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List of Abbreviations

2G – Second generation of mobile wireless technology
3G – Third generation of mobile wireless technology
4G – Fourth generation of mobile wireless technology
AI – Artificial Intelligence (Autonomous machine learning and decision-making)
BPO – Business Process Outsourcing
CoP – Community of Practice
DNA – Deoxyribose Nucleic Acid
ERP – Enterprise Resource Planning
FDI – Foreign Direct Investment
ICT – Information and Communications Technologies
NME – New Molecular Entity
SMAD4 – A protein used in repair of DNA
Key Terminology

Business Intelligence – Information that allows a decision maker to anticipate important strategic events.

Bioinformatics – The use of ICT to make computations concerning molecular processes in human cells.

Biotechnology – The science of using genetic engineering and automated screening techniques to design new drugs or useful compounds.

Computational Neuroscience – The use of ICT to model circuits in the brain.

Factor Endowments – Resources in a nation, organisational, financial, technological, and skills that are used to generate economic transactions.

Genomic Screening – The discovery of the relationship between specific locations on the human genome and (usually) a disease by comparing the genes of thousands of persons.

Industrial Intelligence – Similar to business intelligence but focused on the elements of technology that are strategically significant.

Internet Listening Post – A small team placed in a foreign environment for the purpose of collecting open source information (intelligence).

Industrial Network – A system of production composed of multiple independent businesses coordinating their efforts as though they were a single business.

Patent Analysis – A systematic review of patents using quantitative and other techniques for the purpose of forecasting.

Roadmap – A visual depiction of how a technology is expected to change over time along with description of its practice implications.

Screening – The selection of innovative ideas according to a defined set of criteria; usually associated with elimination of most ideas and selection of only a few.

Technology Ambassador – A person selected to spend time at a company as an observer for the purpose of collecting industrial intelligence.

Technology Intelligence – See industrial intelligence.
Executive Summary

A number of dynamic ICT-related trends set an important context for Azerbaijan in its continual search for innovation. The most important fact is that ICT has become pervasive throughout all sectors of the world’s economy, and throughout organisations internally as they process their transactions, make their management decisions, and craft their strategies. ICT also has enabled a number of transformations across the globe. Research and development have become globalised, and now continues to become highly distributed in nature. ICT makes it possible to have specialised teams around the world coordinate their activities in one integrated effort. Many of the world’s manufacturing sectors have organised themselves into giant industrial networks held together by ICT. What we know of as the multinational enterprise today is an agglomeration of many semi-independent entities located in different jurisdictions around the world, but operating as an integrated whole, all made possible through the coordinative power of information technology.

Within specific domains, important problems that in the past were intractable now are being attacked with the aid of ICT. For example, in neuroscience, one of the most complex areas of research today, ICT is being used automatically to map the human brain with its almost infinite number of neurons. This will lead to understanding never even remotely possible using previous generations of R&D. The use of bioinformatics in the realm of genetics and biotechnology is leading to breakthroughs in cures for cancer and many other important areas such as production of new generations of food or specialised organisms that can perform important functions including the manufacture of useful drugs and compounds such as hormones. Computational genetics and new methods of imaging are making it possible to understand the incredibly complex interactions of proteins, DNA, RNA and other molecules within the human cell, leading to breakthroughs in gene repair.

The rapid developments in artificial intelligence (AI) are poised to revolutionise the role of middle management, primarily by making it obsolete completely. AI is able to make decisions better than humans, faster, more accurately, and at a much cheaper cost. Although it seems like science fiction, it is not. The transition to the economic use of machine cognition already is underway and is not going to stopped because it is too efficient and cost effective. AI also will be used in robotics, including in war fighting.

A final trend that is not widely noticed is the way in which ICT has lowered the barriers to systematic collection and analysis of information. To the extent that this work is carried out for the purpose of developing strategies for the future, it is intelligence. This means that the technology and industrial intelligence systems that traditionally were carried out secretly within
the domain of governments, which were the only entity with the money to pay for such large and organised efforts, now has become commoditised. For example, it is easy to find many examples of big data analytics available for free on the World Wide Web. Social media organisations have developed large lines of information products that represent the aggregation of astounding amounts of data, and with a granularity and specificity never seen in history. Computational methods such as citation and patent analysis show trends that otherwise would remain invisible. Content analysis combined with automatic translation and deeper methods of database mining of unstructured data such as the world’s news media can show patterns that otherwise would take years to understand. These are only a few examples of how what traditionally was intelligence analysis has become available to everyone. The commoditisation of intelligence opens up intriguing opportunities for development of national strategies for innovation in ICT.

