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Explaining the Functional Components of Third Generation University in Regional Progress (Case Studies of Colleges, and Scientific, Research and Technological Centers in the Iranian Oil Industry)

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ABSTRACT

Paying attention to special opportunities and trying to enumerate existing capabilities at the heart of regions by using the scientific and technological capacities available to them are some of the instances in which the shortfalls in development programs can be eliminated and the way can be paved for a balanced progress at the local level with the fair distribution of opportunities. To this end, a transition from first (Education oriented) and second (Education and research oriented) generation universities, towards third generation (3G) universities which, in addition to education and research, actively seek to impact society and the economy, is one of the most central issues which can bring about full scale, dynamic, and sustainable progress in the regions based on science and technology. As a first step in the present research, attributes in third generation universities impacting regional progress have been examined by studying the resources. Using the Delphi method and Shannon's entropy, the mentioned components and their weight were examined based on the opinions of 63 well-known experts active in the national oil industry and specialists in universities, and research, science and technology centers affiliated to the industry. Twenty-eight basic components and six principal components were approved in the survey of

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experts. Of these, three were prioritized and given weight in the following order:

1) Formulating regional endogenous innovation and value creation ecosystems, 2) designing and implementing a regional skills, education, and training system, and 3) developing organizational capacities according to the new functions of regional universities.

1. Introduction

Despite the relatively long experience in planning - over fifty years - in Iran, significant regional imbalances and a lack of progress in science and technology units are still seen across the country for the development of society and the national economy at the desired level. The domination of structuration, central planning for the regions (Darvishi et al, 2018), and a lack of infrastructure and models suited to every region can be cited as the main factors of failure in regional policymaking which need to be examined. Given a country's cultural, ethnic, and ecological diversity, any realistic planning can only be achieved by considering (Farajirad et al, 2013) the skills, abilities, and active participation of its people in the various stages of development (Jaberi & Mohammadzadeh, 2016).

Universities in Iran, as custodians of knowledge-based progress, have been unable to convert basic regional potentials into innovation, entrepreneurship, and knowledge-based enterprises. This requires the formation of a regional knowledge-based ecosystem management (Entezari, 2018) based on a regional technological entrepreneurship model (Keikhakohan et al, 2020). Extensive collaboration is needed on local and provincial levels to achieve this. On the lower echelons, work must begin with a knowledge-based economic model (BazazZadeh et al, 2014) and the conceptual design and implementation of a regional policymaking model with regional custodians of science and technology at the center (Kharchenko et al, 2019).

Relying on an oil-based economy and neglecting the technological and economic potentials at the heart of academic and technological activities has posed the biggest challenge and created a vacuum in exploiting scientific and technological capacities, placing the country in a position of unstable economic conditions. Despite the high share of revenues from crude oil sales in the national budget, the export of petroleum products accounts for a large share of non-crude oil exports. This is a positive harbinger of significant capacities available for the development of trade and technology.

Competent scientists and researchers in industry, easy access to massive oil reserves, and the significant requirements of neighboring countries and those in the Iranian coalition for petroleum products, all create a special opportunity to attract regional academic collaboration. The requirements for achieving this include the promotion of intellectual capital and knowledge development in the structures and mechanisms of the industry (Haghighat-Monfared & Hoshyar, 2010) by creating knowledge and technology nuclei, expanding business opportunities (Seyed-Javadein et al, 2010), and understanding the position of science and technology and its unique role in national and regional development (Rodionov & Velichenkova, 2020). Also, expanding entrepreneurial interaction in universities in terms of regional talents and skills is another instance which can help promote existing capacities while paving the way for a stable, dynamic regional progress with the increasing collaboration of the regional custodians of science and technology (Thomas & Pugh, 2020). On the other hand, interaction between the university and the region is not one-sided and the university must actively work with industry, society, local government, and other entities in the area to upgrade its organizational capacities (Brekke, 2020).

From the geographical point of view, the present research at the national level has examined the role of scientific and technological institutions of the Ministry of Petroleum in the progress of the country's regions. In particular, oil-rich areas and areas with knowledge capital, including the universities of the Ministry of Petroleum, have been studied. With a brief study of the process of prosperity and decline of Masjed Soleiman, as the first oil city in the country, and oil-rich areas with knowledge and technology, including Abadan University of Petroleum and Ahvaz University of Petroleum, we see a significant difference in the formation of both regions based on knowledge and technological capabilities. In fact, despite the many ups and downs in the progress of the country's oil industry in recent years, we are witnessing significant achievements in south Pars gas field and the discovery and extraction of oil despite the most severe sanctions. This achievement has been achieved by relying on the capacities of Petroleum University of Technology and other universities and scientific and research institutions active in this field. As part of one of the most important achievements of the oil industry, we can mention the report of the prestigious Wood Mackenzie International Institute. In this report, Eram gas field and Namavaran oil reservoir are introduced as the first and third major discoveries of the world oil industry in 2019. According to the report, Iran has ranked first in the world in oil and gas exploration in 2019 with the discovery of 4.97 billion barrels of extractable oil with a significant difference.

This success has been achieved by relying on the scientific and technological capacities of the oil industry by improving the performance of the scientific and technological institutions of this industry. In this regard, among the scientific achievements of the Petroleum University of Technology, we can mention the publication of 2 journals and the holding of 6 conferences and the extraction of 2013 prestigious international articles from this center. Also, the Petroleum University of Technology has published 1952 articles in conferences and domestic journals. Of these articles, 201 are journal articles and 1751 are conference papers.

Nevertheless, Iran's share of the regional market is still small. According to reports, Iran's share of the $50 billion market in neighboring countries in oil and gas products is only 10 percent. Similarly, Iran's share of the $40 billion market in neighboring countries in the plastics industry is only 5 percent. This indicates the basic need for a greater connection between science and technology institutions with the country's industry and public and regional capacities. Achieving this goal requires serious planning at the level of policy-making, strategy planning and futures studies as required soft technologies in this field. Similarly, investment in the field of hard technologies and knowledge-based activities in the oil-rich regions of the country, including Khuzestan, should be given special attention. This action is the main prerequisite for moving towards the markets of neighboring countries and international markets, which requires more investment in knowledge-based activities and upgrading the natural and human capacities of the regions.

In fact, one of the most important characteristics in the progress of regions is paying attention to the talents and capacities of the region in the endogenous growth of the region. The most important asset of any region and in any environment is its valuable human resources, which in connection with their native capacities can achieve their own growth and the progress of the region. In this sense, the process of progress and prosperity of the regions should be accelerated as much as possible by identifying, growing and empowering the valuable human resources of the regions and promoting the level of public participation. Achieving this goal requires the active participation of the scientific and technological institutions of the Ministry of Petroleum in upgrading the technological capabilities of the region and training the required human resources.

