# Innovation Policy Learning in Iran's Development Plans

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## Abstract

Apart from "future-shaping" tools (such as forecasting, scenario planning, etc.), many countries also use "backward-looking" approaches to develop long-term strategies for switching to a new economic model. A retrospective assessment of accomplishments and failures (or policy learning, PL) helps one learn lessons and improve the effectiveness of innovation policy. Using the example of Iran, this paper examines the use of PL to assess key initiatives in the field of science, technology, and innovation over the past two decades. Field research allowed the authors to identify the main policy goals, analyze their evolution and the changes in the perception of previously made decisions by politicians themselves. The active use of technical and conceptual PL indicates relative progress made in adjusting the policy vector. At the same time, partisan policy learning remains common, applied to legitimize the current course, which indicates the insufficient maturity of Iran's political system (as is the case in many other developing countries). It was concluded that to make real progress and increase the effectiveness of innovation policy, technical and conceptual aspects should be applied, while keeping the use of partisan policy learning to a minimum.

**Keywords:** policy learning; challenges; lessons; development strategy; foresight; Republic of Iran; technology and innovation policy

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## Introduction

Shaping and implementing science, technology, and innovation policy plays a key role in switching to a new economic model. Various tools are applied to enrich national, corporate, and individual strategies, including retrospective analysis and learning from previous accomplishments and failures (policy learning, PL). History is analyzed in terms of the past choices' impact on future scenarios [*Schoemaker,* 2020]. PL sheds light on the process of shaping science, technology, and innovation policy, helps its developers and experts understand the context in which strategic decisions were made, learn lessons, grasp the essence of the learning process itself, and change politicians' views on the appropriateness of particular steps.

The theoretical foundations of PL were consistently developed in [*Heclo*, 1974; *Sabatier*, 1988; *Bennett, Howlett,* 1992; *May,* 1992; *Hall,* 1993]. Since the 1980s its application was extended from public administration to other areas. Over time PL has become part of a systematic approach to innovation [*Klochikhin,* 2013] and innovation policy [*Biegelbauer,* 2016; *Borras,* 2011; *Braun, Benninghoff,* 2003; *Schwerin, Werker,* 2003].

The use of PL for strategic planning in the context of developing economies is not sufficiently covered in the literature [*Freeman,* 1987; *Kim,* 1997]. Using the example of Iran, this paper examines this process in relation to the shaping of national science, technology, and innovation policy in 2000-2021.

A retrospective review of Iran's past development plans provides an insight into how and why "looking back" can help one "look forward". Strategic planning in Iran began in the middle of the last century [*Bostock, Jones,* 2014]. So far 10 national development plans have been consistently adopted: five before the 1979 revolution and five after it. The last four plans, implemented since the early 2000s, included specific science and technology sections. Some of the targets set there, such as increasing the share of gross domestic expenditures on research and development (GERD) in GDP, total factor productivity (TFP), and protecting intellectual property (IP) still remain relevant, while others were transformed into other, new objectives.

## Literature Review

Approaches to learning lessons for use in making strategic decisions are being actively studied in the scope of various research fields such as organizational studies [*Argote*, 2012], the theory of the firm [*Penrose*, 1959], evolutionary economics [*Nelson, Winter,* 1982], and technological capabilities [*Salisu, Bakar,* 2019]. The concept of PL has expanded from public administration [*Sabatier,* 1988] to other areas including science, technology, and innovation policy studies [*Murrall-Smith,* 2011, *Biegelbauer,* 2016, *Sanderson,* 2002; *McCann, Ward,* 2012]. Depending on the context, PL can be collective [*Hall,* 1993] or individual [*Heclo,* 1974]. [*Hall,* 1993] presents a classification of PL types applied to shape economic and innovation policy in the UK. The author identified three types of policy learning. The first one (*technical PL*) helps to develop and improve policy tools; the second (*conceptual*) implies adjusting policy goals and objectives, while the third (*social*) helps adjust the strategic vector and basic attitudes. Examples of the use of PL in different countries can be found in [*Murrall-Smith,* 2011; *Biegelbauer*, 2016].

Lieu [*Lieu,* 2013] mentions *technical* PL aimed at improving policy tools and programs and *conceptual* PL carried out to adjust strategic goals and directions. The main PL mechanisms include systemic study, observation, experimentation, and collaboration. In Austria, a combination of five PL types proved to be highly effective in innovation policy shaping: social, reflexive, partisan, technical, and managerial PL [*Biegelbauer,* 2016]. The European Commission used PL at the organizational and personal levels to assess the integration of climate policies in member states. *Factual* policy learning extended the understanding of the situation, *constructivist* PL revealed changes in norms, values, and beliefs, while *experimental* PL helped with solving specific problems, gaining experience, and understanding the successes or failures of particular decisions [*Rietig, Perkins,* 2017].

