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Identification of Technological Capabilities of R&D Firms in Technology Development Zones (Tdzs): A Study in Turkish Context

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ABSTRACT: *As the need for the use of technology in production increases, the complexity of the systems are becoming harder to conduct (Cerulli & Filipetti, 2012: 877). So, enterprises need effective capabilities in management of technology in their plants. The present study aims to define the antecedents of technological capabilities by using the date obtained from some companies in Technology Development Zones (TDZs) in Turkey. A scale is adapted from the literature and sent to randomly defined sample. 195 usable responses are obtained and the data is analyzed via descriptive statistics, correlations and factor analyses. The findings showed that the new scale is good at explaining some antecedents of technological capabilities, where some are failed to be statistically be proven. The research also contains some implications for practitioners and academics for further research.*

Keywords: *Technological Capabilities, Technology Development Zones, Turkey*

I. INTRODUCTION

Globalization issued the effective use of technology in manufacturing, marketing and also the other functions of the enterprises (Khayyat & Lee, 2015: 214; Martinez-Noya and Garcia-Canal, 2011: 274). The need for the use of technology is reported to have particular importance in sustaining long-term growth especially in developing countries (Iammarino et al., 2008: 1980). So, enterprises should develop special strategies for better technology management (Corsatea (2014: 474).

Technology Development Zones are places reserved for technology development with a special circular of the Turkish government. These places are being used by spin-off and start-up firms. They are provided special tax rates and supported to have a better understanding of innovation and entrepreneurship. Iammarino et. al. (2008: 1980) mentioned that the technological capabilities may differ according to different regions. Thus, the present study aimed to measure the technological capabilities of R&D firms in Turkish TDZs.

To do so, a scale is developed by adapting the scales of the former studies in the literature. The questionnaire is pre-tested and sent to randomly defined sample. As a result, 195 usable responses are obtained. The results are analyzed via descriptive statistics, correlations and factor analyses. Findings obtained showed that the scale is good at explaining some antecedents of technological capabilities. The results are discussed and some implications are proposed.

II. LITERATURE REVIEW

Enterprises need technology in order to compete in harsh conditions of the global economy (Kim, 1998: 521). Their ability to manage technology defines their position in rivalry (Tzokas et. al., 2015: 134). The former literature covers technology management in different aspects. The literature review revealed that a trivet bunch of studies are executed in former studies. There are research attempts focusing on technology tracking (Zhou & Wu, 2010: 561; Tzokas et al., 2015: 140) and manufacturing capabilities (Zahra et. al., 2007: 1077). There are also econometric studies attempting to assess technological capabilities (Sobanke et. al., 2014: 999). The last leg of the trivet focuses on both manufacturing and process management capabilities (Iammarino et al., 2008: 2003; Coombs & Bierly, 2006: 424). To sum all up, there is need to combine all of these research types and the present study deployed a methodology covering technology tracking, manufacturing capability, process management capability, econometric measures, linkage and cooperation and technological outcomes.

Former literature is reviewed in terms of methodology, scales deployed and findings. The findings of this attempt formed the methodology of the present study. Iammarino et. al. (2008: 1980) focused on technological capabilities in global-local interactions. Their study covered the technological capabilities of enterprises according to different regions of Mexico. The findings of the study revealed that the types of technology and the perceptions of technological capabilities differ in various regions. The present study used this finding as a research question and it is used for reasoning the research attempt.

Furthermore, Tzokas et. al. (2015: 134) covered high tech SMEs' customer relationship and technological capabilities in absorptive capacity and performance context. The study investigates the relationships among the mentioned variables and includes beneficial indices for assessment of technological capabilities. The present study used these items in scale development and made use of its findings in comparison of the findings. Similar to this one, Srivastava et. al. (2015: 346) focused on absorptive capacity. They analyzed longitudinal data obtained from 178 enterprises and searched for the relationships among technological effort and technological capabilities. Their findings indicate that alliance network resources are crucial in order to develop technological capabilities of firms.

On the other hand, Cerulli & Filipetti (2012: 875) included measurement of technological capabilities. They utilized a dataset obtained from 138 countries and made an econometric analysis in terms of technological capabilities. Their findings imply that western countries are leading the technological capabilities.