In this regard, the formation of special economic zones based on science and technology and commercialization of knowledge-based achievements is one of the things that can flourish the capacity of the regions with the focus on regional universities. By moving towards the creation of special economic zones based on technological capabilities, the universities of the Ministry of Petroleum can lead to the expansion of science, technology, commercialization of achievements and endogenous progress of the regions. In addition to welcoming the arrival of science and technology in the region, this approach will pave the way for the synergy of scientific, research and technological institutions with each other and with other social and economic institutions in the region. Also, by observing the activities of scientific and technological centers of the Ministry of Petroleum and the Petroleum University of Technology, we have witnessed the growth of scientific and research activities of these centers in promoting the technological capabilities of the oil industry. In addition to the need to increase the speed and quality of scientific and research activities, moving towards promoting the economic and social effectiveness of the Petroleum University of Technology as the most important scientific institution of the Ministry of Petroleum can have a significant impact on promoting other scientific and research centers and technological achievements. Combining these capabilities with the capacities and needs of the country's regions, especially oil-rich regions with scientific and technological capitals, is one of the most essential activities of this university in the path of growth and prosperity of this industry and its effective role in the country's progress. This issue can be considered according to the capacity of the region by defining the fields of study and skills. In this regard, in accordance with the scientific, research and technological capacity of the regions, attention to economic sciences, management, public policy and science and technology policy on the one hand and attention to hard technologies and engineering sciences on the other hand should be considered.

The Ministry of Petroleum can also play an indispensable role in the progress of regional science and technology with its four universities spread across the country's disposed areas and dynamic activity in research centers and other scientific and technological entities under its supervision. To this end, a transition from first (Education oriented) and second (Education and research oriented) generation universities, to third generation (3G) universities must take place (Amin-Bidokhti et al, 2014). In addition to education and research, third generation universities consider social and economic value creation in interaction with the environment as part of their mission. This can be achieved by studying the three areas of 1) education and research, 2) transfer of technology and innovation, and 3) attracting social participation in regional and national progress (Brătucu et al, 2020). This requires extensive change in the internal procedures and mechanisms, and scientific, research, and technological policies towards entrepreneurship and social and economic value creation in order to exploit regional, inter-regional, national, and transnational capacities (Soares et al, 2020).

Regional development paradigms: from neoclassicism to institutionalism and regional progress

Regional development is a new concept in the theory of planning (Apostolache, 2014). Its evolution can be observed in neoclassical theories to later theories, such as endogenous growth, regional learning, learning areas, and institutionalism (Farajirad et al, 2013). In the neoclassical approach, regions are considered as large production units which seek to balance employment and income based on market performance. This approach ignores the dimension of place (Afrakhteh, 2012), leading to imbalance in the economic and social structures and the formation of structurally unbalanced regional and spatial patterns (Rahnamaei & Vosughilang, 2013).

The growth pole pattern based on Joseph Schumpeter's idea of innovation clusters (Saeidi, 2013) was first introduced by Perroux in 1955. Essentially, it leans towards economic efficiency (Zebardast, 2003) based on growth poles as fields of force with high attraction (effects of concentration) and their effect on the whole economy through channels of growth distribution (effects of distribution) (Ziari et al, 2011). Hirshman named the forces of concentration as a whole unit of a pole in which growth can lead to development in other regions due to high linkages (Saeidi, 2013). Myrdal, Harrison, and Mirra believe that the theory of growth poles leads to increased regional inequality, poverty distribution, and marginalization of noncentral locations in the policies of spatial distribution of habitation systems (Parizadi & Mirzazadeh, 2018).

Friedman and Douglas proposed the agropolitan approach in the 1970s as a group of villages connecting to a relatively small town, with emphasis placed on prioritizing the rural economy for growth and preventing urban domination. With the failure of the above approach in the distribution of endogenous growth (Zali & Poursohrab, 2015), the Mike Douglas regional network strategy (1998) considered forming a cluster of reciprocal rural-urban linkages (Saeidi, 2013). The above approaches mainly address the issue from a physical point of view and consider growth as separate from the region. This leads to instability, destructive effects, and a lack of sustainable growth in the regions. Next, a 1990s institutional approach to the regions is studied, based on economic assets, development paths, and social and cultural insights specific to the habitat of the regions (Farajirad et al, 2013). The resources and foundations of regional progress at the local level based on social interactions, local customs, the development of knowledge and processes of innovation and learning are examined. Policies based on knowledge (Azadi et al, 2019) to support the merits of knowledge, and regional innovation and entrepreneurship, are some of the cornerstones of regional growth and dynamism (Yasoori & Sejodi, 2018). In this context, the importance of learning and the consequential role it plays in expanding human capabilities will lay the groundwork for extensive changes in the higher education system (Brătucu et al, 2020) in terms of scientific production, dissemination, and efficiency, research and technology at the heart of regions through education, and the suitable production of knowledge and technology with local scope (Kharchenko et al, 2019). Such an achievement requires a mutual approach to improving the level of participation by the higher education system to become the focus of policymaking for regional innovation, and create procedures and backup in collaboration with regional entities (Fonseca, 2019).

As can be seen, following the emergence of instabilities and inefficiencies in the theories of development, these have reverted back to the identity of regions from mere physical and economic approaches. It is evident that the patterns of progress for every nation must be in line with its own environment, capacities, and norms. In patterns of progress, meeting the financial needs of people helps them to flourish and further grow their innate talents (Sadeghi-Shahdani & Mohseni, 2013). Also, in the research literature, progress is defined as growth in all individual and social dimensions. The growth and flourishing of such a societ depends on the training of its human capital and creation of an enabling environment for its people (Jafari et al, 2020). In this sense, it is the higher education system as a central institution which must shoulder the task of progress; this can be achieved through academic education and skills development (Bidokhti et al, 2014).

Growth of the oil industry in the regions based on scientific and technological capacities

As a large, oil-rich country, Iran has faced many opportunities and challenges from the starting days of extraction to date. Some of the measures taken in Iran for the first time, with oil as its largest industry in recent decades, include the use of motorized transport, the first power generator, designing the first oil pipeline, building a road from Darkhazineh to Masjed Soleiman, building the first residential complex for the employees of the oil industry in Masjed Soleiman, and so on. But what is the state of those very first Middle Eastern oil cities such as Masjed Soleiman today? With the establishment of Masjed Soleiman as the first oil city in the Middle East, the identity and social role of the city began being neglected as the oil wealth overpowered the local habitat. No plans were made for the post-oil era for the city. In addition to technology, even more important issues must be taken into account at the center of regional progress policies, such as the level of awareness, knowledge, and learning ability of the local manpower (Rantala & Ukko, 2019), and their ability to understand, use, and upgrade technology and manage challenges within the context of regional ecosystems based on regional capabilities. Neglecting these important issues and relying on patterns of development based on single goals and limited resources have turned this city from a modern one a century ago to a declining city with no economic plans (Safaeipour et al, 2012). On a similar note, we are witnessing a one-dimensional national economy which has been taken over by the export of crude oil resources compared with the other economic sectors and a heavy reliance of the budget on oil revenues (Nademi & Hasanvand, 2019). In the long term, this will stunt growth in sustainable economic areas and, in the short and medium term, lead to the emergence of various threats in political conflicts and governance, such as imposing a range of sanctions as a political tool.