Unlike other PL types, *partisan* policy learning does not aim to improve policy [*Oliver, Pemberton,* 2004] or focus on the long term. Its primary functions are managing the current context and minimizing the risks for the current authorities [*May,* 1992; *Nilsoon,* 2005; *Baily, Compston,* 2010]. A similar approach was used in the 1970s in the UK to promote renewable energy sources (RES). Political declarations have never produced any real results [*Murrall-Smith,* 2011]. Studies show that in more mature political systems, the demand for *technical*, *conceptual*, and *social* PL increases [*Moyson et al.,* 2017].

## Methodology

In the Iranian context, due to the lack of important tacit information, case studies were seen as the best approach to assessing policy learning's contribution to strategic planning [*Yin,* 2013]. More important science, technology, and innovation policy areas were identified, the corresponding sections of the economic development plans approved in the last two decades analyzed, and the main PL types, mechanisms, and participants described. The tools used to collect field data included semi-structured interviews, expert publications, development plans, and an analysis of the research and development (R&D) sphere [*Suurs et al.,* 2009]. Officials, experts,

Table 1. **Policy Learning Types**

| Categories of Policy Learning | Technical | Conceptual | Political | Social |
|---|---|---|---|---|
| **Subject/ content of learning** | Effectiveness and feasibility of instruments | Defining problems, goals and strategies | New strategies for supporting specific goals | Values, duties, relations and multiple approaches |
| **Examples of policy learning** | Adjustment in instruments/ standards | Adjustment of new problems and past goals | Symbolic (usually not stable) adjustments over time | Collaboration with stakeholders and testing new mechanisms of cooperation |
| **Evidence of policy learning** | Referring and describing evaluations and behaviors | New systematic problems, goals, and descriptions | New tactics in policy discussions | – |

*Source*: [*Murrall-Smith,* 2011].

scientists, and practitioners involved in the development, approval, and implementation of the plans were interviewed (Tables 2 and 3). The questions asked during the interviews concerned changes in the development goals and areas, visions of the innovation policy vector, arguments used by supporters and critics of various initiatives, ways to obtain relevant competencies, and key participants in the system. In the case of a contradiction in the respondents' assessments, the most common opinion was taken into account. Sixteen innovation system-related strategic goals were identified in the resulting data array for further study (Box 1).

## Implementation of Innovation Policy in the Economic Development Plans

Iran started the systematic planning of economic development in 1948, before most of its peers at the time (such as China, the Republic of Korea, or India) [*Mc Leod,* 1964; *Baldwin,* 1967]. Five economic development plans were consistently put into effect between 1948-1979 (the beginning of the Islamic revolution), but the objectives were fully implemented only in the case of the third (and partly the fourth) plan. The last two plans were focused on industrial development based on technology transfer and import substitution. The implementation of the sixth plan was cut short with the onset of the revolution followed by the war with Iraq. As a consequence, throughout the 1980s support for higher education, science, technology, and innovation was not present on the political agenda. As the situation stabilized, the attitude toward the content of economic plans changed. The promotion of science, technology, and innovation has been renewed since the late 1990s [UNCTAD, 2016]. The agency responsible for drafting the plans (the Planning and Budget Organisation, PBO) was restructured. The first two plans drawn up in the new period were focused on developing higher education and coordinating innovation actors' efforts (respondents 2, 11, and 13). New, more ambitious goals have been added to the previously set ones, which reflects insufficient policy learning in the R&D sphere. Since the 2000s (and the adoption of the third plan), science, technology, and innovation were addressed in a separate section.

Box 1. **Innovation Policy Goals Subjected to Policy Learning**

1. Improving local content and public procurement in favor of T&I development
2. Formulation and implementation of industrial policy
3. Coordination and coherence among STI policy actors
4. STI development policies and systematic approach to innovation policy
5. Enforcing intellectual property rights (IPRs)
6. Commercialization and trading IPRs
7. Expanding international technological collaborations and absorbing foreign T&I investment
8. Developing intermediaries for T&I development (such as S&T parks, incubators, and technology districts)
9. Supporting SMEs, promoting their growth and linkages to large firms
10. Promoting private research and technology (R&T) funds as well as VC funds
11. Insurance of R&T activities
12. Supporting demand- and mission-based research and innovation
13. R&D share of GDP
14. Supporting R&D activities
15. Supporting the creation of technology-based firms affiliated with universities (university spin-offs)
16. Encouraging the development of high-tech technologies (both generally and thematically)

*Source*: authors.