Similarly, Khayyat & Lee (2015: 210) covered developing countries in terms of technological capabilities and uttered a scale to measure. They investigated 61 countries and collected data for 2003-2008 period. They also included an econometric methodology and their findings revealed that some precautions such as paying attention to education, lowering taxes in technology acquisition and developing international relations can be used in order to develop higher technological capabilities in developing countries. Contrary to these, Sobanke et. al. (2014: 991) applied a questionnaire on defining technological capabilities of firms in developing countries. They concluded that technological capability of the firm is bound to some internal and external issues. They included some indices for measuring technological capabilities and these measures are adopted by the present study.

Moreover, Zahra et. al. (2007: 1070) focused on knowledge sharing and technological capabilities. They investigated the moderating role of family involvement. Their research is based on application of a questionnaire to 209 families and their findings indicate that the family involvement can boost technological capabilities of top managers of the firms. The present study utilized some indices for measuring technological capabilities mentioned in this study.

Also Martínez-Noya & García-Canal (2011: 264) searched for technological capabilities in deciding off-shore R&D services. They argued that firms need more outsourcing in R&D activities and firms with higher local responsiveness have superior performance in outsourcing. Thus, the present study used these findings in comparing the results obtained for linkage and cooperation.

On the other hand, Tsai (2004: 183) investigated the impact of technological capabilities on firm performance in Taiwanese electronics industry context. He deployed a longitudinal study and obtained an econometric dataset. By applying models, he derived that technological capabilities of firms boost firm performance.

Corsatea (2014: 469) worked in renewable energy resources context and searched for technological capabilities for innovation activities. Similar to Tsai (2004: 183), she used an econometric model based on longitudinal data. She concluded that technological capabilities of firms boost innovation enterprise-wide.

Schoenecker & Swanson (2002: 36) worked on developing a measure for defining the technological capabilities of firms and focused on validity and performance issues. They collected data in 1988-1992 period and used an econometric scale to determine the technological capabilities. The indices used in this study are adopted by the present study.

Contrary to these, Kim (1998: 517) conducted a research on Samsung electronics and searched for technological capabilities. The study includes many information about processes and products of the firm. However, the technological capabilities are not covered.

On the other hand, Jose & Ortega (2010: 1273) applied a questionnaire to 253 companies with the aim of investigating the moderating role of technological capabilities between competitive strategies and firm performance. Their findings report that technological capabilities enhance the relationships between quality/cost orientation performance. Similar to this study, Coombs & Bierly (2006: 421) focused on measuring technological capability and firm performance. However, this study used econometric scales for measuring technological capabilities of the firms. Moreover, Figueiredo (2002: 685) investigated inter-firm differences in learning process features and technological capability accumulation. Lastly, Hsieh & Tsai (2007: 493) studied on technological capability, social capital and the launch strategy for innovative products. They concluded that the market characteristics play an important role in decision making processes of the firm managers.

Karagouni et. al. (2013: 48) focused on autotelic capabilities and their impact on technological ones. They mentioned that autotelic capabilities are more affective in high-tech institutions and have an impact on technological capabilities and firm performance.

Lastly, Zhou & Wu (2010: 547) investigated technological capability, strategic flexibility and product innovation. They deployed a questionnaire and found that strategic flexibility makes contribution to technological capabilities and thus, it can also have a secondary effect on product innovations.

To sum all up, the literature review revealed many useful information for the methodology of the present study. First of all the trivet bunch of studies are grouped and the theory of the research is derived from these studies. Moreover, the scales deployed in the former ones are adopted and a new scale is derived. Lastly, many findings are obtained in order to support the findings of the present study.
The following table depicts the trivet and the indices used for measuring the technological capabilities.