This sets the context for Azerbaijan, a dynamic country facing both challenges and opportunities. Projections for the production of oil and natural gas indicate a gradual lowering of the supply. Since these commodities account for more than 80% of the exports of the country, their reduction will have serious and long-lasting consequences for Azerbaijan’s economy unless the non-oil sector is substantially grown to take up the slack. As Azerbaijan makes its transition to a non-oil economy, it is being forced to work within a ministry-based economic system that is a relic of the Soviet era. Nevertheless, the track record shows that with strong leadership from the top, Azerbaijan is able to move rapidly the address opportunities, and does so on a regular basis. The strong role of the Office of the President of the Republic guarantees rapid implementation of national policy, something not possible in many countries.

But regardless of the national realisation that in the medium term a substantial transformation is required in its economy, Azerbaijan nevertheless is bounded by its economic, social, cultural, and organisational factor endowments. In the end, Azerbaijan must choose between a number of global integration scenarios and develop an industrial intelligence system to monitor crucial technology developments across numerous sectors and integrate it into its economy. Mere monitoring and collection of information is not enough. Azerbaijan should put in place a systematic technology screening and evaluation system that will ensure government resources are placed to address the best targets. The random and haphazard nature of today’s innovation efforts in Azerbaijan must be replaced by a structured and comprehensive system of technology assimilation that spans all sectors of the economy.

This document describes how such a system can be designed, how it will work, and how it will lead to the proper decisions going forward regarding Azerbaijan’s integration into the world’s
economy. Because of the comprehensiveness of the recommended system, it is estimated that it will take at least eight (8) years to make it operational and effective.
What is a Roadmap?

A Roadmap is a diagram that shows over time key developments in a domain. Roadmaps almost always are presented in two-dimensional Cartesian Space, with time being the X-axis and an important variable of concern being the Y-axis. One of the most common roadmaps shows how the level of integration on microchips will increase in complexity over time. Roadmaps are useful because they allow the viewer to see ancillary phenomena that may be anticipated as a consequence of the technology level found at each interval of time. For example, there are a number of early telecommunications roadmaps for wireless systems that illustrated how the transition from 2G to 3G then to 4G for mobile telephones would enable greater services such as streaming video.

![Figure 1 Roadmap to Knowledge Economy in Azerbaijan](image)

So, in general, we can say that a roadmap has several key components. First, the X-axis must be defined, and the key question is how many years we are looking into the future. In practice, most technology roadmaps look perhaps 5 years into the future. After 5 years, longer periods of time lead to very unstable forecasts if one is seeking specificity. For larger phenomena such as the evolution of complex organisations, longer time periods are used, up to 10–15 years is not
uncommon. Finally, there are long-term forecasts that go out a quarter of a century or more, but they almost certainly are of mere ornamental use for solving pressing problems being faced at the moment.

Second, the Y-axis must be defined. What exactly is being counted or quantified? For microelectronics, often the number of transistors on a single integrated circuit are counted; for networking, the speed of circuits; for databases the number of transactions per second; for large organisations, the number of persons served, or the volume of workflow being processed, and so on.

Third, a choice must be made regarding how the intersection of time and Y-quantity is to be expressed. Generally, this is done in two ways. One way is to give a term to a new technology that might be created. For example, as the number of transistors being integrated into a microchip is increased exponentially, we can assign different terms to the resulting technology. Another way is to express the intersection as a type of phenomena that is made possible by the new development. So, this choice focuses more on the effects of the what is being assessed.

So, the crucial decision is choosing exactly what is going to be the subject of the roadmap. What exactly is going to be measured and assessed over time?

Here, we are examining the entire economy of Azerbaijan and its innovation system. This has a high degree of complexity and is composed of many different entities. Millions of persons are involved, dozens of government ministries, and trillions of economic transactions per second. So, what exactly will be the Y-axis? What is going to be measured, and what will be the destination for the roadmap? Where are we going?

