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DESIGNING DEVELOPED LOCAL MODEL TO ASSESS TECHNOLOGICAL CAPABILITY OF AUTOMOTIVE INDUSTRY IN IRAN (CASE STUDY: MEGA MOTOR COMPANY)

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ABSTRACT

Today, technology is accounted for as a capability in new behaviors, products and strategies for companies which are in economic cycle. So, due to scientific and technological advances in various levels and also the necessity of using new and modern technologies, the assessment technology and innovation is needed more than ever. One of the major factors of failure to apply technology in order for gaining competitive advantage, in developing countries' enterprises, is the lack of knowledge and understanding of enterprise's level of technological capabilities as well as utilizing these capabilities to the relative advantages. Due to considerable importance of the development of technology, companies' senior managersare compelled to identify and evaluate their company's technological capabilities, and similarly recognizethe world's technological evolutions as well as monitor the competitors' efforts to achieve new technologies and also to improve organizational capabilities. On the other hand, this evaluation should be carried out with a model which is consistent with business atmosphere and which is localized along with the country's enterprises. This study,through applying available models and theories in the field of technological capabilities assessment, aims at providing a developed and localized model, which assesses the technology of automotive industry in Iran including Mega motor company that is one of the major partners in automotive industry; then, the utility of this model for applying in automotive Industry of Iran will be proved by statistical and computational techniques as well as experts opinions.

KEYWORDS: Technology, Technology Assessment, Technological Capabilities

Technology has always been seen as an enhancer of human capabilities, and invention of proper tools, from invention of wheel to invention of super-conductors, has helped humans (Nasir-Zadeh, 1991). Now, as a result of the increase in industrial, economical, technological developments and also the disappearance of geographical boundaries, there is an intense competition in production and delivery services; and technological growth has become one of the crucial strategic objectives of managers. Since technological development and growth in an organization is directly related to the economical development, the degree of technological developments in a plant can be viewed as a sign of its authority. In order to develop a technology, at first the specific technology should be achieved, then promotional procedures come next (Tabatabaee, 2005). Productive companies and enterprises are constantly involved in many executive issues such as, purchases, sales, supply of raw materials, accounting matters, insurance, etc. as well as drastic changes in competition environment, so, in order for remaining as a competitor, organizations must inevitably turn to the evolution of technologies as well ascreation of advanced technologies.Here, this question arises as, in the courseof achieving technology, what is the best approach for reducing technological gap? (Ja'fari-Nejad, 1995). Technological capabilities play an important role in developing the technology and economy of countries. Several countries have realized the critical importance of this role and prioritized it in their policies. In fact, developing economies of Asia are investing in it, so as to join the developed countries' league. Technological capabilities (TC) are definedas the ability to utilize modern technology in economical development of any country (Enos, 1991).

Technology and its assessment has always been a fundamental challenge for enterprise managers. Taking this in consideration, especially for those countries which are a consumer rather than a producer of technology, is more necessary (Ronasi, 2011). applying long-running assessment models and methods of technology does not work in enterprises; in other words, technical managers as well as companies and factories' experts,due to their experiences and subjective calculations, are able to determine the extent of their company's capabilities in different technological fields. It seems that technological capability models are appropriate tools for acknowledging and proving these subjective estimates. Experience suggests that those models and methods which are applied in such factories, should exhibit two basic characteristics: first, they should be simple and understandable and secondly,

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provide the results in short term. On the other hand, one of the tasks of strategic managers is to assess and audit the technology, who, with regardto environmental conditions and also their capabilities as well as examining weaknesses, should apply required strategies and policies to improve the organization and its objectives (Tabatabaee, 2005).

REVIEW OF LITERATURE

Technology is known as a systematic knowledge in manufacturing a product or offering services in industry, agriculture and/or business, also as installment or maintenance of an industrial plant or equipment or management of an industrial company (WIPO, 2010).

Technological capability assessment is a procedure in which the current level of technological capabilities and abilities of an organization is measured to identify strong and improvable points of the organization; also, to recognize the technological gaps through comparing technological capabilities of the organization with competitors or ideal technological level (Putranto, 2003).

Also, technological capabilities are considered as the ability to effectively use technical knowledge in attempts to attract, use, adopt and modify the existing technologies (Kim, 1997).

A broader perspective which is emerging in developing countries, defines technological capabilities as: TC includes the local knowledge which is derived from an indigenous learning process, in order to attract, adjust and develop the foreign technologies (Adeoti, 2002).

Another definition of technological capabilities is recalled as the ability to identify, adjust and innovate in a range of capacities of existing technologies and biological environment (Laditan, 2003).

Another definition confirmed by researchers is:technological understanding as a set of equipment, skills, knowledge, aptitudes and attitudes is able to understand, modify, utilize and create productive processes (Marcelle, 2003).

So far, different models have been provided at the level of enterprise for assessing technology. Experience suggests that those models and methods which are applied in an enterprise, should exhibit two basic characteristics: first, they should be simple and understandable, and secondly, provide the results in short term. Khamseh et al. has categorized models of technological capability assessment in other way which is shown in table 1.