Table 2. **Respondents Interviewed during the Study**

| № | Interviewee | Date | Involvement into the plan preparation | | | |
|---|---|---|---|---|---|---|
| | | | 3rd | 4th | 5th | 6th |
| 1 | Senior researcher, member of RTTG | 12-03-2016 | | * | * | |
| 2 | Senior expert at PBO, member of RTTG | 07-03-2017, 12-04-2021 | * | * | * | * |
| 3 | Senior civil servant at VPST & MIMT | 26-01-2016 | * | * | | |
| 4 | Senior policy consultant, member of RTTG | 15-02-2016 | | * | * | |
| 5 | Senior civil servant at PBO | 22-02-2016, 14-04-2021 | * | * | * | * |
| 6 | Former minister | 03-05-2016 | * | * | | |
| 7 | Senior civil servant at VPST | 17-05-2016 | | | * | |
| 8 | Former vice-minister | 24-05-2016 | * | * | | |
| 9 | Former vice-president | 05-06-2016 | | * | | |
| 10 | Civil servant and policy expert | 07-06-2016 | | * | * | |
| 11 | Former senior civil servant at PBO | 15-06-2016, 08-04-2021 | * | * | * | * |
| 12 | Senior policy consultant and expert | 23-06-2016 | * | * | * | |
| 13 | Senior civil servant at PBO | 29-06-2016 | * | * | | |
| 14 | Policy researcher, faculty member | 22-04-2017, 06-04-2021 | * | * | * | * |
| 15 | Senior civil servant at parliament research center | 09-05-2017, 10-04-2021 | | * | * | * |

*Note*: The PBO is the lead agency responsible for drafting economic development plans to be approved by the government and parliament. Every five years the PBO hosts an RTTG meeting; the latter group drafts the science, technology, and innovation sections of the plan over a period of about a year. The RTTG comprises representatives of MSRT, VPST, MICT, MoD, MoE, MoA, MIMT, and ACECR. Please refer to Table 3 for explanations of the abbreviations.

*Source:* authors.

Iran, with its substantial oil and gas reserves, managed to avoid "resource dependence". Over the past decade, industrial production has grown in scale and diversity, so the national economy has become the most diversified among the Middle Eastern countries (the oil and gas sector's share is less than 20% of GDP) [UNCTAD, 2016; McKinsey, 2016].

Three main stages can be identified in the development of Iran's science, technology and innovation policy [*Heshmati, Dibaji,* 2019, UNCTAD, 2016].

- **In the 1990s** priority was given to transforming and developing higher education infrastructure.
- **In the 2000s** the focus shifted to promoting R&D in areas such as bio-, nano-, information, and cognitive technologies.
- **In the 2010s** the transition to a knowledge-based economy, the commercialization of technologies, and supporting high-tech companies came to the fore [*Soofi, Ghazinoory,* 2013, *Souzanchi, Kashani,* 2020].

The main innovation policy areas are presented in Table 4.

Systemic efforts to transform the national economy by promoting the development of science, technology, and innovation have improved statistical indicators. In 2005-2019 significant progress was made in the development of higher education, increasing industrial product exports, and upgrading the information and communication technology (ICT) infrastructure. Though the share of GERD in Iran's GDP did not grow during that period, R&D was actively conducted in new areas including nano- and biotechnology and renewable energy sources. In terms of the number of academic publications, in 2005 Iran was 34th and in 2019 it climbed to 15th place[1]; in terms of the number of papers on nanotechnology it was 4th.[2] The number of patent applications grew from 4,494 in 2005 (28th place) to 12,147 in 2019 (16th).[3]

In 2014-2019 Iran has moved up 59 places in the Global Innovation Index, from 120th to 61st place [*Dutta et al.,* 2020]. The total capacity of power plants operating on renewable energy sources in 2020 amounted to 920 MW (twice as much as in 2017) [*Fartash et al.,* 2021]. The Iranian National Innovation Fund[4] actively supports high-tech product manufacturers; since 2001 it has financed over 5,870 companies with a total turnover of about 28.5 billion USD in 2020.

### *Third Economic Development Plan (2000-2004)*

With the adoption of the law on "maximizing the use of domestic capabilities", the development of an R&D strategy acquired a systemic basis and was described in a separate section of the economic development plan [UNCTAD, 2016]. While previous

[1] https://www.scimagojr.com/countryrank.php, accessed on 30.03.2021.

[2] https://statnano.com/report/s29, accessed on 30.03.2021.

[3] https://www3.wipo.int/ipstats/index.htm?tab=patent, accessed on 30.03.2021.

[4] Established in 2001 with initial capital of 3 billion USD. For more see: https://pub.daneshbonyan.ir, accessed on 30.03.2021.