This concept paper first examines the global trends in technology with a view to understanding how they set an opportunity landscape for Azerbaijan. After that we define the end state – the destination of the roadmap. This is done by defining the strategic objectives of Azerbaijan’s technology policy. After that, we can plot the path along the time dimension and show all of the intermediate steps required to reach the desired destination, even if it may not be specifically known at the moment.

Since we will be examining a roadmap for Azerbaijan’s innovation economy as a whole, we will take the time to show how it should operate once Azerbaijan puts in place an integrated coordination system to identify, assess, and assimilate innovation. Reaches its designation. In Figure 1 Roadmap to Knowledge Economy in Azerbaijan we have shown the roadmap at the level of macro-organisation necessary within the Government of Azerbaijan. There are three milestones that must be passed before Azerbaijan reaches the desired destination. The first step is to build an industrial intelligence system that will monitor technologies world-wide.
Next, Azerbaijan must put in place some type of screening and analysis system that will guide how new technologies and innovations are incorporated into its economy. Finally, mechanisms must be put in place to make those strategic investments necessary to reach the end point, which is effective development of Azerbaijan’s economy.

Global Trends and Changing the Opportunity Landscape for Azerbaijan

There are a number of trends that will continue to have a strong influence on the range of possibilities available for Azerbaijan. Of course, all industries and fields of inquiry have trends, but below we will focus on those that are ICT related, and that are matched most closely with an advanced knowledge-economy. Even if we restrict our discussion to these trends, there nevertheless are more than ample areas to consider.

ICT has Become Pervasive Across All Industries

ICT now has permeated almost every activity in society. All government transactions are carried out using information systems. Recordkeeping has become automated, and paper systems rapidly are becoming an historical artefact. It is perhaps a slow process, but paper has its days numbered. The share of paper-based documentation has fallen so significantly that if governments around the world decided to print out the records they have stored electronically, it would immediately exhaust the entire tree population of the planet. Paper based documents now are only a small fraction of documents, probably less than 0.1% percent.

Most economic transactions are initiated by machines using other machines as counterparts – humans play a small role in the world economy.

The same has happened in economic transactions. Before the age of computerisation, economic transactions were carried out by persons. Measurement of the GDP entailed counting economic transactions that were initiated from one person to another. Now, humans initiate a very small share of economic transactions. If we divide economic transactions into two classes – those initiated by humans and those initiated from one information system to another – machine to machine communication – then we would find that the number of human-initiated transactions has fallen down to a very small level of the overall total. The result is that most economic transactions are initiated by machines using other machines as counterparts – humans play a small role in the world economy.
The same has happened in the realm of decision-making. In the classical organisational structure, a few persons at the top make the crucial decisions, middle management is in charge of monitoring the activities of the organisation, and the base level of the pyramid is tasked with actually carrying out the transactions. This bureaucratic hierarchy as defined by the German sociologist Max Weber has been permeated by information technology. In the first phase of informatisation, the transactions occurring at the lowest level of the organisational structure were more efficiently handled in batch and then online transactions processing systems. At the middle management level, summary reports of these economic transactions were used by decision makers to determine their actions. The top levels of the pyramid remained focused on external information that helped set the context for the organisation as a whole. See Figure 2 The Classical Pyramid of Decision Making and Information Technology.

The decisions made by Middle Management generally were carried out according to a number of principles worked out in the field of operations research and in business schools where the focus was on business strategy frameworks or game theory. The information that was used for making these decisions was compiled by using management information systems to process the numerous transactions occurring at lower levels in the organisation.
The current trend is to use Artificial Intelligence (AI) to automate the decision-making that traditionally was made at middle management levels. This is done by analysis of the decision rules used in the past. The result is that very quickly an entire class of middle management has become obsolete as more and more of the algorithms used in their decision making are being encoded into artificial intelligence.

This permeation of ICT into all realms of economic activity is a continuing trend, and one that is accelerating. There is no economic domain in society that has not been permeated by information technology.