Under such circumstances, sanctions can be implemented due to a lack of domestic growth rather than being the cause of it. Despite much media attention on the impact of external powers in managing and lifting sanctions, the main solution lies within, in proportion to the scientific, technological, commercial, and political power of the country. Also, sanctions as a behavior or habit of governance do not have only one-sided effects and both parties to the sanctions are affected. Based on estimates by the Heritage Foundation, sanctions imposed on 76 countries have reduce US exports by $17 billion and lost 700 thousand jobs in this sector (Mohebati, 2018). As a result, no permanent trends can be envisaged for sanctions. In fact, this is a war of attrition. It will either end in the imposition of the will of the sanctioning country as the sanctioned country succumbs to the pressures, or else, it will make the sanctioned country stronger and defeat the sanctions regime.

Two strategies can be envisaged in reviewing the research literature, explaining the policy of countering sanctions, and solving the currency and financial problems of the country. The first strategy is the efforts of the diplomacy apparatus to lift the sanctions and export oil to its customers and large corporations active in the sector. As such, talks between Iran and the P5+1 were not successful and the inefficiency of this method has already been seen. Even if this strategy is successful, it will still lead to economic ailments and other social problems in the long run if the country's endogenous capacities are not strengthened. The second strategy is to strengthen the economy domestically while looking to the outside world as the diplomatic apparatus endeavors to lift sanctions. In the latter, instead of exporting oil on a large scale to a few designated destinations, countless trade interactions can be carried out on a smaller scale by meeting the vital technological needs of regional countries and those with which it is possible to form an economic alliance. In fact, while trying to lift sanctions, this strategy will make it harder and more costly for the US government to keep up the sanctions regime and reduce US bargaining power to align other countries in imposing sanctions on Iran.

Table 1: Volume of trade between Iran and EAEU (BN dollars)

Country	2015		2016		2017		2018		2019	
	Iranian exports	Iranian imports	Iranian exports	Iranian imports	Iranian exports	Iranian imports	Iranian exports	Iranian imports	Iranian exports	Iranian imports
Russia	173.1	517.4	219	1544.1	292	727	280	1342	457	1158
Kazakhstan	137.9	87.2	173.5	210.8	168	66.7	1304	87	127	105
Armenia	102.1	13.3	179.2	20.9	202	25.8	158.6	22.6	129	40
Kyrgyzstan	22.1	1.7	26.6	3.5	38.7	6.1	33.2	11.3	65	11
Belarus	4	23.6	2.5	29.2	1.7	31.9	207	23.9	12	14
Total	439.2	643.2	600.8	1808.4	702.4	857.5	605	14.86	790	1328
Volume of trade (total imports and exports)	1082		2409		1560		2091		2118	

As can be seen, the volume of trade between the IR of Iran and the Eurasian Economic Union (EAEU) rose from 1.08 (2015) to 2.4 (2016) billion dollars. In 2017, this figure reached 1.56 billion dollars. After the US exit from the Joint Comprehensive Plan of Action (JCPOA) in 2018, another rise is seen in Iranian exports from 1.5 billion (2017) to 2.09 billion (2018) dollars, and 2.11 billion dollars (2019). This indicates that it is possible to conduct trade under sanctions and can be pursued as a basic strategy. Hence, establishing strategic alliances to provide technological products and services required by regional countries and countries allied with Iran, in accordance with the capacities and capabilities of the country, can be considered as a basic strategy. By examining the volume of non-oil exports, a high share of exports for petroleum products can be seen compared with other sectors. Given the technological nature of these industries, the great demand in this area, and availability of abundant oil resources, this is the harbinger of a bright future in the advancement of the national economy.

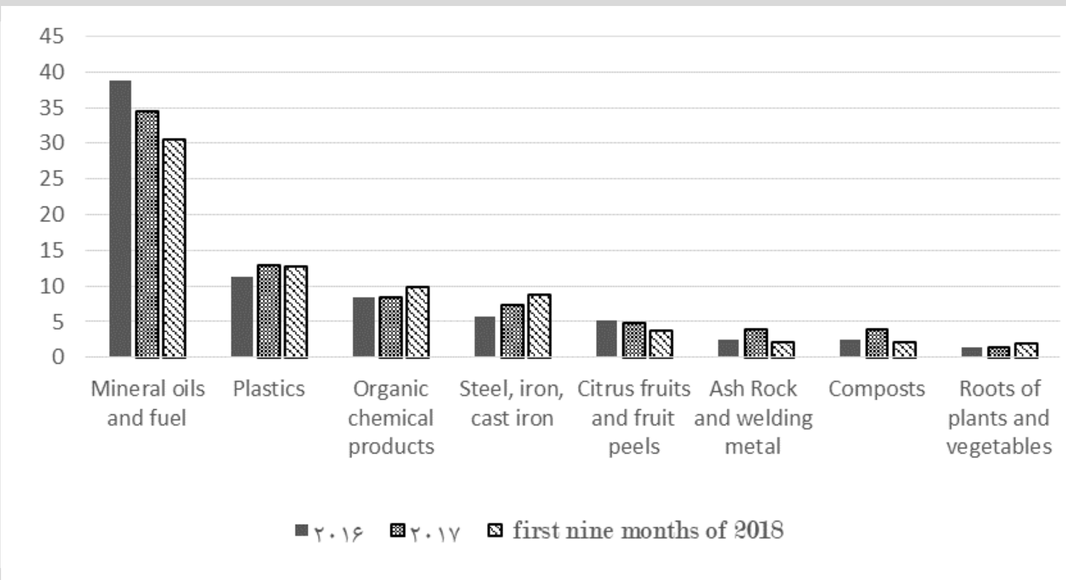

Figure 1: Share (%) of different sectors from non-oil exports

As shown in the above chart, other than crude oil exports, petroleum products, plastics, and chemicals accounted for 73% of all exports in the first nine months of 2018. This shows a vast capacity for Iran in this sector. For the optimal exploitation of this opportunity, attention to knowledge, technology, and commercialization of these products and services based on domestic capabilities must be underscored. When examining the strategic document for the development of human resources in the oil industry, it can be seen that the priority is to attract, train, employ, and keep the best employees and transform this into a modern, dynamic, and growing industry in the world (Baradaran & Safavirad, 2015).