Table 3. **List of Organizations Mentioned in Table 2**

| Name | Acronym |
|---|---|
| Planning and Budget Organization | PBO |
| Research and Technology Task Group | RTTG |
| Ministry of Science, Research and Technology | MSRT |
| Vice-Presidency for Science and Technology | VPST |
| Ministry of ICT | MICT |
| Ministry of Defense | MoD |
| Ministry of Power | MoP |
| Ministry of Agriculture | MoA |
| Ministry of Industry, Mines and Trade | MIMT |
| Iranian Academic Center for Education, Culture and Research | ACECR |
| Source: authors. | |

programs did provide for developing new technologies and competencies, they were not sufficiently consistent and specific. The authors of the law set the goal to promote technological cooperation with foreign companies (respondents 2 and 5). The policy vector pursued in the late 1990s was recognized as a mistake. To better coordinate the work, the Ministry of Culture and Higher Education was transformed into the Ministry of Science, Research, and Technology and was given extended powers (respondents 6, 8, and 11). However, this decision is now also seen as unproductive.

Significant resources were allocated to support private research foundations and companies. Publicly funding half of the costs of demand-driven research by universities was an initiative that counts as a successful one and was renewed in subsequent economic development plans (respondents 4, 11, 13). Universities were allowed to establish high-tech companies and own a controlling interest in them. A radical change in the attitude toward promoting R&D development was reducing the role of the state and encouraging the private sector (respondent 2). Given that after the revolution the nationalization of large enterprises and banks was stepped up, this university reform was evidence of active *conceptual* PL. The third plan was implemented in the context of low oil and gas prices and allowed the country to avoid an economic downturn. Its overall implementation is estimated at about 50% and the implementation of the R&D-related sections was above average (respondents 2, 5, and 11).

The fourth, fifth, and sixth plans lacked clear, realistic goals. Their content was a rather chaotic medley of diverse political objectives and tools, including attracting foreign direct investment, promoting the commercialization of R&D results and international technological cooperation, and the development of the national innovation system as a whole (respondents 1, 2, and 11).

### *Fourth Economic Development Plan (2004-2009)*

Unlike the previous one, the fourth plan was developed in the context of high energy prices. A wide range of poorly coordinated ideas and initiatives were proposed for inclusion, so their harmonious integration into a five-year cycle turned out to be problematic (respondent 9). The key goals and visions looked unrealistic and utopian. At the same time, it was recognized that changing the economy's focus from natural resources to research and knowledge could only be based on increasing TFP

Table 4. **Main Innovation Policy Initiatives**

| Policy | Year of ratification | Ratified by | Objectives |
|---|---|---|---|
| 2025 Vision: 20-year Vision Plan | 2005 | Supreme Leader | Providing desired status of Iran, including STI, for a 20 year period |
| The Law of Registration of Patents, Industrial Designs, and Trademarks | 2007 | Parliament | Protection of intellectual property rights |
| Law for Supporting Knowledge-based Firms and Commercializing Innovations | 2010 | Parliament | Supporting KBFs to facilitate transition to a knowledge-based economy |
| National Master Plan for Science and Education | 2011 | Supreme Council for the Cultural Revolution | Presenting objectives, policies, strategies, structures, and requirements for the development of T&I until 2025 |
| National Policy for S&T 2014 and National Policy for a Resilient Economy | 2014 | Supreme Leader | Providing a holistic framework policy for supporting T&I development and industrialization |
| Development plans (containing STI-related articles) | 6th plan approved in 2017 | Parliament | The most comprehensive framework policy of Iran for a five-year period to fulfill the 2025 vision, overarching all other national policies, to spearhead the development of Iran in all aspects including STI |
| Act of Maximum Use of Production and Services to Satisfy the Country's Needs and Enhance Them in Exports | 1996, revised in 2012 & 2019 | Parliament | Supporting local content and active role of domestic firms in international projects to enhance their capability |
| *Source*: authors basing on [*Soofi, Ghazinoory,* 2013; UNCTAD, 2016; *Souzanchi, Kashani,* 2020]. | | | |

through intensive innovation development (respondents 5 and 9). The implementation of the law on maximizing the use of national capabilities remained a priority. Compared to previous plans, the promotion of the "technological" vector and improving the domestic value chains was considerably stepped up, in line with the highly open economic policy at the time. The focus was on promoting the growth of small and medium-sized enterprises (SMEs), strengthening their links with big businesses, developing value chains in industrial clusters, supporting technology parks, and creating special technology zones. The national innovation system's productivity was supposed to be increased through the institutional modernization of the R&D sphere, including strengthening intellectual property protection, improving research infrastructure, stepping up commercialization, and creating a technology brokers' institution. Support for private foundations and science and technology projects aiming to meet actual demand was expanded.