Table 1: Categorizing models of technological capability assessment at the level of enterprise (Khamseh et al., 2012)

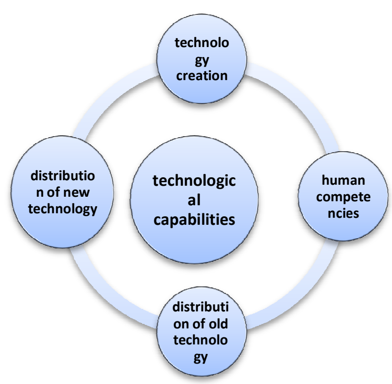
Models of determining technological gaps	Models ofassessing the causes of technological gap	Models providing solutions for compensating technological gap
Atlantic technology model	Ford's model	Ford's model
Porter's model	Lindsay model	Lindsay model
Panda and Romanson Model	Atlantic technology model	Fall model
Floyd model	Floyd model	Garcia- Arula model
Technology needs management model	Technology needs management model	Lean model
Technology content assessment model	Model of levels of technological capabilities	Technology needs management model
Technology status assessment model		Models of science and technology management information systems
EVA model		Technology needs management model

In technological capabilities assessment, all performances of a company which has value added as well as its technologies are examined in terms of enterprise's capabilities. Technological capabilities assessment, in comparison to other competitors, examines the stages of creating value added as well as existing technological gaps at the level of company's capability, and also shows the causes of the creation of gap and offers some solutions for compensating the gap.

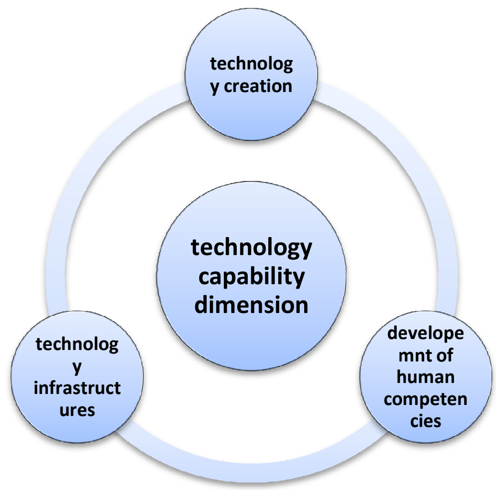
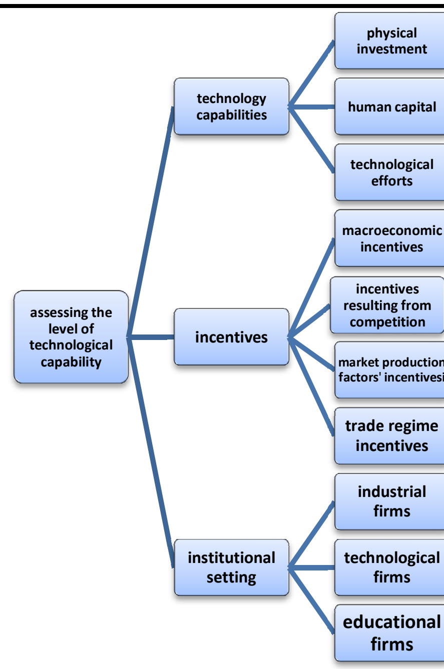
Besides, it helps the organization, along with enterprise strategy, to state the extent of enterprise capability in implementing and utilizing the potential critical existing technologies.

On the other hand, technological capability assessment models at the national level are illustrated in table 2:

Table 2: Models of technology capability assessment at national level

Assessment model	Characteristics	figure
UNDP[1] model	In this model, technological dimensions are categorized in four groups, as shown in figure 1. These dimensions are related to technological policies of all other countries (Tabatabaee, 2011). 1- technology creation: perhaps there is no need for all countries to be on the verge of technology, however, they all need adequate capacity to be innovative. Without the ability to create in terms of localizing products and procedures, the ability of being innovative in using technology cannot develop thoroughly with local situation. 2- dissemination of new technology: in order to use network era opportunities, all countries ought to adjust their innovations. 3- dissemination of old technologies: advances in technology is an accumulative process and wide dissemination of older technologies is essential for adoption of new ones. 4- human competencies: both creator and consumers of technology need human competencies. Today's technologies require adaptability, and the cornerstone of such capabilities is the fundamental	 **Figure 1: technological capabilities assessment model, UNDP**

[1]United National Development Program

	education for developing cognitive skills as well as science and mathematical competencies.	
Arko's model	3 main dimensions of this model are: technology creation, technology infrastructures, development of human competencies. This model is based on other models and reports such as, UN technology acquisition model, World economic forum model, RAND model and also some international credible reports, and to them some changes and improvements have been made (Tabatabaee, 2011).	 **Figure 2: Arko's model of technology capability assessment**
Deaf model	According to analytic model of Deaf, assessment framework of the degree of technology capability at the national level includes 3 dimension which are: technological capabilities, incentives and institutional settings (Tabatabaee, 2011).	 **Figure 3: Deaf's model of technology capability assessment**

RESEARCH QUESTIONS

1- What is the developed model for assessing technological capability in automotive industry?