Table 1. Indicators Of Technological Capability

Indicators	**Studies**						
	Zhou & Wu (2010: 561)	**Tzokas et al. (2015: 140)**	**Zahra et. al. (2007: 1077)**	**Sobanke et. al. (2014: 999)**	**Schoenecker & Swanson (2002: 37)**	**Iammarino et al. (2008: 2003)**	**Coombs & Bierly (2006: 424)**
Acquiring important technology information	✓	✓					
Identifying new technology opportunities	✓	✓					
Responding to technology changes	✓	✓					
Mastering the state-of-art technologies	✓	✓					
Developing a series of innovations constantly	✓						
Skill in conducting applied R&D			✓				
Ability to transform R&D results to products			✓		✓		
Skill to develop new products			✓		✓		
Ability to upgrade existing products			✓				
Speed of new product development			✓				
Efficiency in developing new products			✓		✓		
Efficiency in manufacturing own products			✓				
Skill in manufacturing			✓		✓		
Overall technological skills			✓			✓	
Investment Functions				✓	✓		
Product Engineering Functions				✓			
Process Innovation Functions				✓		✓	
Process Engineering Functions				✓		✓	
Industrial Engineering Functions				✓			
Product Innovation Functions				✓			
Linkage Functions				✓	✓		✓
R&D Spending					✓		
R&D Intensity					✓		✓
Patent counts					✓		✓
Current Impact Index					✓		✓
Technology Cycle time					✓		✓
Sales/employee					✓		
Sales growth					✓		
Operating profit margin					✓		
ROE					✓		

These indices showed that, neither econometric formulas, nor perceptional scales can only be used to measure the technological capabilities of the firms. So, there is need for a holistic approach in measurement of these capabilities.

III. TECHNOLOGY DEVELOPMENT ZONES

"Technology Development Zones" were established in Turkey in 2001 with the enactment of Law No. 4691. According to the data of the year of 2016, 51 of them are still actively operating while 64 are being established with the decision of the Council of Ministers (Bilginer, 2016: 53).

By the end of 2015; The number of companies that have conducted R&D work in the TDZs in operation reached 3,744. 39% of these firms operate in the software sector, 19% in the computer and communication technology, 7% in the electronics and 5% in the machinery and equipment manufacturing areas. While a total of 38,239 personnel were employed in these regions, the number of completed R&D projects reached 18,318 and the R&D project carried out reached 8,525. The exports of technological products of these

companies reached approximately US $ 2.4 billion by the end of 2014 (www.tgbd.org.tr). There are studies about usage and importance of knowledge and technology in Turkish context (Ağır and Aydın, 2014: 283; Yeşil et. al., 2013; Bakan and Şekkeli, 2015: 39; Şahin and Yılmaz, 2013: 265; Tekin and Kılınç, 2010: 331; Taşlıyan and Bakan, 2002: 1; Gülen and Birgün, 2007: 148; Çelikçapa, 2010: 187).

IV. TECHNOLOGICAL CAPABILITIES

Firms need to use technology in order to compete in the global economy (Tzokas et. al., 2015: 135). Moreover, Tsai (2004: 183) reports that the technological capabilities of firms make impact on performance. Furthermore, Corsatea (2014: 469) concluded that technological capabilities boost innovation across the firm.

Moving here there is need for identification of robust measures for technological capabilities as their performance reflect their manufacturing and process management capabilities (Kim, 1998: 519; Zhou & Wu, 2010: 549). Furthermore, these capabilities require constant technology tracking and creating linkages and sustaining cooperation with business partners (Karagouni et. al., 2013: 56; Schoenecker & Swanson, 2002: 43). Lastly, these capabilities can result good economic indices and technological outcomes.

The present study is based on the findings and the methodology of the former research and aims to cover the trivet of technological capabilities literature. To do so, it combined the measures deployed in the former studies besides the indices used to assess the technological capabilities and included technology tracking, manufacturing and process management capability, econometric measures, linkage and cooperation and lastly technological outcomes in the theory of the research.