In a research on knowledge management at the National Iranian Oil Refining and Distribution Company (NIORDC), Seyed-Javadein (2010) described the empowerment of the workforce and their skills as being a top priority in the industry by providing more learning space and transferring knowledge as the most important factors (Seyed-Javadein et al, 2010).

Haghighat-Monfared (2010) has also studied the National Iranian Oil Company (NIOC) indices for science and technology and concluded that the variables of storage, transfer and application of knowledge are classified as the next priorities at a very long distance after the variable of knowledge creation. This indicates the necessity to reform and promote the institutions in charge of science and technology in this industry (Haghighat-Monfared & Hoshyar, 2010).

In another study, Nademi and Hasanvand (2019) have researched the impact of oil, trade, and economic sanctions imposed on the country in recent years and prioritized the indices of human resources, educational opportunities, upgrading the level of education, linking them to the labor market and job opportunities (Nademi & Hasanvand, 2019).

In a feasibility study by Aghajani (2014) for the implementation of planning systems at the NIOC in Sari, northern Iran, improving cognitive skills were defined as one of the most important priorities, indicating the importance of the custodians of knowledge and learning in this industry (Aghajani et al, 2014).

In a study of the NIORDC by Kheirandish and Abtahi, in addition to prioritizing learning, knowledge sharing, and knowledge-based leadership, they also mention the differences between the existing condition and optimal condition of the above, indicating the need to focus on the institutions in charge of learning, production, redistribution, and use of knowledge in the industry (Kheirandish & Abtahi, 2011).

In assessing the impact of regional developments on the central ethylene pipeline project, Rahbar and Mirshojaian-Hosseini explained the need to pay attention to comprehensive scientific approaches based on regional and national mapping to plan the strategies of major national industries, including the oil industry (Rahbar & Mirshojaian-Hosseini, 2009). In fact, improving the scientific, research, commercial, and economic capabilities of the industry will play a significant role in the emergence of professional experts in the country (Mossalanejad & Sheikhzadeh, 2013). Therefore, the Ministry of Petroleum can play a fundamental part in expanding the national oil industry based on local and regional scientific and technological capacities, while endeavoring to benefit from existing capacities in the scientific, research, and technological institutions, plus the four universities, research center, and other expert centers affiliated to the oil industry with the help of its 250 faculty members and a large number of researchers and students. To achieve this, the university system must be reformed to use all available capacities and pave the way for further social and economic influence. Regional stakeholders must be given the facilities for a timely participation in and contribution to expanding these capacities (Wagner et al, 2019). To this end, the main prerequisite is to make adequate preparations for the mutual interaction and participation of individuals, organizations, and active regional and national entities in science, technology, and innovation, identifying talents and capacities and bringing these together to accomplish progress at all levels (Asheim, 2019).

In research literature, this is considered the transition from first and second generation universities to third generation universities. Accordingly, those universities solely based on education are called first generation, those providing education and research are dubbed second generation, and universities providing the latter coupled with technological innovation, commercialization of academic technology, and creation of productive jobs and wealth for their alumni and the community are called third generation universities (Aghajani et al, 2014). Essentially, the main focus of 3G universities is to convert academic activities to wealth on a regional, national, and transnational level. In examining the role of the institution in charge of knowledge and technology in regional progress, Iranian-Islamic progress can be explained in five general areas: training and growth of human resources, upgrading knowledge and technology, promotion of public welfare and social capital, increased productivity, and increased efficiency (Abdolmaleki, 2012). The present research is a case study of the resources and elites of the scientific and research community in the oil industry, focusing on the said five areas. It examines the role of universities and the custodians of science and technology in regional development.

2. Research method

The research onion includes the philosophical foundations of realistic research which examines a fact in our environment. An inductive research approach is adopted to explain the basic theory. Next, deductive reasoning is used to test the basic theory and determine the weights by conducting interviews with a panel of experts. Qualitative content analysis is used to examine the components, the Delphi method is used in surveying the experts, and the entropy method and Likert scale are used to determine the weight of each variable in the quantitative method. Library resources are used for data collection in content analysis, and field study is used in the Delphi method and the entropy method. The research strategy is thematic analysis due to the content-oriented nature of the arguments and the survey method has been used to question the experts. The research purpose is to explore the attributes of university influence in the region and to investigate and explain the relationship between these attributes and the progress of the region from the perspective of experts. Data collection and research have been carried out with library resources and conducting interviews.

In the present study, the effects of 3G universities on regional progress have been examined with as a case study of universities affiliated to the oil industry. Initially, the effects of the basic and principal components of these institutions on regional progress were examined using the content analysis method. The Fuzzy Delphi Method (FDM) is used to examine and determine the entrepreneurial ecosystem and the socio-economic impact of the university on the region by surveying the experts. Finally, the entropy method was used to determine the weight of each component.

The thematic method is used to analyze the content by dividing it into the five main categories of awareness of content, coding, analyzing the codes, reviewing, and renaming the new content in order to achieve a macro classification of the basic and principal contents. FDM is used to discover innovative ideas and share information in order to reach a decision based on the consensus of the relevant experts. As a result, the credibility of this method is dependent on the scientific and experimental validation of the experts rather than the number of participants. Usually, there are between 5 and 20participants in this method. In the FDM algorithm for screening, a fuzzy spectrum must first be developed for the linguistic preferences of the respondents. For instance, the triangular fuzzy number on a 7-point scale for the importance of the criteria is as follows:

Table 2: Fuzzy Rating Score on the Likert Scale

Extremely low score	Very low score	Low score	Medium score	Some score	Very high score	Extremely high score
(1,0,0)	(0,1,3)	(1,3,5)	(3,5,7)	(5,7,9)	(7,9,10)	(9,9,10)

After selecting or developing the suitable fuzzy spectrum, the views of the experts are collected and applied to fuzzy sets. The forecast of every expert is presented as a triangular fuzzy number: $A_i = (L_i, M_i, U_i)$. In the next step, the fuzzy mean method is used to collect forecasts. The difference between the opinions of the experts and the mean opinion score is calculated using the following equation and returned to the relevant expert:

$$A_{AVE} = (\frac{\sum l}{n}, \frac{\sum m}{u}, \frac{\sum u}{n}) \qquad \text{Equation 1}$$

$$A_{AVE} - A_i = (\frac{\sum l}{n} - l_i, \frac{\sum m}{n} - m_i, \frac{\sum u}{n} - u_i) \qquad \text{Equation 2}$$