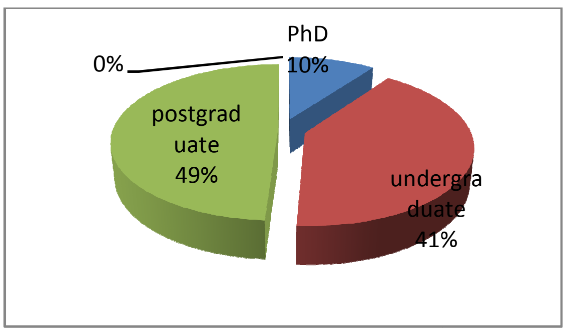
2- Has this model the necessary utility and validity to assess technological capability in automotive industry?

STATISTICAL POPULATION

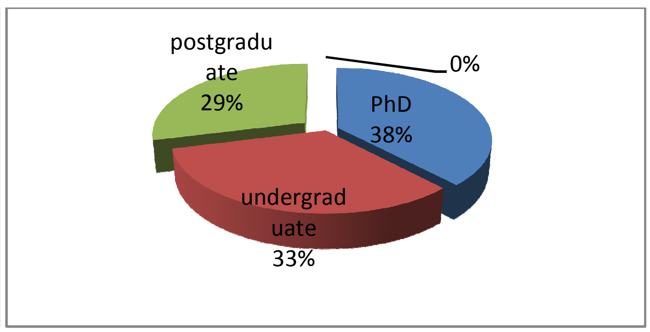
Senior and middle managers and specialists in automotive industry with undergraduate and graduate degrees as well as work experience of more than one year, known as experts, form the statistical population of this study. Statistical population is specified according to project's time conditions and also via Cochran test (table 3 & diagrams 1, 2).

Table 3: Academic profile and work experience of participants who completed questionnaire

Education	Number	Percent of total	Work experience
Undergraduate	16	41.03	
Postgraduate	19	48.72	
Phd	4	10.26	
Sum	39	100.00	



Graph 1: Education of Sample



Graph 2: Sample's Work Experience

RESEARCH FINDINGS

- **First question findings:**

Based on the comparison of technological capability assessment models at the level of enterprise, their dimension of participation is summarized according to table 4.

Also, based on the comparison of models of technological capability assessment at national level, their participation dimension are summarized in table 5.

Table 4: Comparison of technological capability dimension of models at enterprise leve

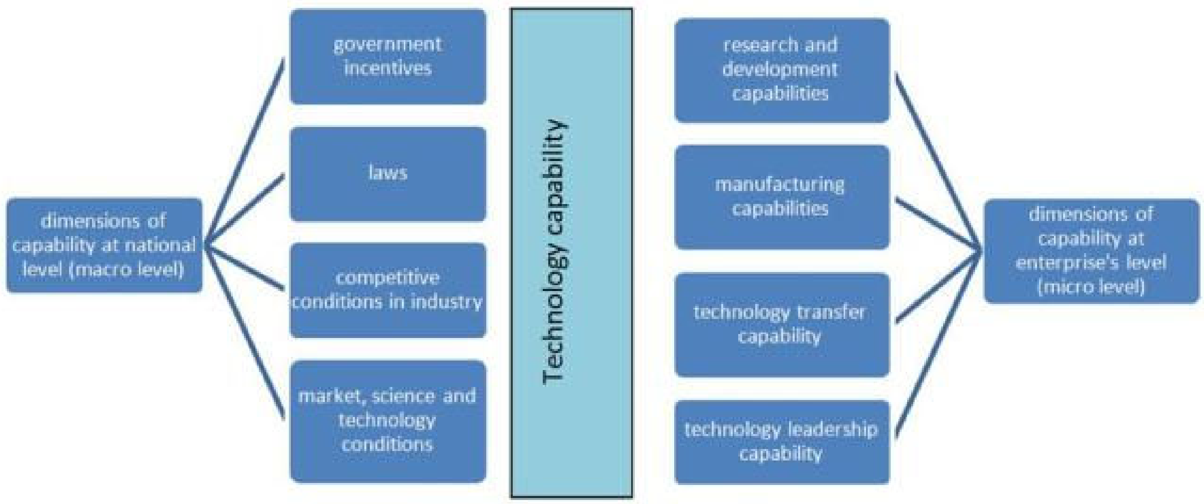
Technology capability dimensions	Fall model	Technological needs assessment model	Model of Technological capability levels	Panda & Romanson model
Knowledge/ search/ identification	√	√	√	
Acquisition	√	√		√
Application, utilization & attraction	√	√	√	
Assessment & selection (select)	√	√		
manufacturing			√	√
Engineering design and R&D			√	√
Support and maintenance			√	√
Core competency		√		
Technology strategy		√		
learning		√		
External links and incentives		√		
innovation				√
Marketing and sales				√
After sales services				√
leadership				√
maintenance	√			