4.1. Technology Tracking

In order to have higher technological capabilities it is essential to focus on the developments in the state-of-art in the industry (Zhou & Wu, 2010: 561). By doing so, firms can have the advantage of responding rapid changes in the market. Moreover, Jose & Ortega (2010: 1273) reports that technological capabilities boost firm performance and they can obtain competitive advantage by benchmarking the technologies. Figueiredo (2002: 685) also reported that constantly learning and innovating organizations can boost their performance via technological capabilities. Moreover, Hsieh & Tsai (2007: 493) reported that firms should continuously track the new opportunities in order to see the changes of the market characteristics. Thus, the following hypotheses can be derived;

H1: Technology tracking capability of the firm boosts manufacturing capabilities.
H2: Technology tracking capability of the firm affects the firm's process management capability.
H3: Technology tracking capability of the firm can make contribution to econometric measures.
H4: Technology tracking capability of the firm enables the enterprise to create linkage and cooperation
H5: Technology tracking capability of the firm can boost technological outcomes (patents etc.)

4.2. Manufacturing Capability

Having an eye on the technological developments the firm is supposed to renew its manufacturing infrastructure to meet the changing demand in the market (Kim, 1998: 524). Moreover, Zhou & Wu (2010: 547) noted that strategic flexibility in manufacturing can boost technological capabilities. They also mentioned that higher technological capabilities can make contribution to product innovations. Thus, it is clear that manufacturing capability can be used as an identifier of technological capability and the following hypotheses can be derived;

H6: Manufacturing capability affects process management capability in a positive way.
H7: Manufacturing capability has a positive impact on econometric measures of the enterprise.
H8: Manufacturing capability affects technological outcomes positively.

4.3. Process Management Capability

Technological capabilities are reported to be a useful tool that can be used in benchmarking processes with rivals (Jose & Ortega, 2010: 1273). Moreover, Karagouni et. al. (2013: 48) reported that autotelic capabilities which are related to the engineering and process management issues of technological capabilities can make contribution to firm performance. Furthermore, Figueiredo (2002: 685) reported that technological capabilities are being affected by process related issues in technological capabilities. Moving here, the enterprises are supposed to have more effective process management by other technological capability indices. Thus, the following hypotheses are derived;

H9: Process management capability of the firm affects econometric measures in a positive way.
H10: Process management capability of the firm makes contribution to technological outcomes.

4.4. Econometric Measures

The econometric measures for technological capabilities are reported to be the intensity and amount of R&D, patents count, current impact index, sales growth, sales per employee, profit margin and ROE (Schoenecker & Swanson, 2002: 37; Tsai, 2004: 189; Corsatea et. al., 2014: 470). These indices are a result of many processes being held in the enterprise. If these indices are in good condition the firm managers think about new innovations and investments. So, they are supposed to be in relation with other technological capability indices. Moving here, the following hypotheses are formed;

H11: The econometric measures affect the technological outcomes of the firm.

4.5. Linkage And Cooperation

Firms need to benchmark their processes with rivals in order to see whether they are doing good or bad in the industry. To do so, they need to create linkages and cooperate with business partners. Moreover, the literature review revealed some evidence about the effects of linkages and cooperation on other indices of technological capabilities. For instance, Figueiredo (2002: 685) implied that creating linkages and cooperating with business partners can make contribution to technological capabilities of the firms. Furthermore, Hsieh & Tsai (2007: 493) reported that the market characteristics are decisive in technological capabilities of the firms. In order to have the market characteristics, firms should cooperate and create linkages. Moreover, Martínez-Noya & García-Canal (2011: 264) argued that firms with higher responsiveness to local outsourcing have superior performance in R&D and technological capabilities. Thus, the following hypothesis is derived;

H12:The linkage and cooperation ability of the firm affects other technological capability aspects.

4.6. Technological Outcomes

Tracking the new technological opportunities constantly and making innovations in the processes create many technological information that can be used in order to obtain new forms of technology (Khayyat and Lee, 2015: 216; Martinez-Noya and Garcia-Canal, 2011: 268). Thus, the level of the enterprise in obtaining technological outcomes such as patents depict that the firm is doing good in technological capabilities. As the former part of the theory of the present work includes the relations between technological outcomes and other indices, no hypothesis is developed for this construct.