***Fifth Economic Development Plan (2011-2017)***

A local version of the US Bayh-Dole Act (1980) was adopted. Priority was given to an integrated industrial development strategy, strengthening the country's technological potential, and gaining a competitive edge. The focus was on protecting intellectual property and encouraging universities and research organizations to establish private knowledge-intensive start-ups. Note that according to previous plans, such companies could be exclusively owned by universities.

***Sixth Economic Development Plan (2017-2021)***

As was the case with the previous plan, the parliament had to overcome the government's reluctance to approve it (respondents 2, 9 and 12). Initially the government committed to fully implementing the economic development plans, but then found a way to get around this obligation (respondents 2 and 12). The provisions of the fifth and sixth plans essentially coincide with the fourth one. They were relatively proactive and endogenous, with the exception that the executive authorities were officially allowed to implement the initiatives specified in the plans selectively. Export promotion and integration into global value chains were brought to the fore, along with public procurement to promote R&D, support for small and medium-sized businesses, and strengthening their ties with large companies. Continuity has been maintained with the fifth plan regarding intellectual property and research-intensive university start-ups. The sixth plan is mainly focused on promoting R&D potential through international cooperation and attracting foreign direct investment. The effort to engage the private sector in developing high-tech projects was stepped up.

## The Use of Policy Learning in Drafting Economic Development Plans

Key aspects of innovation were identified through a content analysis of the plans, policy documents, drafts, and reports prepared by the Research and Technology Task Group (RTTG). The R&D-related development goals were identified using two main criteria:

- feasibility of the science, technology, and innovation objectives (assessed mainly on the basis of the comments of the respondents directly involved in drafting the plans, and partly by analyzing the wording of the documents)
- presence in at least two plans.

The goals of the last four plans presented in Tables 5-8 were identified primarily from their approved versions, and the final RTTG report. Table 9 indicates relevant PL types, the participants who conducted it, and the mechanisms applied to adjust the policies.

The fact that policy tools have been modified indicates that *technical* policy learning took place, while a change in benchmarks suggests the use of *conceptual* PL. We learned about *social* and *partisan* policy learning mainly from the respondents' comments. Changes in the nature of political dialogue on particular issues indicate *social* PL.

*Partisan* policy learning was confirmed by policymakers' justifying and maintaining their legitimacy. PL of various types was carried out in relation to the 16 basic policy goals (see Box 1). The only case of *social* PL was discovered, resulting in a changed attitude toward the knowledge economy and knowledge-intensive companies and the emergence of a common position to provide comprehensive support for them. Six cases of *partisan* policy learning were established with the objective of strengthening legitimacy by making minor adjustments to strategies. *Technical* PL was revealed in seven basic areas, leading to the development of improved and diversified policy tools (the exact opposite of *partisan* PL). The seven cases of *conceptual* policy learning indicate a willingness to align goals with the requirements of technological and innovative development.

All in all, Iran has not been successful in accomplishing the targets set in the economic development plans (respondents 1, 2, 8, and 11). The fact that these targets were transferred into subsequent plans essentially unchanged indicates an awareness of their relevance and ongoing efforts (albeit unsuccessful) to accomplish them. The frequency of *partisan* learning indicates attempts to maintain legitimacy by transferring unfulfilled tasks to the next

Table 5. **Status of the Considered Policy Issues in the 3rd Plan (2000–2004)**

| Policy issue | Status in the 3rd plan |
|---|---|
| 1 | Abiding by MULC law (A5 88); minimum of 10% share of local content in international contracts (A 89) |
| 2 | *No direct implication* |
| 3 | Establishment of MSRT as the main coordinator among T&I policy actors (A 99) |
| 4 | *No direct implication* |
| 5 | Preparing bill of IPR law one year after approval of plan (executive solutions, 15 in S&T section) |
| 6 | *No direct implication* |
| 7 | *No direct implication* |
| 8 | *No direct implication* |
| 9 | *No direct implication* |
| 10 | Facilitating establishment of private R&T funds and supporting them (A 100) |
| 11 | Providing supportive insurance for R&T development activities of private research organizations (A 101) |
| 12 | Funding up to 60% of research projects that have demand from a governmental organization and are carried out by universities and research organizations (A 102) |
| 13 | 1.5% of which two thirds should be funded by government with a 15% share of basic research (A 102) |
| 14 | Providing the private sector with incentives to increase their engagement in R&D activities (A 102) |
| 15 | Authorization of universities to establish governmental R&T-intensive firms with up to 49% ownership held by university staff (A 154) |
| 16 | Supporting establishment of firms involved in advanced technology development (A 171) |

*Note:* In the tables 5-8, A means Article associated with each policy in development plans.
*Source:* authors.