Table 5: comparison of technological capability dimensions of models at national level

Dimensions of technology capability	UNDP	Arko	Deaf
Technology creation/ technological efforts	√	√	√
Dissemination of old and new technology	√		
Human competencies	√	√	√
Technology infrastructures		√	√
Economical incentives/ market/ competition/ trade regime			√
Competition incentives			√
Industrial/ technological/ educational institutions			√

According to above tables and also by applying some Iran-specific variables, the developed model of technological capabilities assessment in Iran's automotive industry is drawn as in figure 4. Based on this model, technological capabilities in automotive industry of Iran will be affected by two types of variables, those which are intra-enterprise variables and those that are variables at national level.

Figure 4: Developed Model of Technological Capability Assessment of Automotive Industry



Bases on the developed model, and through reviewing literature as well as using standard questionnaires of international models, project indices and questionnaires were designed; also, the validity of questionnaire was confirmed by thejudgment of experts and its reliability was approved byCronbach's alpha coefficient 0.89. The questionnaire consisted of 37 indicators.

- **Second question findings**

According to experts and also through using "binomial test" which follows the two-tailed distribution, it has been revealed that in most indices the binomial test is significant, which means that more than 80% of experts agreed with this index, or in other words, there was a ratio of 80 to 20 of proponents which showed the confirmation of indices.

- **Confirmatory factor analysis**

After conducting binomial test to validate content value of each indexin order to measure the proposed contents, in this section the validity of the proposed model is examined through confirmatory factor analysis.

In case of researches which are related to the technology management, based on his research goals, the researcher can enjoy the two approaches of Co-variance and Partial least squares (Chin, 1998).In this study, regarding research goals which are discussed later, the partial least squares is used for conducting confirmatory factor analysis.

- **Confirmatory factor analysis, first phase**

In confirmatory factor analysis, firstly, construct validity should be examined to determine whether the selected indicators for measuring their intended constructions are accurate.In such a way that factor loadingof each indicator ispositive and the t value more than 1.96with its construct. It means that factor loading is significant at 0.05 or less. Thus, this indicator is sufficiently exact for measuring the construct or the latent trait (Nunnally &Bernstein, 1994). The values of factor loading and t-statistics for the indicators of each construct are given in table 6. In addition, factor weighting method was used for rating the importance of each factor's indicator in its measurement, which rates the indicators of each factor according to the degree of their importance. The results of factor weightings are reported in table 6.

Table 6: Factor loading values for each construct in the form of measurement model

The results of Confirmatory factor analysis, first phase				
items		factor loading	t-statistics	results
R&D capabilities	1	0.954	71.923	Indicator verification
	2	0.965	69.565	Indicator verification
	3	0.867	25.406	Indicator verification
	4	0.736	7.616	Indicator verification
	5	0.895	35.414	Indicator verification
	6	0.904	46.816	Indicator verification
Manufacturing capability	7	0.571	3.652	Indicator verification
	8	0.853	16.865	Indicator verification
	9	0.745	8.902	Indicator verification
	10	0.733	6.895	Indicator verification
Technology transfer capability	11	0.897	26.670	Indicator verification
	12	0.751	6.676	Indicator verification
	13	0.890	17.369	Indicator verification
	14	0.927	28.245	Indicator verification
	15	0.863	18.041	Indicator verification
	16	0.916	25.828	Indicator verification
Technology leadership capability	17	0.824	13.015	Indicator verification
	18	0.931	31.845	Indicator verification
	19	0.878	20.969	Indicator verification
	20	0.936	42.559	Indicator verification
	21	0.911	24.955	Indicator verification
	22	0.947	48.527	Indicator verification
مشوقهایدولتی	23	0.805	10.489	Indicator verification
	25	0.811	6.532	Indicator verification
State incentives	26	0.860	15.837	Indicator verification
laws	27	0.954	47.806	Indicator verification
	28	0.968	138.423	Indicator verification
Competition conditions in industry	29	0.853	22.391	Indicator verification
	31	0.926	31.581	Indicator verification
	32	0.751	7.282	Indicator verification
	33	0.843	11.670	Indicator verification
Technology and science marketing conditions	34	0.539	5.270	Indicator verification
	35	0.645	5.534	Indicator verification
	36	0.572	3.095	Indicator verification
	37	0.818	7.672	Indicator verification

Based on the results shown in table 6, it is indicated that all indices had t-value higher than 1.96 and therefore, they were included in the analysis procedure. According to the factor loading, capability of developing new products in R&D development dimension, the ability to set up lines in manufacturing capability dimension, the ability to use imported technology in technology transfer capability dimension, the ability to determine basic priorities of technology to gain competitive advantages in technology leadership capability, grants and subsidies to access new technologies by government in state incentive dimension, the existence of required institutions of individual property rights as well as patents in society in laws dimension, equal distribution of advantages and incentives among automobile companies by government in the dimension of competition conditions in industry, and the possibility of exporting products and their parts to other countries by automobile companies in science and technology marketingconditions dimension, have priority. Indices with t-value of higher than 1.96 are included in analysis process. So, construct validity, which was conducted for examining the importance and accuracy of selected indicators as well as measuring the constructs, shows that the remained indicators provide properfactor constructs in order for measuring dimensions studied in the research model.