V. METHODOLOGY

As indicated before, just econometric nor perceptional measures are efficient in measuring technological capabilities. So, in terms of scale development, the present study utilized the findings of the literature review and adopted a new scale. Prior studies covered the topic for their own purposes. So, prior indices used to determine the technological capabilities are assessed. Zhou & Wu (2010: 561) included acquiring important technology information, identifying new technology opportunities, responding to technological changes, mastering state of art technologies and developing a series of innovations constantly. Similarly, Tzokas et al. (2015: 140) covered acquiring important technologies, identifying new technology opportunities, responding to technology changes and mastering state of the art technologies. To this end, it is observed that technology tracking and process management capabilities must be included in the present study.

Moreover, Zahra et. al. (2007: 1077) included skill in conducting applied R&D, ability to transform R&D results to products, skill to develop new products, ability to upgrade existing products, speed of new product development, efficiency in developing new products, efficiency in manufacturing your products, skill in manufacturing and overall technological skills in order to measure technological capabilities. Moving here, it is essential to cover manufacturing capabilities and process management capabilities.

Furthermore, Sobanke et. al. (2014: 999) issued investment, product, industrial and process engineering, innovation management and linkages in order to measure technological capabilities. So, it is essential to include linkage and cooperation skills, process management skills, econometric measures and manufacturing capabilities to assess technological capabilities.

On the other hand, Schoenecker & Swanson (2002: 37) used a more tangible methodology to measure the technological capabilities. They included R&D spending & intensity, patent counts, current Impact index, science linkage, technology cycle time, new product introductions, total assets, sales/employee, sales growth, operating profit margin and ROE. This implies that econometric measures, linkage and cooperation, process management capabilities, technological outcomes and manufacturing capability should be included in the present scale. Besides these, Iammarino et al. (2008: 2003) covered the topic in a trivet of product, process and overall in terms of technological capabilities. So, it is essential to focus on the indices mentioned by other studies as a whole. Lastly, Coombs & Bierly (2006: 424) included technology strength, science linkage and strength, technology life circle, current impact index, R&D intensity and patents to measure the technological capabilities. This shows that linkage and cooperation, technological outcomes and process management capabilities should be included in the study.

To sum all up, there have been attempts to measure technological capabilities in the former studies (Zhou & Wu, 2010: 561; Tzokas et al., 2015: 140; Zahra et. al., 2007: 1077; Sobanke et. al., 2014: 999; Schoenecker & Swanson, 2002: 37; Iammarino et al., 2008: 2003; Coombs & Bierly, 2006: 424). However, the purposes of these studies are different and as a result of this fact, the measures deployed are covering different dimensions. So, the present study utilized a new methodology to measure technological capabilities by adopting the former scales. The new tool included technology tracking, manufacturing capability, process management capability, econometric measures, linkage and cooperation and technological outcomes.

The new scale is added demographic features such as age, sex, position, income and type of the firm (start up, spin off). Items included Likert-type scale ranging from 1 to 5, where 1= Strongly Disagree and 5= Strongly Agree (Tzokas et. al., 2015: 137). Then, a pre-test of the scale is applied to both academics and practitioners. The necessary points are revised and the scale is applied to a randomly defined sample in the Turkish TDZs context. In order to acquire higher response rates, follow up phone calls are made after mailing the questionnaire link (Martínez-Noya & García-Canal, 2011: 268).

The scale is sent to most of the companies in Turkish TDZs (the ones that mentioned communication information in the web sites) and as a result 195 responses are gathered.

Table 2. Demographic Features Of The Sample

		Frequency	Percent
Income (in ₺)	0-2000	47	24,1
	2001-4000	45	23,1
	4001-5750	35	17,9
	5751 or higher	46	23,6
Gender	Female	36	18,5
	Male	159	81,5
Employment	Employer	151	77,4
	Employee	44	22,6
Company type	Spin-off	57	29,2
	Start up	138	70,8
Age	21-28	48	24,6
	29-34	52	26,7
	35-39	45	23,1
	40-60	50	25,6

The sample mostly consisted of males (81,5%) and this shows that there is much to do in female entrepreneurship in Turkish context. The ages varied between 21 and 60. This shows that TDZs are being used by a large scale of people. Monthly income of the respondents are asked and it varied from 1000 ₺ to 90.000. As the age and income of the sample contained many different values, these variables are grouped into similar quartiles in terms of frequency. The companies mostly consists of start-up firms and most of the respondents are employers. This depicts that there is much to do in increasing the number of spin-off firms and the number of employment in order to achieve better economic effects. To sum all up, the sample fits with the recent situation of Turkish TDZs and further analysis can be conducted by using this data.