Table 6. **Status of the Considered Policy Issues in the 4th Plan (2004–2009)**

| Policy issue | Status in the 4th plan |
|---|---|
| 1 | Abiding by MULC law (A 42); abiding MULC in all international contracts (A 13); public procurement directed toward technology development (A 37) |
| 2 | Formulating an industrial policy to improve technological capabilities and spillovers (A 21) |
| 3 | *No direct implication* |
| 4 | Formulation and implementation of NIS (A 46); formulating a holistic research and technology development system (A 43) |
| 5 | Design and implementation of a comprehensive IPRs system (A 45) |
| 6 | Putting into effect mechanisms for IP valuation and trade (A 45) |
| 7 | Developing effective international technological collaboration supports and mechanisms (A 46); developing incentives to encourage foreign investment directed toward T&I development (A 48) |
| 8 | Developing institutional infrastructures for promoting knowledge-based activities such as S&T parks and incubators (A 45); extending incentives provided to free economic zones to firms located in S&T parks (A 47) |
| 9 | Enhancing linkages between SMEs and big firms (A 39); removing barriers impeding the growth of big firms (A 39); developing industrial networks and clusters to boost manufacturing (A 39) |
| 10 | Supporting the establishment and growth of private R&T funds (A 45); support the creation and development of technology financing mechanisms such as VC funds (A 40) |
| 11 | Designing proper mechanisms for insuring T&I development activities (A 50) |
| 12 | Funding up to 60% of research projects that have private sector demand and are carried out by universities and research organizations (A 45); directing R&D activities toward demand- and mission-based projects (A 46) |
| 13 | 2% funded entirely by the government (A 46); |
| 14 | Providing financial and non-financial incentives to increase the involvement of SMEs in R&D activities (A 45) |
| 15 | Authorization of universities to establish governmental R&T-intensive firms with up to 49% ownership held by university staff (A 51) |
| 16 | Taking measures to improve domestic absorptive capacity in advanced technologies (A 40); adopt a plan to improve technology development in areas such biotech; nano, ICT, nuclear, and environment (A 43) |

*Source:* authors.

Table 7. **Status of the Considered Policy Issues in the 5th Plan (2010–2015)**

| Policy issue | Status in the 5th plan |
|---|---|
| 1 | Abiding by MULC law (A 150); priority of public procurement from local firms (A 78); facilitation of local content (A 150) |
| 2 | Formulating an industrial policy supporting enhanced industrial manufacturing and value added (A 150) |
| 3 | Coordination among T&I policy actors in policymaking and supervision by MSRT and SCSRT6 (A 16) |
| 4 | Implementation of national master plan for science and education (A 6); formulating an Islamic-Iranian development model (A 1) |
| 5 | Changing IPR evaluation system from declarative to assessment-based (A 17) |
| 6 | Establishment of IP stock market (A 17); supporting manufacturers to acquire IP (A 17); transferring ownership of IP in projects funded by government to universities and research organizations (A 17) |
| 7 | Promoting technological international collaboration to acquire know-how and encourage foreign firms to bring some of their R&D facilities to Iran (A 17) |
| 8 | Supporting the establishment of private S&T parks & incubators (A 17) |
| 9 | Supporting the creation of technological startups (A 17); developing brokers to link SMEs and big firms and facilitate commercialization by startups and their acquisition by big firms (A 17 & 80); improving linkages of SMEs and big firms which aids in the development of industrial networks, clusters, and local content (A 80) |
| 10 | Support VC funds by providing them with managed funds annually (A 151) |
| 11 | *No direct implication* |
| 12 | Funding up to 50% of research projects that have demand from a non-governmental organization and are carried out by universities and research organizations (A 102) |
| 13 | 3% with annual increase of at least 0.5% (A 16) |
| 14 | Facilitate access of private technology-based firms to research labs and R&D facilities (A 17) |
| 15 | Faculty members at universities are authorized to establish R&T-intensive firms with the approval of university boards of trustees (A 17) |
| 16 | Leveraging advanced technology development to improve industrial competitiveness and added value (A 150); acquiring know-how in areas such as petrochemical; biotech, nano, ICT and microelectronics (A 129 & 197) |

*Source:* authors.