Convergent validity, which was used for examining the maximum correlation of each indicator with its construct, compared to other constructs, and cross loadings factor was used for examination of this case (Rencher, 1998). In so doing, the degree of correlation of each indicator with all other constructs was calculated, in which values of the selected constructs of the researcher should be higher than other constructs. Therefore, each indicator should show the highest correlation with only its construct and have the lowest correlation with other constructs. The research results also suggested that convergent validity is verified. since the average of indicators shows highest factor loading only with their constructs. According to table 7, factor loading value of each indicator with respect to its construct is higher than that of other indicators, then, the results show that the accuracy of measurement of each construct via its indicators is the highest, because, first, based on the results, construct validity shows that each indicator has significant factor loading with its construct and second, each indicator has measured only its own construct and disordered indicators are not observed in construct measurements, and this can be inferred based on convergent and reliable validity.

Table 7: examination of convergent loading through cross loadings factor

No.	R&D	Manufacturing	Technology transfer	Technology leadership	State incentives	laws	Competitions in industry	Technology & science market
Q1	0.858	0.273	0.062	0.049	0.270	-0.105	0.164	0.145
Q2	0.791	0.375	0.287	0.118	0.237	0.029	0.154	0.069
Q3	0.722	0.331	0.239	0.063	0.109	0.019	0.149	0.040
Q4	0.872	0.016	0.042	-0.098	-0.127	0.246	0.012	-0.076
Q5	0.736	0.317	0.155	0.174	0.267	-0.015	0.162	0.258
Q6	0.783	0.392	0.073	0.086	0.007	0.202	-0.007	0.315
Q7	0.222	0.546	0.406	0.139	0.253	0.326	-0.139	0.324
Q8	0.213	0.838	0.102	0.207	0.231	0.198	0.130	-0.082
Q9	0.052	0.803	0.082	0.246	-0.020	0.009	0.415	-0.021
Q10	0.224	0.635	0.358	0.384	0.173	-0.088	-0.292	0.102
Q11	0.390	0.113	0.824	0.084	-0.092	-0.035	0.202	0.007
Q12	0.010	0.152	0.705	-0.063	-0.118	0.046	0.213	0.413
Q13	0.126	0.122	0.779	0.166	0.125	0.155	0.406	0.062
Q14	0.163	0.017	0.868	0.210	0.260	0.039	0.077	0.068
Q15	0.258	0.241	0.731	0.401	0.167	0.215	-0.180	-0.061
Q16	0.342	0.201	0.799	0.214	0.150	0.087	-0.108	0.160
Q17	0.504	0.161	-0.013	0.556	0.318	0.305	0.163	0.163

Q18	0.437	0.152	0.097	0.757	0.003	0.242	0.274	-0.007
Q19	0.095	0.470	-0.008	0.776	-0.180	0.181	0.157	0.082
Q20	0.293	0.318	-0.066	0.798	-0.002	0.129	0.053	0.252
Q21	0.384	0.268	0.106	0.775	0.187	-0.115	0.084	0.133
Q22	0.286	0.175	0.075	0.861	0.006	0.011	0.268	0.078
Q23	0.140	0.376	0.409	0.150	0.559	0.036	0.056	0.264
Q25	0.236	-0.010	-0.115	0.167	0.859	0.00	0.060	0.038
Q26	-0.002	0.353	0.068	-0.012	0.687	0.275	0.009	0.046
Q27	-0.050	0.190	0.242	0.214	0.106	0.765	0.007	0.165
Q28	0.199	0.205	0.417	0.122	0.188	0.730	-0.064	-0.027
Q29	0.543	0.182	0.283	0.284	0.164	-0.008	0.589	0.211
Q31	0.190	0.266	0.425	0.400	0.115	-0.086	0.682	0.068
Q32	0.305	0.538	0.117	0.667	-0.175	-0.117	0.689	-0.116
Q33	0.268	0.496	0.134	0.004	0.004	-0.025	0.792	0.055
Q34	0.243	0.325	-0.050	0.253	0.038	0.131	-0.020	0.792
Q35	0.186	0.064	0.083	0.074	0.062	0.037	-0.037	0.958
Q36	0.246	0.289	0.292	-0.049	0.117	0.014	-0.029	0.783
Q37	0.363	0.076	0.272	0.263	0.114	0.133	0.013	0.783

In confirmatory factor analysis method, besides using construct validity and convergent validity which were applied in examining the significance of selected indicators in terms of measuring constructs, discriminant validity has also been considered; this means that indicators of each construct, relative to other constructs, finally provide proper separation in measurement. To put it simply, each indicator only measures its own construct and they are combined in such a way that all constructs can be separated properly. This process can be studies by two methods, which are both applied in this study. According to the first method, through average variance extracted index, it was found that all constructs of the study have the average variance extracted of higher than 0.4, and these coefficients are shown in table 8 (Nunnally &Berntein, 1994).