Table 3. Inter Item Correlations, Descriptive Statistics And Reliability Of The Measures

	TechTrack	ProMan	ManCap	Econometric	Linkage	Std. Deviation	Mean	Cronbach's Alpha	N of Items
TechTrack	1					0,89280	4,1885	0,906	4
ProMan	,745**	1				0,78079	3,9015	0,903	5
ManCap	,716**	,762**	1			0,90956	4,1718	0,868	5
Econometric	,168*	,354**	,195**	1		0,95694	3,2137	0,818	5
Linkage	,340**	,479**	,355**	,533**	1	0,84528	3,4735	0,675	5
TechOut	,357**	,526**	,357**	,278**	,401**	1,10608	3,4295	0,888	5
TechTrack= Technology Tracking, ProMan= Process Management Capability, ManCap= Manufacturing Capability, Econometric= Econometric Measures, Linkage= Linkage and Cooperation, TechOut= Technological Outcomes									
**. Correlation is significant at the 0.01 level (2-tailed).									
*. Correlation is significant at the 0.05 level (2-tailed).									

After obtaining satisfactory results from demographic features of the sample, descriptive statistics, inter-item correlations and reliability tests are conducted (Schoenecker and Swanson, 2002: 38; Sobanke et. al., 2014: 997). The results showed that all of the items asked in order to measure the same item are reliable. Also, descriptive statistics put forth the highest mean in technology tracking and the lowest in econometric measures. This finding shows that the companies are in search of new technologies, but they lack econometric resources in order to achieve their goals. The correlations show that the highest correlation is between manufacturing capability and process management capability. This finding implies that the companies are good at sustaining manufacturing activities and they also do well in process management. This finding can also explain the number

of toll manufacturing activities in Turkish context. To sum all up, the descriptive statistics and correlations showed that further analysis can be conducted with the obtained data.

Table 3. Factor Analysis Results

	Component 1	**Component 2**	**Component 3**	**Component 4**	**Component 5**
s1	0,866				
s2	0,909				
s3	0,718				
s4	0,826				
s8				0,557	
s9				0,544	
s10				0,710	
s17			0,906		
s18			0,851		
s19			0,721		
s20					0,526
s21					0,683
s22					0,576
s25		0,781			
s26		0,796			
s27		0,823			
s28		0,823			
Total Variance Explained: 71.54%					
KMO : ,921					
Bartlett's Test :O^2=4189,749, df=406, sig. 0.000					

Following the findings of the prior analysis, the study included an Exploratory Factor Analysis (EFA) and five factors are obtained. The items are reanalyzed and they are found to be asked in order to measure technological tracking, manufacturing capability, econometric measures, linkage and cooperation and technological outcomes. The KMO is found to be satisfactory (,921) in terms of acquiring sufficient sample size (Ortega, 2010: 1276). The Total Variance Explained is found to be 71,54%, which shows that the construct validity is achieved (Cerulli and Filippetti, 2012: 881; Bakan and Şekkeli, 2015: 39; Yeşil et. al., 2013: 217). However, the items used to measure the process management capability all failed to explain a factor. Thus, these items are excluded from the analysis. This analysis showed that some items are listed under another factor and further analysis is needed in order to test the theory of the research.