Table 8. **Status of the Considered Policy Issues in the 6th Plan (2016–2021)**

| Policy issue | Status in the 6th plan |
|---|---|
| 1 | Maximum utilization of local content to strengthen technological learning and capability (A 51) |
| 2 | Enhancing domestic industrial capabilities through entering GVCs (A 4) |
| 3 | *No direct implication* |
| 4 | Achieving one fourth of national productivity by improving TFP (A4) |
| 5 | Enhancing IPR enforcement at the firm level (A 4) |
| 6 | Supporting research commercialization (A 4) |
| 7 | Leveraging foreign investment and projects managed by MNCs to enhance domestic technological capability (A 4; A 51; A64) |
| 8 | Improving STI diplomacy (A 105) |
| 9 | Supporting the establishment of private technology towns (A 74) |
| 10 | Supporting and empowering knowledge-intensive firms in production and export (A 51) |
| 11 | Establishment of high-tech fund under the MIMT (A 69) |
| 12 | *No direct implication* |
| 13 | Funding up to 50% of research projects that have demand from and are done by universities and research organizations (A 64); Creation and stimulation of demand for knowledge-intensive products (A 51) |
| 14 | 3% by 2021 |
| 15 | All governmental organizations and firms should spend at least 1% and 3% of their annual budget and income, respectively, on R&D (A 64) |
| 16 | Faculty members at universities are authorized to establish private R&T-intensive firms (A 1) |

*Source:* authors.

Table 9. **Findings on Technology and Innovation Policy Issues and their Associated Policy Learning**

| No. | Policy issue | Type of learning | Actors involved | Learning mechanisms |
|---|---|---|---|---|
| 1 | Improving local content and public procurement in favor of T&I development | TPL; PPL | CS; PE&C; HO | EIPP; DI; T&LD |
| 2 | Formulation and implementation of industrial policy | TPL; PPL | CS; PE&C; HO | T&LD; DI |
| 3 | Coordination and coherence among STI policy actors | PPL | CS; HO; PE&C; RTTG | T&LD; EIPP; DI |
| 4 | STI development policies and systematic approach to innovation policy | SPL; PPL | CS; HO; PE&C; RTTG | T&LD; DI |
| 5 | Enforcing IPRs | TPL | RTTG; CS; PE&C | EIPP; DI |
| 6 | Commercialization and trading IPRs | TPL | RTTG; CS; MoA | EIPP; T&LD; DI |
| 7 | Expanding international technological collaboration and absorbing foreign T&I investment | CPL | RTTG; CS | EIPP; T&LD |
| 8 | Developing intermediaries for T&I development (such as S&T parks, incubators, and technology districts) | CPL | RTTG; PA; CS; HO | EIPP; T&LD |
| 9 | Supporting SMEs, promoting their growth and linkages with big firms | TPL; CPL | CS; PE&C | EIPP; PPE |
| 10 | Promoting private research and technology (R&T) funds as well as VC funds | TPL; CPL | RTTG; CS; PE&C | EIPP; T&LD |
| 11 | Insurance of R&T activities | CPL | RTTG; CS | T&LD; |
| 12 | Supporting demand- and mission-based research and innovation | CPL | RTTG; CS; PE&C | EIPP; |
| 13 | R&D share of GDP | PPL | RTTG; CS | EIPP; T&LD |
| 14 | Supporting R&D activities | PPL | RTTG; CS | EIPP; |
| 15 | Supporting the creation of technology-based firms affiliated with universities (university spin-offs) | CPL; SPL | RTTG; PA: HO: | EIPP; DI |
| 16 | Encouraging the development of high-tech technologies (both generally and thematically) | TPL; | RTTG: CS; HO | T&LD; DI |

*Legend:*
TPL: Technical policy learning
CPL: Conceptual policy learning
PPL: Political policy learning
SPL: Social policy learning
RTTG, MoA — see description at Table 3
CS: Civil servants at member organizations in RTTG
PE&C: Policy experts and wider policy communities including media, academics, consultants, and policy entrepreneurs
PA: Public authorities beyond government including judiciary, parliament, and public organizations
HO: High level officials at least at vice-ministerial level
T&LD: Systemic practical and academic training as well as lesson drawing from other countries
PPE: Previous related policy experience
EIPP: Evaluation and implementation of previous plans
DI: Discussions and interactions among policy actors.

*Source:* authors.

plans intact or in an even more ambitious format. This issue is typical for developing countries and without dealing with it, achieving tangible science, technology, and innovation policy results would be impossible [*Compston,* 2010, *Casady, Parra,* 2020].

## Discussion

Now we will discuss the similarities and differences between our results and the practices described in the literature as well as their applicability to other developing countries. Iran's situation is similar to the one described in [*May,* 1992]: policymakers do not see the pragmatic adjustment of policy goals and tools as a priority, but focus on strengthening their own legitimacy through rhetoric and declarations of commitment to the set goals [*Murrall-Smith,* 2011]. A similar situation is also observed in certain African countries which also update their national development plans every few years. Despite the declared goals to increase the share of GERD in GDP, sufficient funds to promote R&D are not actually allocated, while relevant official statistics are not published [*Siyanbola et al.,* 2016; *Oladeji, Adegboye,* 2019].