Table 8: Examining the average variance extracted values

index	(AVE)	Acceptable level
R&D capabilities	0.792	0.4
Manufacturing capability	0.536	0.4
Technology transfer capability	0.767	0.4
Technology leadership capability	0.819	0.4
State incentives	0.682	0.4
laws	0.924	0.4
Competition conditions in industry	0.715	0.4
Technology and science marketing conditions	0.426	0.4

The second method for examining discriminant validity is using square root of average variance extracted. So, the square root of average variance extracted should be higher than other correlations of other factors with this construct (Nevitt & Hancock, 2001). This is shown in table 9.

The results of discriminant validity examination indicate that selected indicators in terms of measuring existing constructs have the necessary discriminant validity, since, based on table 8, it can be stated that first, all constructs have variance extracted value of higher than 0.4, and second, based on table 9, it can be stated that square root of average variance extracted of each construct, which is shown in the matrix diagonal of table 9, is higher than all correlations of other factors with that factor.

Table 9: Examination of square root values of average variance extracted with correlations

No.	variant	1	2	3	4	5	6	7	8
1	R&D capability	0.89							
2	Manufacturing capability	0.607	0.73						
3	Technology transfer capability	0.415	0.522	0.88					
4	Technology leadership capability	0.620	0.550	0.628	0.90				
5	State incentives	0.269	0.464	0.469	0.264	0.83			
6	laws	0.526	0.467	0.431	0.729	0.492	0.96		
7	Competition conditions in industry	0.584	0.615	0.663	0.707	0.703	0.807	0.85	
8	Technology and science marketing conditions	0.369	0.335	0.414	0.501	0.347	0.497	0.504	0.65

Finally, composite reliability was used for examining the reliability and its results are illustrated in table 10. Reliability means that different respondents of the study draw the same inference from questions. The composite reliability coefficient is also used in methodology of structural equation modeling, in which values of higher than 0.6 for each construct represent the proper reliability (Nunnally & Bernstein, 1994). According to table 10, all construct have composite reliability of higher than 0.8 which indicates the suitability of this index in all constructs.

At this stage and with respect to the completion of variable refining phase as well as certainty of the accuracy of indices in measuring concepts and related variables, the confirmatory factor analysis phase two and research hypothesis test can be proceeded.

Table 10: Reliability examination of applied scales by composite reliability

Scale (construct)	Composite reliability	Acceptable level
R&D capability	0.958	0.6
Manufacturing capability	0.819	0.6
Technology transfer capability	0.952	0.6
Technology leadership capability	0.964	0.6
State incentives	0.865	0.6
laws	0.960	0.6
Competition conditions in industry	0.908	0.6
Technology and science marketing conditions	0.743	0.6

- **Confirmatory factor analysis, phase two**

The test of research theoretical model and hypotheses in PLS method is possible through examination of path coefficient (loadings factor) and R2 values (Seyyed Abbas-Zadeh et al, 2012). In order to calculate t-statistics values for determining the significance of loadings factor, Bootstrap method (with 500 sub-samples) was used. Loadings factor are used to determine the contribution of each predictor variable in explaining criterion variance, alsoR2 values indicate the criterion variance explained by predictor variables. In addition, Stone-Geisser Q2 coefficient was used to evaluate, based on independent variable, the predicting ability of dependent variables. Positive values of this coefficient indicate the prediction ability (Venzi et al., 2010). Also, in terms of explained variance, R2 values of 0.67, 0.33, 0.19 in PLS model are significant, moderate and weak, respectively (Seyyed Abbas-Zadeh et al., 2012). According to these criteria, the results in table 7-4 show that the amount of explained variance of constructs intechnology transfer capability (0.579) and state incentives (0.627) are at moderate level. Also, the amount of explained variance in R&D capability (0.726), manufacturing capability (0.679), technology leadership capability (0.768), laws (0.726), competition conditions in industry (0.762) and technology and science marketing conditions (0.753) are at significant level. According to table 7-4, the Q2 index for variables of R&D capability (0.561), manufacturing capability (0.350), technology transfer capability (0.455), technology leadership capability (0.624), state incentives (0.418), laws (0.639), competition conditions in industry (0.535) and technology and science marketing conditions (0.295) are positive, which indicates that these variables are significantly able topredict technological capabilities.

For prioritizing variables, weighting factor data are used, which are shown in table 11. According to this table, the most important variables are technology leadership capability (0.876), market competition conditions (0.873), technology and science marketing conditions (0.858), R&D capability (0.852), laws (0.852), state incentives (0.792) and technology transfer capability (0.760), respectively.

Besides, with regard to figure 5, for overall technological capability in Mega-motor company, the capability at national level has higher priority over the capability at enterprise level.