**Research and Development has Become Globalised and Highly Distributed**

Research and development have become international in nature. The Internet has allowed the sharing of scientific information at levels never seen before. Many systems development groups work together for years without ever having met each other in person. International collaboration systems enable this type of coordination. Apart from the enabling nature of information technology, two other factors are driving this trend. First, much research, particularly concerning products destined for specific markets, must be created to be attractive in the local market. Second, and perhaps more important, there is a global shortage of skilled information workers capable of performing real R&D.

The result is that R&D no longer should be thought of as something that is constrained within a national boundary. In some ways, it is accurate to say that there is no such thing as national research. This is the case because all research now is linked into the international scientific community and there are no national borders involved. Science is global, politics is not.

The practical result of this is two-fold. First, it is possible for an organisation that needs substantial R&D to locate resources in other countries. These resources will be able to perform the needed R&D functions either less expensively or with higher skills than otherwise available domestically. This can lead in turn to development of R&D clusters or agglomerations of research facilities and communities of practice that will take in work from all over the world. This development presents significant opportunities for Azerbaijan, as we will discuss later.

**Many Sectors Have Organised Themselves into Global Industrial Networks**

The multinational enterprises that control almost all of the world’s industrial production have gone through several phases.

1. **Domestic Production 1940’s-1960’s.** The first stage of a business. It creates products and services that are consumed domestically.
2. **International Sales.** The next stage in which the enterprise starts to export its goods overseas in order to meet the needs of foreign markets. Many companies even today operate in this mode. All of their goods are produced in a single location, and then they are shipped to meet demands in other areas of the world.

3. **Overseas Subsidiaries.** Multinational enterprises set up wholly-owned subsidiaries overseas. These subsidiaries mimic the structure of the original corporation. There is little trade *within* the organisation. Essentially, the company consists of the original company plus a number of duplicates of the original form.

4. **Functional Integration 1970’s-1980’s.** Using primarily information technology, functional elements of the enterprise are rationalised and centralised. For example, large Enterprise Resources Planning (ERP) systems operate for the entire corporation worldwide. This is usually centralised.

5. **Globalisation 1990’s-Present.** Many functional elements of the enterprise are set up so that they are optimised for each region of the world where they operate. The enterprise does not truly have a nationality but instead is operating in countries all around the world as a single integrated entity.

6. **Industrial Networks 1990’s-Present.** The strength of information technology allows entire parts of the enterprise to be spun off into separate companies or outsourced. This creates specialisation in each location of the world, lowers costs of production, and increases the flexibility for suppliers to escape from captivity to service the world market. This is the type of global business environment we have now in the first quarter of the 21st century.

The result of this astonishing transformation is that apart from production of physical components and raw materials, this same type of information technology intermediated coordination works across all functional areas of the enterprise, including R&D, administrative processing, plant and equipment, and other domains as well.

One of the consequences of this for countries such as Azerbaijan is that the rise of globalisation and industrial networks has lowered the barriers and increased the opportunity for its companies. Azerbaijan finds that it is easier to join the world’s economic system because there are so many opportunities that can be pursued. This will be discussed further below.
Computational Neuroscience Has Emerged as a New Frontier

What started first with the exceptional drawings of the Spanish histologist Santiago Ramón y Cajal, now has become a complex problem that only can be solved by use of information technology. Research has shown that the human brain is composed of around 80-100 billion neurons and an equal number of other cells. These cells form various circuits that form and then break apart as we learn. They are very small, from 4 to 100 microns in diameter. No one has been able to map the circuits, yet this is necessary to understand how the brain works.

By use of computer modelling and automated techniques for identifying circuits, ICT will be used to create maps of the human brain and unlock how it works. This will take many more years, but it will be done. Computational neuroscience is another example of how ICT has permeated important fields of human activity and has become essential for its operation. Without computation, there will be no science.