In contrast to *partisan* PL, *social* policy learning is much less common in Iran. Our study revealed its application in relation to only two policy goals, which is again typical for other countries. For example, in Lebanon the government has implemented at least five science, technology, and innovation development plans, but the situation remains largely unchanged [*Gaillard,* 2010].

Nevertheless, positive changes have also been noted in Iran. Over the past five years the dialogue on the relevance of creating innovations domestically

has been strengthening and is being taken very seriously; concerns about the transition to a new economic model are growing. These issues are discussed by the general public and taken into account through *social* policy learning.

Since 2010 the attention paid to science, technology, and innovation has grown significantly. After the lifting of the sanctions imposed on Iran in 2016, the government introduced special requirements for the "technology section" of the plans, including the requirement to conduct R&D in the scope of all international contracts. An example of a systemic approach is encouraging the innovation-based development of universities. *Technical* and *conceptual* policy learning were applied more often than other types (seven times each). *Technical* PL did not imply changing policy goals but helped to improve the tools for their implementation. There are known examples of its application in shaping innovation policy in Malaysia, Singapore [*Lim,* 2018, *Narayanan, Yew-Wah,* 2018], and other countries [*Smits, Kuhlmann,* 2004; *Boekholt,* 2010]. *Conceptual* policy learning changes policy vision, its scope, and target groups. Priority was given to international cooperation, providing support for R&D projects in various forms, linking them to actual demand, and focusing on accomplishing the set goals. Over the past two decades, this type of policy learning has led to a shift in political emphasis from research to technology development, and in the past six years, to innovation (including the abandonment of a linear approach to creating innovations in favor of building an innovation system). The focus on increasing supply is giving way to initiatives to promote demand. There were important changes in approaches to supporting commercialization, attracting foreign investment, and encouraging international partnerships in the R&D sphere. *Conceptual* PL has also been actively applied in Indonesia and the Philippines [*Damuri et al.,* 2018; *Quimba et al.,* 2018].

PL was most actively carried out by the RTTG and officials at different levels. A similar situation was observed in Thailand, where the National Science, Technology, and Innovation Committee (NSTIC) and the National Research Council (NRC) made key contributions to the development of innovation policy [UNCTAD, 2015].

The role of experts is increasing: they participated in PL for eight of the 16 objectives under consideration. As to the PL mechanisms, the most common ones are learning from past experience and evaluating the implementation of previous plans (applied in 11 and 12 cases, respectively). This means that R&D policy in Iran is increasingly shaped using a scientific, evidence-based approach. Given the growing involvement in PL of various kinds of actors, primarily experts, establishing a dialogue between them is becoming increasingly important.

## Conclusion

This paper presents a case study of the practical application of PL in shaping Iran's science, technology, and innovation policy. Based on the survey results and strategy analysis, different policy learning types and mechanisms have been identified. The findings can be useful for shaping appropriate policies in other countries, primarily developing ones.

1. To accomplish real shifts and increase the effectiveness of innovation policy, technical, conceptual, and social PL should be used, while keeping the use of partisan PL to a minimum. This would be possible only if a wide range of stakeholders are involved in policy shaping, with a sufficiently deep dialogue between them. The economic effect will be achieved if innovation development is consistent with other policy areas (educational, industrial, policies and so on).

2. Pragmatic short- and medium-term goals should be set, for example, to increase businesses' contribution to R&D by introducing relevant incentives.

3. PL procedures should be improved upon by experimenting with the innovation system in line with evidence-based principles. Not only formal quantitative indicators should be taken into account (e.g., the export of new products), but also its contribution to economic growth [*Albert et al.,* 2013]. Policy evaluation allows one to determine whether the goals and the tools applied to achieve them were adequate [*Dawkins, Colebatch,* 2006]. Regular foresight studies can provide informational context, describing the mainstream and emerging technology landscape.

4. Previous results must be evaluated prior to developing new strategies; a limited number of basic issues should be identified to focus on.

5. The importance of emerging windows of opportunity for the R&D sphere should be demonstrated to the government in a sufficiently clear way [*Lee,* 2005]. Gaining political support for making use of such windows will help build up the technological potential in the short or medium term already.

6. An efficient transition to the knowledge economy would not be possible without the involvement of politicians. To form such a commitment, the potential contribution of R&D to accomplishing various economic, social, and environmental objectives should be demonstrated [*Mazzucato,* 2021].

Other important factors contributing to the increased maturity and stability of the innovation system are introducing effective mechanisms to protect domestic high-technology markets, promoting demand for relevant products, and involving businesses in policy-making and the creation of development institutions.

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