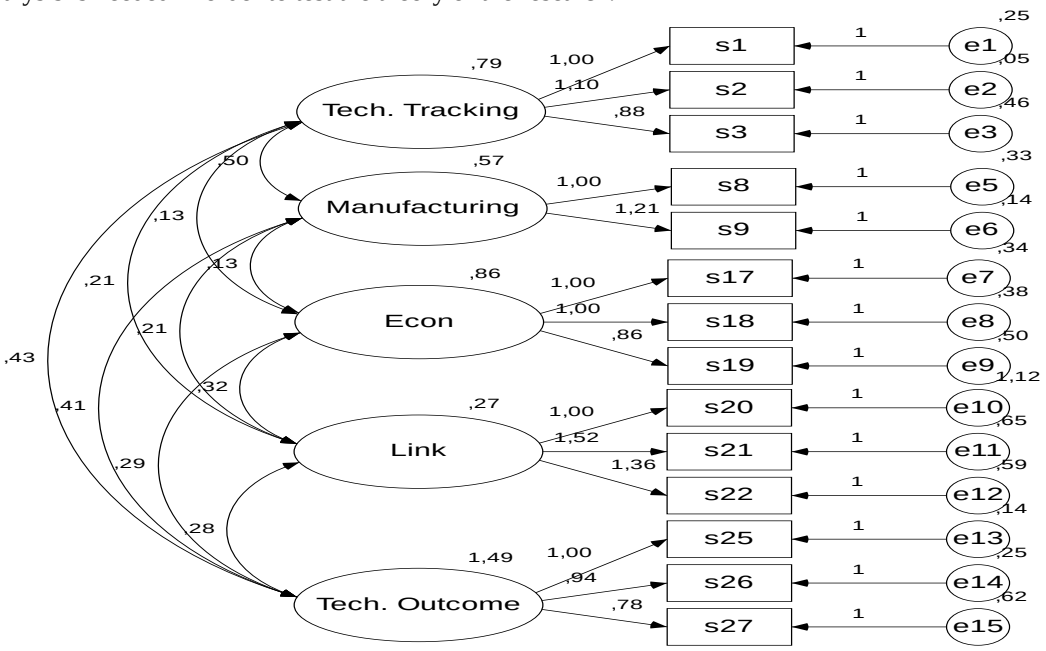

Figure 1: Confirmatory Factor Analysis (CFA) Model

By receiving the results of the EFA, a Confirmatory Factor Analysis (CFA) is done (Tzokas et. al., 2015: 138). The measurement model, depicted in Figure 1, achieved to fulfill the acceptable thresholds (CMIN/df= 2,318; RMSEA=0,,82; NFI=,911; RFI=,879; IFI=,947; TLI=,928; CFI=,947) (Zhou and Wu, 2010: 553; Zaim et. al., 2010: 89). The covariances reported positive relationships between the factors. The results of this analysis is used in testing the hypotheses;

Table 4. Hypotheses Testing Results

Hypotheses	Result
H1: Technology tracking capability of the firm boosts manufacturing capabilities.	Accepted
H2: Technology tracking capability of the firm affects the firm's process management capability.	Failed
H3: Technology tracking capability of the firm can make contribution to econometric measures.	Accepted
H4: Technology tracking capability of the firm enables the enterprise to create linkage and cooperation	Accepted
H5: Technology tracking capability of the firm can boost technological outcomes (patents etc.)	Accepted
H6: Manufacturing capability affects process management capability in a positive way.	Failed
H7: Manufacturing capability has a positive impact on econometric measures of the enterprise.	Accepted
H8: Manufacturing capability affects technological outcomes positively.	Accepted
H9: Process management capability of the firm affects econometric measures in a positive way.	Failed
H10: Process management capability of the firm makes contribution to technological outcomes.	Failed
H11: The econometric measures affect the technological outcomes of the firm.	Accepted
H12:The linkage and cooperation ability of the firm affects other technological capability aspects.	Accepted