Bioinformatics and Biotechnology are Revolutionising Health Sciences

In a related field, ICT is being used to understand the human genome. Large-scale genome studies promise to identify the cause of inherited diseases, and to cure maladies such as cancer, which many times is caused by un-repaired pieces of DNA. The sequencing of the human genome is a statistical process in which the genes of thousands of persons are compared to one another. Sometimes, it is possible to pinpoint the precise location in the human gene where something has gone wrong and tie it to a specific disease. For example, when an error on the gene cuts off production of the SMAD4 protein, the cell loses its ability to suppress tumours. This type of granularity in research is being made possible by gene sequencing. A process that in 2001 cost $100 million dollars, dropped to $10 million by 2007, then $100,000 by 2009, then $10 dollars by 2013, and now is less than $1,000 dollars. As measured in thousands of gene bases analysed per day, the numbers are equally revealing. In 1996 around 9 could be analysed, by 2002 approximately 100, by 2005 this number had risen to 10,000; by 2008 to 1 million; and by 2014, 1 billion. These trends have continued, leading to a complete revolution in gene science, all made possible by information technology.

In biotechnology, the engineering of new molecular entities (NME) has been accelerated, and by using computerised simulation and analysis, it is possible to test these new substances to determine their potential therapeutic effect. It also is possible to use computer simulation instead of live human trials to weed out entities that might produce harmful side effects. As

1 This Nobel laureate lived May 1, 1852–October 17, 1934 and is considered to be one of the founding fathers of neuroscience. See (Swanson, 2017).
2 See https://ghr.nlm.nih.gov/gene/SMAD4
many as 5,000 NMEs are needed to find a substance that is suitable for further testing as a beneficial drug.

Both in drug discovery and gene studies, we can say that these sciences simply would not exist without information technology. Although the examples given here are dynamic, we can find comparable examples in most other sectors of the economy.

**Artificial Intelligence Promises to Make Obsolete Most Middle Management**

Artificial intelligence promises to replace middle management (Rao, 2016). We already can see this in car services such as Uber and Lyft which use AI for automated dispatching of cars, and also for pricing. Drivers eventually will be replaced by self-driving vehicles. Workplace automation will continue to change the nature of employment, and dramatically reduce the number of available jobs (Autor, 2015). When this happens, countries that have based their economic system on inexpensive labour will be made irrelevant. There also are important implications of artificial intelligence in public administration (Barth & Arnold, 1999).

In the same way that nations around the world were substantially challenged by the Internet, and the rise of social media, we can expect an even more traumatic change will be caused by artificial intelligence.

In many societies, working for large organisations, including the government, is a mainstay of economic survival. But what will happen when it is no longer necessary to employ so many persons? This will happen to bureaucracies around the world, and it will happen in Azerbaijan. The question is when, and where, and what will be the strategies to adjust to this new wave of disruptive information technology?

**Intelligence Collection and Analysis Has Become Privatised**

In previous generations, the collection of intelligence, including industrial intelligence or technology intelligence, traditionally was reserved for the government. The primary reason for this is that governments were the only entity that was able to spend the resources to organise giant teams of specialists both within a country and without in order to collect and process information then turn it into intelligence.

The difference between intelligence and data is based on the context in which it is used. Data is simply an accumulation of facts. Information is typically defined as data that is used to make a decision. Intelligence is defined as reasonably certain information concerning an event of significant importance that will occur in the future.

The history of a strong government role in the collection of technology intelligence is a long one. But here, we are concerned with technology intelligence that will be of benefit to the
overall economy, including non-military sectors. Thus, the developments in virtually all areas of technology potentially are of importance to Azerbaijan.

Like in so many fields, the tools of intelligence analysis have been revolutionised by the introduction of ICT. It now is possible to develop many databases with relevant information, and to utilise a vast number of tools that help not only with data analysis, but also with the overall process of performing intelligence analysis.\(^3\)

However, in the past decade, many of the important tools of intelligence analysis and data analysis have become commercialised. They can be purchased by anyone. To give only a single example: Social media companies are able to provide empirical data on how different trends are sweeping through social media. Companies such as Twitter\(^4\) are able to data mine vast quantities of data in order to extract real time trends in society. Many complex analytical tools are available on a commercial basis. Most of these tools are at least as good as similar tools found elsewhere, including inside governments.

The amount of information that can be found online has reached overwhelming proportions. The problem in collection of useful intelligence has been transformed. In the past, analytical methods were almost customised or purpose-built for a specific problem, and information (data) was extremely scarce. Now, information and data are overwhelming, and the task is to find open source or commercially available tools that can analyse the vast amount of information available.

The practical result is that any organisation, if trained carefully, can operate a comprehensive technology and industrial intelligence operation using the vast number of analytical tools that are available on the open market.