Expert opinions are collected again and a new fuzzy mean is calculated. The Delphi opinion cycle is stopped when two consecutive averages A_{ave}, B_{ave}, C_{ave}, are clearly close together:

$$X = \frac{l + 4m + n}{6} \qquad \text{Equation 3}$$

After defuzzification and comparison of opinions obtained in the first stage with results obtained in the next stage, if the difference between the two stages is less than the lowest threshold (1/0), the survey will stop (Shafiei-Nikabadi & Razavian, 2018). Also, after defuzzification of values, a tolerance threshold is given for screening the items, which is usually 0.7 (Rahdary & Nasr, 2017). In the next step, given the obtained results, the weight of the components is examined using the entropy method. Based on conventional methods, determining the weight of components is done through subjective, objective and integrated methods. In subjective methods, the opinion of experts is the most important issue in determining the weight of components (Noori & Heidari-Buiki, 2016). The main feature of subjective methods is the use of personal experiences and judgments. In fact, the main source of decision-making in this method is "internal matter" which shows significant changes according to the situation of the decision maker. Subjective methods are inexpensive and fast. Also, these methods are in line with the common tradition in non-democratic systems and have a long history in the life of organizations (Mousapour, 2006). The AHP method, weighted least squares method and Delphi method belong in this category. (Lotfi & Fallahnejad, 2010) However, in objective methods, the weights are extracted through the use of mathematical models. In fact, in these methods, the experts' mental judgments have no significant effect on determining the weight of the criteria. As a result, with decreasing the effect of mental orientations and individual tendencies of experts in determining the weight of criteria, the accuracy of evaluations increases (Noori & Heidari-Buiki, 2016). Objective methods are based on data that have been obtained from the reality of external phenomena and are accessible to all. Also, the method of data collection, processing and analysis is systematic and is based on certain principles (Mousapour, 2006). Among the most common objective methods, Standard Deviation (SD), CRITIC method, Correlation Coefficient and Standard Deviation (CCSD) method (Heidari-Dahooie et al, 2017), multiple objective programming and principal element analysis (Lotfi & Fallahnejad, 2010) can be mentioned. Likewise, according to experts, one of the most practical objective methods for determining weight of components is the entropy method. Entropy in information theory is an indicator for measuring uncertainty which is expressed by a probability distribution (Feizi et al, 2019). Entropy indicates how the most important factors and variables can be determined from the effective factors of an event (Roostaei et al, 2020). In this method, the weight of the components is determined based on the amount of changes in the information of a component for different options. Obviously, the lower the effect of the decision-maker's opinion, the lower the probability of human error and the higher the validation of the calculations. In fact, the greatest advantage of the entropy method is because of its objectivity. In other words, in this method, the relative importance of decision options is evaluated in a specific criterion without the direct intervention of the decision maker (Al-Aomar, 2010). Also, due to the entropy method's attention to data scattering and fluctuations, this method has a high degree of adaptation that distinguishes it from other methods (Bakhtiari & Khakestari, 2016). According to the above and the title of the present study, the entropy method is used as an objective method to determine the weight of the components in this study. To use this method, the score for each respondent (Fij) is normalized using relationship 1 (Pij), and then the information load for each component (E_j) is calculated using relationship 2. In this relationship, m is the number of respondents and n is the number of components (Shieh et al, 2017).

$$P_{ij} = \frac{F_{ij}}{\sum_{i=1}^{m} F_{ij}} \qquad (j = 1,2,\dots,m \text{ ، } j = 1,2,\dots,n) \qquad \text{Equation 4}$$

$$E_J = -k \sum_{i=1}^{m} P_{ij} \times \ln P_{ij} \qquad j\epsilon\, 1,2,\dots,n \qquad k = \frac{1}{\ln(m)} \qquad \text{Equation 5}$$

In this relationship, the closer E_j (entropy of j) is to m, the closer the impact of the said index to zero in the prioritized categories. The degree of deviation (d_j) indicates the indicator's useful level of information for decision-making. The weight value (W_j) of each component is also calculated by dividing each d_j by the sum of d_js.

$$d_j = 1 - E_j \qquad \text{Equation 6}$$

$$w_j = \frac{d_j}{\sum_{i=1}^{m} d_j} \qquad \text{Equation 7}$$

3. Research findings

In examining the most basic components of the university's influence in regional progress, in the first step, environmental and internal conditions and strategies appropriate to them should be considered. In examining the most basic components of the university's influence in regional progress, in the first step, environmental and internal conditions and strategies appropriate to them should be considered. According to the subject, the role of the Petroleum University of Technology in the progress of the country's regions and in particular the oil-rich regions, we study the internal and external environment of the oil industry and its requirements and strategies. In accordance with the proposed strategies, in the next step, we will identify and categorize the most basic components in this industry in the progress of the country's regions. For this purpose, the SWOT matrix is used as a strategic tool to identify strengths and weaknesses within the oil industry and the threats and opportunities of this industry in the external environment and to review appropriate strategies for these conditions. The main approach of the research in studying the SWOT matrix is to explain the role of the university in increasing public capacities, technological capacities and human capacities in the development of the oil industry and endogenous progress of the regions of the country.

Based on this approach, by studying the sources, we examine the threats, opportunities, weaknesses and strengths based on the content analysis method. Similarly, the strategies are studied and explained in accordance with the four positions of the SWOT matrix and based on the content analysis method. Then, the obtained components are examined and polled by experts according to the Delphi method. The statistical population at this stage of the Delphi method is 18 experts who are familiar with the subject of research. Surveys were conducted in three stages. By performing Delphi method calculations, defuzzified values of all components were obtained more than the threshold value of 7. In this way, all the mentioned components were approved by experts. Also, the "growing trend of market demand for petroleum products (especially in the Middle East)" was suggested by experts in the opportunities section in the first round as a proposed component. In the next round of the Delphi method, this component was excluded from the table by obtaining a defuzzified values of 6.67 which is less than the threshold value of 7. The defuzzified Delphi values of the components can be seen in front of each of them according to the table below.

Table 3: SWOT matrix in Iranian petroleum industry

Weaknesses(W)	Defuzzified Delphi	**Strengths(S)**	Defuzzified Delphi	SWOT matrix in Iranian petroleum industry	
W1: Lack of national strategy for industrial development and national strategy for knowledge and technology development.	7.78	S1: High capacity of universities and research centers of the Ministry of Petroleum and other universities and technological centers of the country	7.01	Strengths(S) and Weaknesses(W) Opportunities (O) . And Threats(T)	
W2: Weak industry-university interactions and lack of utilization of the capacities of research institutes and universities in the country	7.8	S2: Possibility of developing the non-governmental sector in the form of specialized companies in performing ancillary operations and providing the required services in the oil industry.	7.13		
W3: Weak technology, expertise and management in production, supply and participation in regional and international markets.	7.71	S3: Superior political position in the Middle East, privileged geopolitical position, and access to trans-boundary waters.	7.01		