The results of the CFA proved many hypotheses. Besides the failure in explaining the process management capability caused the failure of some hypotheses. As a result of these facts, the technology tracking capability of the firm improves manufacturing capability. There are indices in the literature supporting this finding in terms of following technological changes can boost manufacturing capability (Tzokas et. al., 2015: 135; Zahra et. al., 2007: 1073). Following up new technologies can make contribution to the financial management of the firm as H_3 puts forth. The literature is rich in studies in mentioning such kind of an effect (Schoenecker and Swanson, 2002: 36; Khayyat and Lee, 2015: 212; Tsai, 2004: 189). As indicated in as H_4technology tracking capability of the firm enables the enterprise to create linkage and cooperation. The firm should keep in contact with suppliers and make use of the latest version of the infrastructure. There are also some supporting information in the former studies (Figueiredo, 2002: 687; Hsieh and Tsai, 2007: 500). The technology tracking capability of the firm can boost technological outcomes, as proved in H_5. The literature has some supporting findings parallel to the findings of the present study in terms of technological outcomes (Srivastava et al., 2015: 352; Martinez-Noya and Garcia-Canal, 2011: 269). The manufacturing capability has a positive impact on econometric measures of the enterprise as attested in H_7. There are supporting ideas in the literature mentioning this kind of a relationship (Iammarino et. al., 2008: 1981; Tsai, 2004: 189). The study also proved that manufacturing capability of the firm affects technological outcomes positively as indicated in H_8. The literature is also rich in studies supporting this finding (Schoenecker and Swanson, 2002: 37; Khayyat and Lee, 2015: 218). As mentioned in H_{11}, the findings of the present study showed that the econometric measures affect the technological outcomes of the firm. This effect is also supported by former literature (Iammarino et. al., 2008: 1990; Tsai, 2004: 189). Lastly, the results of the study proved the relationship between the linkage and cooperation ability of the firm and other technological capability aspects. This finding is attested in $H_{12}$and has many confirmatory information in the literature (Kim, 1998: 517; Srivastava et al., 2015: 357; Tsai, 2004: 185; Sobanke et al., 2014: 992; Karagouni et. al., 2013: 519). Hypotheses testing made contribution to the literature but the failure in measuring the process management capabilities inclined the researchers to make further analysis on discriminant validity (Schoenecker and Swanson, 2002: 36; Tzokas et. al., 2015: 138; Zhou and Wu, 2010: 553). As a result of the test, values in terms of Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and Average Shared Variance (ASV).

Table. 5. Discriminant and Convergent Validity Measures

	CR	AVE	MSV	ASV	Link	Tech.Tra	Man.	Econ	Tech.O
Link	0,638	0,379	0,444	0,281	0,615				
Tech. Tracking	0,904	0,761	0,561	0,236	0,450	0,872			
Manufacturing	0,853	0,745	0,561	0,268	0,530	0,749	0,863		
Econ	0,851	0,657	0,444	0,143	0,666	0,161	0,191	0,810	
Tech. Outcome	0,914	0,781	0,197	0,153	0,444	0,393	0,440	0,259	0,884

In order to have a measure which has both convergent and discriminant validity the AVE should be higher than 0,5, and the MSV and ASV should be lower than AVE (Schoenecker and Swanson, 2002: 40; Tsai, 2004: 189; Zhou and Wu, 2010: 553; Zaim et. al., 2010: 89). The results of the analysis showed that the items used to measure linkage and cooperation failed to have discriminant and convergent validity. This finding showed that the scale used can be further applied in terms of process management capability and linkage and cooperation. On the other hand the scale is proved in terms of other technological capability antecedents.

VI. CONCLUSION, LIMITATIONS AND IDEAS FOR FUTURE RESEARCH

The present study aimed to measure the technological capabilities of the firms in TDZs in Turkish context. In order to do so, former studies are reviewed and a new scale is adapted from their factor analysis and measures. The new scale is applied to 195 firms and the obtained data is analyzed via descriptive statistics, correlations, factor analyses and discriminant and convergent validity.

The results revealed many useful information for both academics and practitioners. As discussed in the methodology, the firms in TDZs of Turkey has much to do in achieving better econometric results and gender equality in entrepreneurship. Furthermore, the study uncovered many relationships between the antecedents of technological capability. Researchers can make use of the findings and the methodology of the present study in different contexts and the measure developed can be adapted to different contexts. The results of the study brought out some research implications such as interrogating the relationships between the antecedents and focusing on the consequences of technological capabilities. Practitioners can also make use of the findings of the present study as they indicate more econometric success and pay attention to the factors in antecedents of technological capabilities. Besides the contributive results of the study, the research has major limitations. First of all, the items aimed to measure the process management capabilities failed in EFA and also the items of linkage and cooperation in CFA. This shows that the scale can be revised again and the study can be repeated in similar and different contexts. Then, it can be possible to have attested hypotheses and make a greater contribution to the literature.

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