**The Opportunity Landscape**

As seen in Figure 3 The Opportunity Landscape for Technological Innovation in Azerbaijan's Economy, it is necessary to have an industrial intelligence system that is able to scan the horizon for emerging possibilities, evaluate their match to national priorities, and then integrate the important developments into the economy.

\(^3\) It is beyond the scope of this document to cover the details of various technology analysis tools that are available on the market.

\(^4\) See [http://analytics.twitter.com](http://analytics.twitter.com)
The opportunity landscape for technology available to Azerbaijan is vast and constantly changing. Given the global nature of industrial networks, R&D, and manufacturing systems, it is necessary to track developments in many different regions of the world at once. The principle difference in today’s opportunity landscape from previous decades is its changed nature.

1. **No single point of innovation.** Although in the past much has been written about innovation clusters, and as a result many nations have attempted to make investments in “parks” or other places where it was hoped it might be possible to attract industries, actually the global situation has changed. Although there remain clusters in a few industries, each industry including all of its manufacturing, and research and development work is distributed globally. The clusters themselves have become merely a more complex nexus of a vast global network of interactions. For example, Silicon Valley is thought of as an industrial cluster. Not so. Instead, it is merely a centre of a vast network of ICT related activities that are present all over the world. The same can be said of the biotechnology cluster in Southern California, and the pharmaceutical cluster that has emerged in the Boston Area in Massachusetts.

2. **Components must be monitored.** In the past, focus was placed on monitoring developments in finished products such as automobiles, machine tools or computers. Now, it is the integration of numerous components from a number of sources around
the world that must be monitored. In order to understand developments in technology, the components and subsidiary processes of innovation that create them must be understood, not merely the overall trend in the finished product. It is more important to know where each of the components of today’s automobile are sourced rather than knowing a great deal about where the point of final manufacturing and assembly is located.

3. **There is much scientific literature.** The amount of scientific literature has exploded. When this is combined with the trade press, and the numerous online sources, it is possible to track almost every emerging development in technology using open source tools.\(^5\)

4. **Patent Analysis shows immediate trends.** The global scope of technological innovation also has driven an explosion in the number of intellectual property issues to manage. There is no universal patent. Instead, it is necessary for a company to seek protection in many different jurisdictions around the world. Each new technology must be protected by a number of patents, each for a different region or country. The rules are different from one part of the world to another. But the up-side of this is that it is possible merely through the intense study of patents to forecast short-term (3-5 year) developments in manufacturing, investment, and deployment of new technologies, in all fields, including ICT. As a consequence, it is necessary for any technology monitoring program to have a built-in group whose sole function is the continual analysis of patents from around the world. There are important elements of skill in patent analysis that need to be mastered. Doing so will give a medium-term window of what is likely to be deployed, and thus of emerging possibilities for Azerbaijan.

5. **Lengthy value-added chains offer many places for relationship building.** An additional factor is that since the goal of integrated global manufacturing systems has been replaced by industrial networks composed of many different semi-independent actors operating in a coordinated fashion, the result is a proliferation of opportunities for organisations in Azerbaijan to break into the value-added chain. Understanding these options and having a systematic method of making evaluations to determine the most promising possible relationships is an important element of management for the opportunity landscape.

6. **There is little secrecy.** Finally, although every enterprise and government company has a policy of keeping confidential its activities in the future, the reality is that it is practically

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\(^5\) It requires much skill to perform this type of technology monitoring, but all of these skills can be learned, provided the correct students are selected to receive specialised training.
impossible to maintain a secret. Particularly if there is a capability for monitoring technology intelligence in multiple languages, given the vast amount of online news systems via. blogs, press releases, and other analyses, virtually every move being planned by any significant corporation is revealed either directly or indirectly. Normally it would be impossible to monitor all of these developments around the world, but with today’s open source technology, for the first time, it is possible to engage in such monitoring, and with relative ease since artificial intelligence search engines can be employed to ferret out the critical pieces of information that are needed. There are no secrets, if one is able to use automated tools to data mine through the ocean of open source information available. Again, this has significant implications for Azerbaijan. In practice, it means that as never before, it is possible to monitor technology developments worldwide, and without overly burdensome resources deployed to do so. There no longer are any secrets in the world of technology.