W4: Weak industry interactions with the non-governmental sector and the use of public participation.	7.79	S4: Having abundant oil and gas resources in the top international rankings.	8.03		
W5: Weak planning in directing academic projects towards the research and development needs of the industry.	8.06	S5: Possibility to take advantage of prominent Iranian elites living abroad.	7.46		
Reinforcement Strategies - Solving Internal Challenges		Aggressive-developmental strategies			
Strategy title (W O)	Defuzzified Delphi	**Strategy title (S O)**	Defuzzified Delphi	**Opportunities(O)**	Defuzzified values
WO1: Development of soft and hard technologies in industry management, leadership based on knowledge and technological capacities in the country's oil industry. (Hypothesis: O1 O3 O4 W2 W4 W5)	7.59	SO1: Development of relations between the institutions in charge of science and technology with the Ministry of Petroleum and universities and scientific and research and technology centers under this industry. (Hypothesis: O1 O3 O5 S1 S5)	7.56	O1: Laboratory and research capacity of universities to develop cooperation with the oil industry and scientific-research institutions of this industry	7.03
WO2: Promote the share of financial, technological and managerial contributions from the public and non-governmental sectors. (Hypothesis: O2 O3 O4 W3 W1)	7.91	SO2: Achieving a leading position in the field of export of petroleum products to countries in the region and the Commonwealth of Independent States. (Hypothesis: O2 O3 O4 S2 S3 S4)	7.49	O2: Existence of a vast market for the technical achievements of the country in the region and the world	7.52
				O3: Possibility of using many research and industrial achievements of the upstream oil sector in other industries.	8.14

WO3: Adjusting the industry development strategy based on public capacities, capacities of universities and scientific and research centers of oil industry and capacity of other science and technology institutions. (Hypothesis: O1 O2 O3 O5 W1 W2 W3 W4)	8.01			O4: Increasing the international price of upstream contracting projects and higher economic justification for the presence of domestic contractors	7.61
				O5: Capacity of technology studies, policy research and science and technology policy in the field of soft technology development in the oil industry	8.02
Defensive Strategies - Economic Entrepreneurship		Competitive Strategies - Solving External Challenges			
Strategy title (W T)	Defuzzified Delphi	**Strategy title (S T)**	Defuzzified values	**Threats(T)**	Defuzzified values
WT1: Investing in available projects based on existing scientific and technological capacities. (hypothesis: T1 T5 W1 W2 W4 W5)	7.32	ST1: Increasing the speed of industry development and optimization in the processes from production to supply by relying on existing knowledge and technological capacities. (hypothesis: T1 T2 T3 S1 S2 S5)	8.06	T1: Increasing the speed of oil exploration and extraction in neighboring countries from joint oil and gas reservoirs.	7.19
				T2: Lack of demand, consumption and distribution management.	7.92

WT2: Laying the groundwork for public participation in knowledge-based entrepreneurship in downstream industries and export of engineering, technology and management technical services in upstream industries. (hypothesis: T2 T3 T4 W1 W3)	7.14	ST2: Utilizing regional, political and geopolitical capacities in creating strategic alliances and creating product supply markets and exchanging knowledge and technology. (hypothesis: T1 T2 T5 S3 S4 S5)	7.82	T3: Lack of distinction between the two concepts of maximum production (crude sales) and optimal production (promotion of productivity in the extraction, production and supply of petroleum products)	7.21
				T4: Ignoring the added value of the downstream sector in raising the overall potential of the country's economy by relying on the entrepreneurial capacities of knowledge-based and the participation of non-governmental organizations	7.06
		ST3: Development of economic diplomacy at the international and regional levels along with upgrading technological, managerial and strategic capabilities. (hypothesis: T1 T2 T5 S1 S3 S4)	7.37	T5: Restrictions on International Sanctions on Access to New Technologies.	7.15

As can be seen from the ten proposed strategies in the SWOT matrix, SO1, WO1, WO3, ST1, ST2, ST3 ,WT1, WT2 strategies directly point to the basic role of scientific and technological capital in the development of the oil industry and the progress of the country. Similarly, in reviewing the proposed strategies in the SWOT matrix, the WO2, WO3 and WT2 strategies point to the importance of public participation based on internal and regional capacities in the development of industry and regional progress. These strategies explain the important impact of the university in relation to public and regional capacities in the developments of the oil industry and the progress of the country's regions. On this basis, more specifically, the Petroleum University of Technology and other scientific and research centers of the Ministry of Petroleum will have an important mission in advancing the scientific and technological achievements of this industry.

Based on this, the present research uses content analyses, the Delphi method, and the entropy method to identify, examine, and give weight to the effects of 3G universities based on the views of experts and researchers in the oil industry in three stages. In the first stage, by studying and referring to more than 50 different resources and over 120 frequent key points, the core categories have been identified and classified into basic components and principal components relevant to the topic of the research. Twenty-five basic components and six principal components were selected as shown in the following table.

Table 4: Content analysis of resources on the effects of 3G universities on regional progress
(Core category: Functional and effective attributes of 3G universities in regional progress)

Basic components	Principal components
Commercializing achievements by gradual technology transfer to existing and entrepreneurial universities	Commercializing achievements and university-based entrepreneurship
Diversifying and deepening the university's business cooperation with regional industries, organizations, and institutions	
Expanding university-based entrepreneurship	
Expanding technical infrastructures	
Expanding financial and trade infrastructures	
Upgrading organizations (structure & mechanism) for integrated regional policymaking	Expanding organizational capacities in line with the functions of regional universities
Reforming the structure and internal mechanisms of the university and increasing organizational flexibility to support regional value creation, entrepreneurship, and innovation	
Transformation from a program-oriented organization to a virtual organization (network structure with flexible boundaries) to overcome environmental complexities and uncertainties	
Improving the evaluation and evaluation mechanisms of universities and academics in accordance with the missions of universities in the region	
Promoting regional governance maturity level	
Generating knowledge required by the region	Generating and distributing knowledge and technology focused on regional learning
Expanding learning opportunities and knowledge transfer in the region	
Using innovative capacities in regional progress	
Constructing discourse on regional progress at the university and in the region	
Increasing the awareness and skills of students and regional manpower in entrepreneurship, and social and economic value creation	Planning and implementing a regional system of skills, education, and training
Expanding the infrastructure for education in line with the mission of the university	
Reforming the education system and syllabus to facilitate relations between the university, market, and society	
Expanding and deepening relations between the university, industry, government, civil society, and environment (quintuple helix)	Shaping and leading the region's endogenous innovation and value creation ecosystem
Knowledge-based architecture of regional economy and society	
Networking, organizing, and integrating the capabilities of active academic and regional elements	
Ability to lead and determine strategies in relation to active regional elements with a focus on regional universities	
Laying the groundwork for participation in regional innovation, technology transfer, and learning	
progress of entrepreneurial culture and social and economic value creation in all educational, research and management procedures	
Increasing local capacities and forming a regional attitude towards progress	Regional capacity building
Alignment with the social and cultural conditions of the region on the path of progress	

