts. In addition, academics see no relation between Information Sharing and Qualified Human Resource while industry indicate a strong link between these concepts. However, the main difference of opinion about Turkish defense industry supply chain concepts is on Flexibility and Competitiveness. From the academic perspective, flexibility stated as a cardinal concept to adapt changing customer requests to stay competitive. Besides, industry sees competitiveness as a basis aspect rather than Flexibility for a reliable robust supply chain. Consequently, main results from this comparison for Turkish defense industry are those;

- Industry is hesitant to trust and university and research collaboration
- Academics don't see competitiveness as a superior concept
- Academics believe that information technology usage is not relatively indispensable
- Industry don't think that they can gain much from Flexibility
- Industry do not believe the power of qualified human resource much.

5. CONCLUSION

One of the major objectives of this study is to identify and rank the supply chain enablers in Turkey Defense Industry, to establish interrelations among these identified enablers using ISM and discuss the managerial implications for improving the Turkish Defense Industry Supply Chain. After analyzing collected responses of relevant academic and sectoral point of views on 11 enablers determined utilizing the existing researches already carried out, following fundamental implications are obtained;

- All of the selected concepts are acutely related to the Turkish Defense industry supply chain and all of them should have taken in consideration.
- Dependent variables of the model are as R&D ability, economic sustainability and competitiveness. Therefore, these enablers are targeted abilities of Turkish defense industry supply chain.
- Information technology usage, program management understanding and qualified human resource are the independent variables of the model, which industry professionals have to interest primarily.
- Defense industry, contrary to academics, is still hesitant to trust, university, and research collaboration along supply chain.

Beyond any doubt, sharing these findings with industry and ensuring inputs for strategic plans will gain important favors to Turkish defense industry and in consequence of county economy and security.

6. LIMITATIONS AND SCOPE FOR FUTURE WORK

In this paper, only 11 variables identified for modelling the enablers to Turkish defense industry supply chains. Further, the model developed from the perspective of academic and industrial experts. In future research, more studies that are extensive needed to explore the variables affecting Turkish defense industry supply chains of large scale. The help of experts has sought to analyze the driving power and dependence of the variables, but the framework developed depends upon the opinion of relatively few stakeholders and may have some element of bias. Through ISM, a relationship model of the variables of Turkish Defense Industry supply chains is developed but this model should validated. Path analysis or structural equation modelling approaches have the capability of testing the validity of such a hypothetical model. SEM based software could be used to further examine the relationships derived from this model. In the ISM model presented in this paper, one of the most important barriers relates to the lack of metrics to quantify the infrastructure and qualified human resource in a supply chain. However, literature has identified several measures but further research is still required to identify and develop a metric to quantify infrastructure and qualified human resource from a perspective of an integrated supply chain.

REFERENCES

Aykın, S.M., Saatçioğlu, O.Y., Özmen, O.N.T. (2014), Yapısal yorumlayıcı modelleme ile ınovasyon sürecinde karşılaşılan engellerin incelenmesi: Türkiye gerçeği. Yönetim ve Ekonomi, 17(2), 207-225.

Bellais, R., Guichard, R. (2006), Defense ınnovation, technology transfers and public policy. Defence and Peace Economics, 17(3), 273-286.

Dowdall, P. (2004), Chains, networks and shifting paradigms: the uk defence ındustry supply system. Defence and Peace Economics, 15(6), 535-550.

Elrod, C., Susan, M., Sundeep, B. (2013), A review of performance metrics for supply chain management. Engineering Management Journal, 25(3), 39-50.

Ersöz, F., Kabak, M. (2010), Savunma sanayi uygulamalarinda çok kriterli karar verme yöntemlerinin literatür araştirmasi. The Journal of Defense Sciences, 9(1), 97-125.

Fawcett, S.E., Wallin, C., Fawcett, A.M., Allred, C., Magnan, G.M. (2011), Information technology as an enabler of supply chain collaboration: A dynamic-capabilities perspective. Journal of Supply Chain Management, 47(1), 38-59.

Gates, E. (2004), The defence firm of the future. Defence and Peace Economics, 15(6), 509-517.

Graham, G., Hardaker, G. (1998), Defence sector procurement and supply chain relationships. Supply Chain Management: An International Journal, 3(3), 142-148.

Hofmann, H., Busse, C., Bode, C., Henke, M. (2014), Sustainability-related supply chain risks: Conceptualization and management. Business Strategy and the Environment, 23(3), 160-172.

Hult, G.T.M., Ketchen, D.J., Arrefelt, M. (2013), Strategic supply chain management: Improving performance through aculture of competitiveness and knowledge. Strategic Management Journal, 894, 12-20.

Jackson, I. (2004), The future of the defence firm: The case of the UK aerospace ındustry. Defence and Peace Economics, 15(6), 519-534.

Johnsen, T., Howard, M., Miemczyk, J. (2009), UK defence change and the ımpact on supply relationships. Supply Chain Management, 14(4), 270-279.

Mavengere, N.B. (2013), Role of ınformation systems for strategic agility in supply chain setting: Telecommunication ındustry study.

The Electronic Journal Information Systems Evaluation, 17(1), 100-112.

Middleton, A., Bowns, S., Hartley, K., Reid, J. (2006), The effect of defence R and D on military equipment quality. Defence and Peace Economics, 17(2), 117-139.

Quetglás, G.M., Grau, B.C. (2002), Aspects of university research and technology transfer to private ındustry. Journal of Business Ethics, 39(1-2), 51-58. Available from: https://www.link.springer.com/article/10.1023/A:1016375832641. [Last accessed on 2018 Sep 28].

Sinkovics, R.R., Jean, R.J.B., Roath, A.S., Cavusgil, S.T. (2011), Does IT ıntegration really enhance supplier responsiveness in global supply chains? Management International Review, 51(2), 193-212.