All of these trends present a challenge to Azerbaijan. In particular, it needs to develop a roadmap system that will be able to monitor medium- and short-term trends, but also be able to analyse the vast number of possibilities available and choose those options that are best for incorporation into Azerbaijan’s economy and industrial system.

The Current Situation in Azerbaijan Sets the Context for Technology and Innovation Assimilation

Defining an innovation roadmap for Azerbaijan depends on the internal economic and social situation in the country and longer-term economic trends. Azerbaijan has many unique aspects to its current situation.

Declining Productivity in Oil Production is Driving Transition to a Non-Oil Economy

Some estimates hold that oil and gas production in Azerbaijan has peaked and that for the foreseeable future, the only trend to expect is downwards in the total amount of production. This is not expected to be a sudden process, but instead will take place over approximately two decades.

Therefore, it is reasoned that policy makers in Azerbaijan at most have twenty years in order to build up other parts of Azerbaijan’s economy. The key question, then, is that if the economy is going to be transitioned in a non-oil direction, then how can this be done? What technologies and innovations should be adopted? How can they be selected and evaluated? Which sectors are going up and which ones are going down? What are the medium and long-term trends?
How much credibility can be placed on different forecasts? Finally, even if a trend is known, then how can an assessment be made as to how realistic it is to integrate the new related innovations into Azerbaijan?

**Innovation is Dominated by a Ministry Based System**

Another factor that sets the context for innovation is the role of the government in Azerbaijan’s society. The Government of Azerbaijan is characterized by a powerful executive branch and a number of ministries and state affiliated organisations that together control much of the capital availability and deployment of resources throughout the country.

In particular, the ministerial system is comprehensive, covering almost every area of Azerbaijan’s economy and it has the power to make most if not all strategic decisions that will have an effect on any sector.

The strength of Azerbaijan’s ministerial system is that it is capable of significant long-term planning, and it can control deployment of national resources. The weakness of the ministerial system is the lack of coordination between different ministries. In some circumstances, this lack of coordination and information sharing between ministries can inhibit innovation because it is more difficult to discover and exploit trans-ministerial and trans-domain innovations. This difficulty is one reason why e-Government initiatives in Azerbaijan are being spearheaded through a single office that operates under the auspices of the Office of the President of the Republic.

**Azerbaijan Enjoys an Effective Governing Structure for Policy Implementation**

The result of having a strong executive branch of government and an entrenched ministerial system is that altogether these make up an effective governing mechanism for the country as a whole. Indeed, the track record shows that when national decisions are made in Azerbaijan, there are few barriers set up, if any, that would inhibit accomplishment of a state-approved plan.

**Azerbaijan’s Factor Endowments Set the Context for National Strategy**

The structure and historical practice of the Government of Azerbaijan combined with consideration of other factor endowments sets the stage for innovation.
Figure 4 The Global Economy, National Factor Endowments, and Development Priorities Determine Azerbaijan’s National Innovation Roadmap and Strategy

As seen in Figure 4, any national innovation strategy and the roadmap it is following is set within the context of the world’s global economy and the opportunities that it offers. Once these opportunities are located and analysed, then government resources can be put into play in order to realize the strategy. Without careful evaluation of opportunities, it is impossible to accurately deploy those national resources allocated by the Government of Azerbaijan or through any other mechanism of capital investment.

Choosing Global Integration Scenarios is a Key Challenge

Finally, even if suitable innovations are chosen for integration into Azerbaijan’s economy, this is the “old model” of technology transfer. This model is insufficient for today’s global economy. The roadmap of innovation for Azerbaijan must evaluate a number of scenarios for exploitation of innovation, not merely rely on the simple idea of importing innovations from overseas and integrating them into Azerbaijan’s economy.

The key task is not to integrate innovation and new technology into Azerbaijan’s economy, but instead the task is to integrate Azerbaijan’s economy into the global economy.
Defining a National Roadmap

Strategic Objectives

The strategic objectives of innovation of all types in Azerbaijan are conditioned by an assessment of the long-term viability of its economy given the current trajectory and trend of major segments in the world’s overall economy. In addition, the specific factor endowments enjoyed by Azerbaijan as well as the forecasts regarding the continued supply of oil and gas play a major role.