Subsequently, by using the Delphi method and content analysis, the effects of the university on knowledge-based regional progress based on relevant resources and field interviews is examined. A university population of 63 people familiar with the oil industry, faculty members, and researchers of centers affiliated to the oil industry were interviewed. The snowball method of sampling was used in three rounds. Using the Delphi method after the first and second rounds, and after defuzzification of results, given the views expressed in round three and their comparison with the results of the previous round, the difference between the rounds was less than the lowest tolerance threshold (1/0), which indicates the adequacy of progress in the Delphi method. There are no clear rules for determining the sample size in the Delphi method. But factors such as the homogeneity of the society under study, the ability of the research team to conduct the study and examine the answers, and the compatibility of the questions with the topic being studied, can increase the response rate and level of participation by the panel of experts in this method. In a range of resources examined, the number of participants is usually less than 50 and a maximum of 15-20 people in a homogeneous population (Rahmani et al, 2020). Examining the forecasts in the present study shows that a population of 63 experts from this sector was an adequate sample size.

The dispersion of the experts' answers and the numbers they assigned to the components based on the entropy method is one of the multi-criteria decision-making methods to calculate the weight of each criterion and the mean weight of every group of components. In this formula, the closer the entropy value of j (Ej) to the value of one, the lower the impact of the index in the prioritization of options. If an index is given the same value in all the options, its entropy will be one and it will not affect the choice of options or components being studied. The degree of deviation (dj) in the relationship also quantifies the amount of useful information for decision-making. By dividing every unit of dj by the total degree of deviation, the weight and priority of every component is given compared with the others.

Table 5: Defuzzified Delphi values and weighting based on the entropy method

Principal components	**Basic components**	**Defuzzified Delphi values**	**basic Component weights based on the entropy method**	**Weight rating of each basic component**	**Weight of principal components**	**Weight rating of each principal component**
University-based entrepreneurship and commercializing achievements	Expanding university-based entrepreneurship	7.87	0.03357	25	0.035	4
	Commercializing achievements with the gradual transfer of basic technologies to existing university-based companies	7.01	0.03758	4		
	Expanding financial and trade infrastructures	7.78	0.03592	15		
	Expanding technical infrastructures	7.6	0.03366	24		
	Diversifying and deepening trade collaboration of the university with regional industries, organizations and entities	7.99	003602	13		
Expanding organizational capacities in line with the functions of regional universities	Upgrading organizations (structure & mechanism) for an integrated regional policymaking	7.25	0.03697	7	0.0358	3
	Reforming the structure and internal mechanisms of the university and increasing organizational flexibility to support regional value creation, entrepreneurship, and innovation	7.47	0.03409	22		
	Transformation from a program-oriented organization to a virtual	7.01	0.03603	12		

	organization (network structure with flexible boundaries) to overcome environmental complexities and uncertainties					
	Laying the groundwork for the formation of inter-regional, national, and transnational communication	7.8	0.03601	14		
	Improving the evaluation and evaluation mechanisms of universities and academics in accordance with the missions of universities in the region	7.29	0.03577	18		
	Promoting regional governance maturity level, creating mechanisms for observation, dynamic evaluation, and monitoring of the region	7.23	0.03619	11		
Generating and distributing knowledge and technology focused on regional learning	Expanding learning opportunities and knowledge transfer in the region	7.83	0.03284	27	0.0351	5
	Generating knowledge required by the region	8.09	0.03385	23		
	Using innovative capacities in regional progress	7.88	0.0365	10		
	Constructing discourse on regional progress at the university and in the region	7.03	0.03723	6		

Planning and implementing a regional system of skills, education, and training

	Increasing the awareness and skills of students and regional manpower in entrepreneurship, and social and economic value creation	7.82	0.03666	8	0.0359	2
	Expanding the infrastructure for education in line with the mission of the university	7.68	0.03494	21		
	Reforming the education system and syllabus to facilitate relations between the university, market, and society	8.11	0.03662	9		
	Promoting the intellectual and spiritual capital of the region	6.8 (lower than tolerance threshold)	--	--		
	The need to pay attention to training and skills in addition to the main educational approach at the university and for the regional workforce	8.13	0.03554	19		
	Expanding and deepening relations between the university, industry, government, civil society, and environment (quintuple helix)	7.73	0.03774	3	0.0369	1
	Knowledge-based	7.84	0.03781	2		

Shaping and leading the region's endogenous innovation and value creation ecosystem	architecture of regional economy and society					
	Expanding the capacities of intermediary and complementary individuals and entities to form an active network in the region	7.04	0.03984	1		
	Networking, organizing, and integrating the capabilities of active academic and regional elements	7.57	0.0359	16		
	Ability to lead and determine strategies in relation to active regional elements with a focus on regional universities	7.08	0.03584	17		
	Laying the groundwork for participation in regional innovation, technology transfer, and learning	7.52	0.0373	5		
	Progress of entrepreneurial culture and social and economic value creation in all educational, research and management procedures	8.08	0.03541	20		

Regional capacity building	Increasing local capacities and forming a regional attitude towards progress	7.61	0.03085	28	0.032	6
	Alignment with the social and cultural conditions of the region on the path of progress	7.5	0.03334	26		

The three attributes of "Expanding the capacities of intermediary and complementary individuals and entities to form an active network in the region", "Laying the groundwork for the formation of inter-regional, national, and transnational communication", and "The need to pay attention to training and skills in addition to the main educational approach at the university and for the regional workforce" were added to the survey as suggested by the panel of experts as new components in the next round of the Delphi method. These were evaluated and approved by the experts. Also, the component of "Promoting the intellectual and moral capital of the region" was suggested by the experts and evaluated in the next rounds. In contrast to the previous components, the latter component was eliminated from the study in the next calculations due to a lack of consensus in the expert survey in approving it as it showed a value of 6.8 in defuzzied value, which is less than the tolerance threshold of 7. The attribute of "Promoting regional governance maturity level" and "Promoting regional governance maturity level, creating mechanisms for observation, dynamic evaluation, and monitoring the region" were changed and approved by a consensus of experts in rounds two and three by obtaining a 7.23 defuzzied value.

With the addition and subtraction of the mentioned components and the approval of other components in the Delphi survey process, In the study of the impact of universities under the supervision of the oil industry in particular in the cities of Abadan and Ahvaz, we are witnessing the consensus of experts on the effectiveness of science and technology in institutionalizing progress in the regions. In fact, the regions benefiting from the knowledge capacity of the country's oil industry colleges, in addition to providing national and transnational achievements, have been able to train the human resources required in this industry and increase the human capacity in the regions. The result of this action is to walk a different path from the empty areas of the institution of science and technology and move towards the progress of more and more areas in relation to this institution. This is a proof of the fundamental role of the university as the most central institution in charge of science and technology in the progress of regions and its connection with the major goals of the country. This is achieved based on the capacity and habitat of the region.