Table 11: Results of confirmatory factor analysis phase-two of technological capability

Construct	Loadings factor	t-value	R^2	Q^2
R&D capability	0.852	27.001	0.726	0.561
Manufacturing capability	0.824	18.748	0.679	0.350
Technology transfer capability	0.760	7.461	0.579	0.455
Technology leadership capability	0.876	19.946	0.768	0.624
State incentives	0.792	11.731	0.627	0.418
laws	0.852	18.702	0.726	0.639
Competition conditions in industry	0.873	18.837	0.762	0.535
Technology and science marketing conditions	0.858	12.807	0.753	0.295

Figure 5: Tested Model of Technological Capabilities (Path Coefficients)

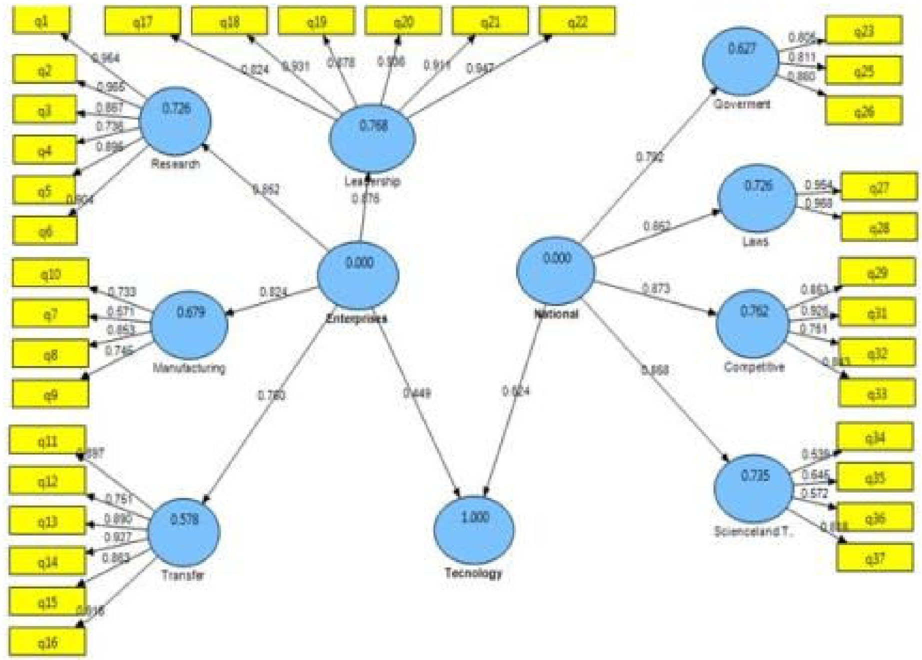
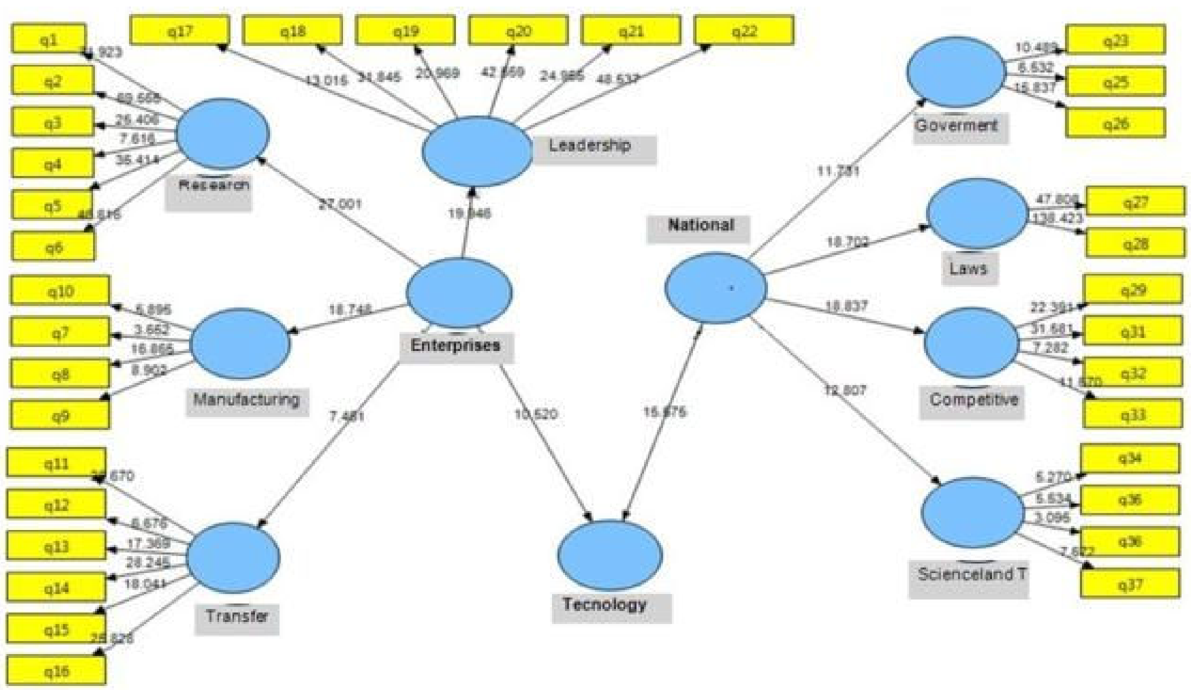


Figure 6: Tested Model of Technological Capabilities (t-Statistics)



- **Fitting tested model of research**

Finally, fit indices of structural equation models have been applied through partial least squares method, to demonstrate the validity of the research findings.