As a result, the components of "Expanding the capacities of intermediary and complementary individuals and entities to form an active network in the region", "Knowledge-based architecture of regional economy and society", "Expanding and deepening relations between the university, industry, government, civil society, and environment", "Commercializing achievements by gradual technology transfer to existing and entrepreneurial universities", and "Laying the groundwork for participation in regional innovation, technology transfer, and learning", were the first five priorities identified by the experts with the most weight among available components for the active impact of the university on regional progress. Based on the above table, by examining the principal components, the components of "Shaping and leading the region's endogenous innovation and value creation ecosystem", "Planning and implementing a regional system of skills, education, and training", and "Expanding organizational capacities in line with the functions of regional universities" were respectively defined as the first three components of university influence in regional progress according to the experts. The following chart displays six principal components and their basic components to explain the university's influence on regional progress.

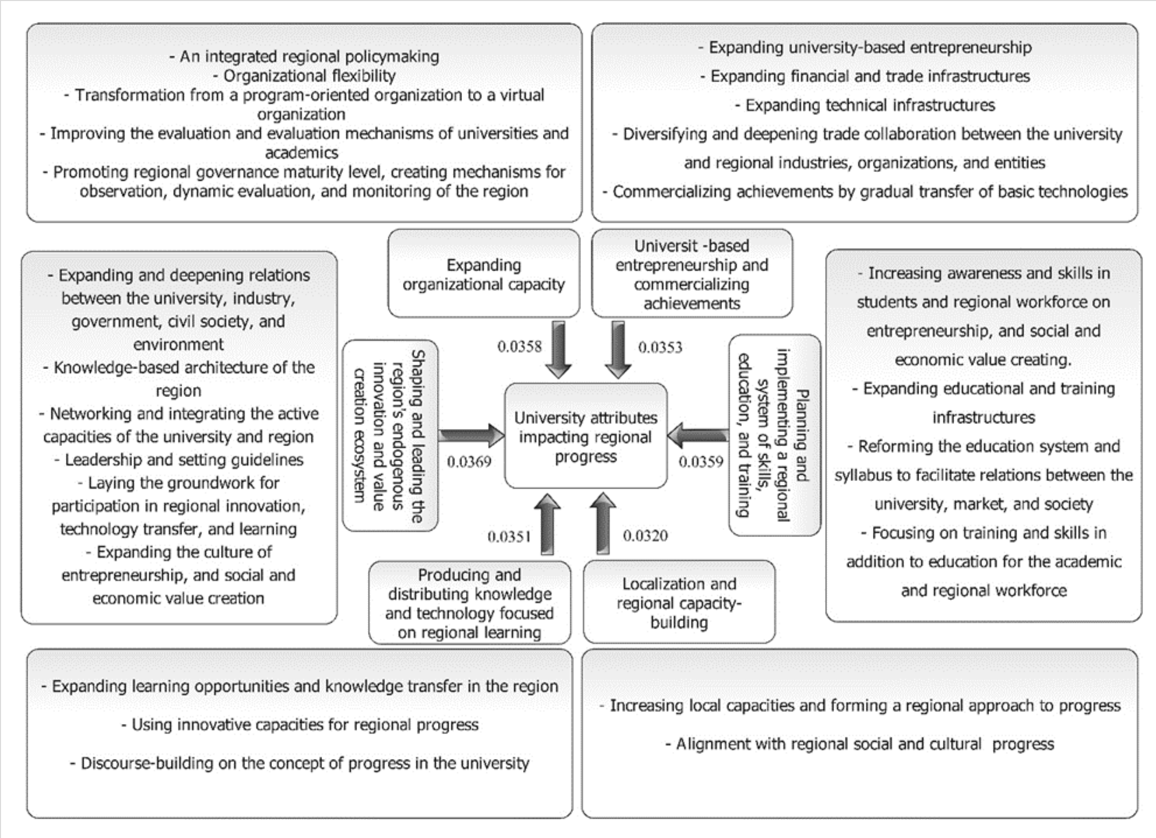

Figure 2 : Final model for "Components of the influence of the third generation university on regional progress"

4. Conclusion

With the passing of nearly fifty years since development programs began in the country, we are witness to a lack of balanced development in various dimensions and an unbalanced distribution of opportunities between regions. Productivity indicators in the manufacturing, industrial and technological sectors have also not improved. This is highlighted further despite having an oil industry which is over a 100-years-old, making the lack of success in development programs to reach their objectives all the more tangible. A lack of alignment at the local and regional level, neglecting the endogenous growth of different areas, and not providing them with the opportunity to use their capacities to grow and prosper, are some of the main shortfalls of national development programs. On the other hand, given the existing capacities at the heart of entities which are the custodians of science and technology, together with the many social and economic opportunities at the core of regions, efforts to promote the capabilities of the said entities on a regional level is one of the instances which can focus attention on the local areas and their habitat, taking their available capacities into consideration in a regional, inter-regional, national, and transregional context. The Ministry of Petroleum, both as an entity with many links to universities and science and technology centers, and as an organ with its own research centers and universities in regions which are ready to grow, can play a vital role in the progress of regions in line with their local habitat and capacities. Also, according to the scientific, research and technological growth of Petroleum University of Technology, promoting the economic and social effectiveness of this university is a fundamental action in the path of growth and prosperity of this industry and the country. This issue is especially defined in oil-rich areas with scientific and technological capital as an important priority for Petroleum University of Technology. Petroleum University of Technology and other scientific and research institutions of the Ministry of Petroleum, considering the economic opportunities available in the markets of neighboring countries, can use the scientific and technological capacities and public capacities to provide the ground for endogenous growth in the country's progress and prosperity.

To achieve this, the university system must move from the first generation (education oriented), and second generation (education and research oriented) universities to third generation universities which, in addition to education and research, consider social and economic value creation in regional habitats as their vocation. Therefore, the attributes of universities impacting regional progress were studied based on available resources. After determining the relevant basic and principal components, these were presented to a population of experts in the oil industry for evaluation. Eventually, 29 basic and six principal components were approved. The entropy method was used to evaluate the weight of these components from the viewpoint of the said experts. Next, the components of "Shaping and leading the region's endogenous innovation and value creation ecosystem", "Planning and implementing a regional system of skills, education, and training", "Expanding organizational capacities in line with the functions of regional universities", "University-based entrepreneurship and commercializing achievements", "Generating and distributing science and technology focused on regional learning", and "Regional and local capacity-building", were respectively prioritized and approved as functional components of the university as a science and technology institution affecting regional progress and progress.

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