The overall fitting index of the model in PLS is Goodness of Fit index, which is used for evaluating the validity or quality of PLS model in general. GOF index is of two types, absolute, which is used for evaluating and comparing different groups, as well as relative, which its value equals to the division of absolute GOF by maximum degree of GOF that can be obtained from the tested model. Relative GOF index is used for overall fitting of the model. This index is also similar to fitting indices of Lisrel model, which is within interval [0,1], and values close to 1 indicate the good quality of the model (Venzi et al., 2010). In table 12, fit indices of measurement and structural model of the research are given.

Table 12: Fit indices of research measurement and structural models

Absolute fit index	Relative fit index	Measurement model fit index	Structural model fit index
0.49	0.91	0.93	0.87

In this study, absolute fit index for tested model was 0.49, relative fit index was 0.91. The value of relative fit index indicates the proper fit for the tested model. Also, fit index of the measurement model was 0.93 and structural model was 0.87, which indicates the proper fit of research measurement and structural model.

Bias-variance status in terms of independent predictive variables of research model suggests that each independent variable has its distinctive role, and make no significant interference in forming the degree of explained model variance. Because, in case of two independent constructs, VIF index has been calculated less than critical limit of 5, for this critical value is the maximum degree of overlap tolerance coefficient of explained variances, and lower values indicate the lack of replacement property among independent variables, which is one of the basic hypotheses in simultaneous equations.

Finally, with respect to research model fit data, linear equation of research can be provided through a structural model. Indeed, direct effects of variables which have been affected in the studied sample, are illustrated in the form of the following equation.

Table 13: Separate bias-variance status for independent variables

Scale (construct)	Variance inflated factor(VIF)	Acceptable level
Capability at enterprise level	1.520	Less than 5
Capability at national level	1.520	

Technological capabilities= capability at enterprise level 0.449 + capability at national level 0.624
Technological capabilities= technology leadership capability 0.876 + R&D capability 0.825 + manufacturing capability 0.824 + technology transfer capability 0.760 + state incentives 0.792 + laws 0.852 + competition conditions in industry 0.873 + technology and science marketing conditions 0.858

In table 14, in terms of final model, factor loadings, average variance extracted and composite reliability are reported. According to this table, all research constructs has proper validity and reliability in analysis. Later, research hypotheses will be discussed.

Table 14: Final model of loadings factor, average variance extracted and composite validity

construct	Item No.	Loadings factor	AVE	Composite validity
R&D capability	1	0.954	0.792	0.958
	2	0.965		
	3	0.867		
	4	0.736		
	5	0.895		
	6	0.904		
Manufacturing capability	7	0.571	0.536	0.819
	8	0.853		
	9	0.745		
	10	0.733		
Technology transfer capability	11	0.897	0.767	0.952
	12	0.751		
	13	0.890		
	14	0.927		
	15	0.963		
	16	0.916		
Technology leadership capability	17	0.824	0.819	0.964
	18	0.931		
	19	0.878		
	20	0.936		
	21	0.911		
	22	0.947		
State incentives	23	0.805	0.682	0.865
	25	0.811		
	26	0.860		
laws	27	0.954	0.924	0.960
	28	0.968		
Competition conditions in industry	29	0.853	0.715	0.908
	31	0.926		
	32	0.751		
	33	0.843		
Technology and science marketing conditions	34	0.539	0.426	0.743
	35	0.645		
	36	0.572		
	37	0.818		

RESEARCH RESULTS

Technological capability assessment is one of the key tools in technology management space, which its corresponding literature has been widely extended and developed in the last years. The most important application of this tool is to identify technological pros and cons with the goal of measuring technological gap of the existing technology, based on which one can embark on formulating strategies and planning technologies. Although the main development of the literature of this issue is at enterprise level, it can also be used at national level in terms of technological ranking of countries for developing international industrial co-operation and relations.

A review of Iran's automotive industry performance in the last two decades represents the growth in this industrial section, and one of its accelerators has been technological development in automotive industry. Since automotive industry is of high importance in the world as well as Iran, designing a model in order for assessing technology capability in this industry in terms of future developments is necessary. Thus, technological capabilities of automobile companies can be evaluated by utilizing the proposed developed model in specified time intervals; also, with respect to existing gaps in each dimension of capability model, appropriate improvement projects can be defined and implemented in technological capability at enterprise and national level.

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