If we had to say there is a single strategic objective of all economic development in Azerbaijan, we could surmise it is the desire to develop the non-oil part of the economy, a segment that at present has a very low profile, less than 20% of the total economic activity.

Access to Leading Technology and Ideas

Plotting an innovation path for Azerbaijan will rely upon having in place some systematic method of scanning the world’s technology developments and considering them at an even greater level of detail than normally would be the case. This can be done only if a significant amount of additional coordination is dedicated to these efforts.

There is simply too much information available to evaluate unless a disciplined system of analysis is put in place. Later in this document, we describe how to organise a global industrial intelligence system that will collect information worldwide, and process it in a way that is designed to directly supplement the national economic development objectives of Azerbaijan.

An additional factor for consideration is that not all technology is immediately visible. Much technology that we will see in the near future still is not visible. An additional aspect of our proposed information efforts is the development of methods that will anticipate technology developments and advancements in innovation.

Faster Technological Assimilation

In a number of fields, particularly ICT and biotechnology, the rate of scientific progress has been accelerating. The consequence of this is that any nation reliant on keeping up with technology constantly must accelerate the speed of its internal assimilation of innovation.

But assimilation involves many complex actions, such as detailed industrial planning, recruitment of human resources, preparation of a legal framework, and finding appropriate capital investment, that can be deployed against the challenge. In Azerbaijan, this implies that government and ministerial resources dedicated to innovation constantly must to shorten their reaction time to stand up an innovation once the decision has been made to pursue it.
An additional notion is that from the point of view of a government, the number of innovations that must be considered and built upon itself is increasing. This places a premium on the ability of the government to speed up its deliberation process, and inject investment immediately following the discovery of a credible opportunity.

Later in this document, we will show how during the process of considering and screening ideas for innovation and further investment, the government can play a role throughout the early stages of consideration. This will greatly improve the feasibility of any adopted innovation, as it will make it impossible to adopt a decision in favour of a project unless all of the financial and investment details already have been worked out with specificity in detail.

Integration into the World’s Industrial System

Another aspect of defining a national roadmap is to ensure that the economy of Azerbaijan reaches a higher level of integration into the world’s economic system. Azerbaijan is too small to rely on its internal economy to support significant innovation, particularly when leading companies, including multinational enterprises, are able to access a world market for their goods and services.

This implies that from the very beginning industries in Azerbaijan need to work under the assumption that they are planning to address a global world-wide market, not merely the closed and relatively small market within their own country.

It is through integration with the world’s industrial networks, possibilities for investments, and sources of technological information will become visible to policy makers within the Government of Azerbaijan. In the Scenarios for Global Integration section towards the end of this document, we discuss a number of possible vectors that might be employed for integration.

Higher Value-Added for Economy

It is only through integration into the world’s economy that Azerbaijan can seize the opportunity to create more value-added in its economy. Small countries that are approximately the size of Azerbaijan, such as The Netherlands (approximately the same size and population but with even fewer natural resources), or Sweden (approximately the same population) have reached high levels of prosperity through being able to identify and exploit higher levels of value added in their industries. Sweden, for example, has a few manufacturers, such as SKF, that have gained a world market share based on a single product (bearings). The Netherlands has an agricultural sector that is similar in size to that of Azerbaijan, but it is dominated by automated warehousing, green houses, and use of genetic engineering to create some of the world’s best vegetables.
It is by being able to identify niche sectors of the global economy where Azerbaijan and its industries can process the highest value-added that success will come. But there is no way to do this easily; instead a long-term, comprehensive and systematic method must be used, and it must be informed by accurate information.

In the next few sections of this document, we will describe how Azerbaijan can identify and exploit the highest value-added strategies for its industrial development.

Part 1 – Building a National Industrial and Economic Intelligence System for Azerbaijan

The first step in operating a technology and innovation roadmap system is to collect intelligence on developments worldwide. This is what is necessary to identify the opportunities that are available for exploitation.

It is crucial to note that what is being suggested herein is the building of an inter-ministerial and inter-organisational coordination mechanism that works across all sectors of Azerbaijan’s economy. This is not something that should be implemented separately within each ministry, as would normally be the case in Azerbaijan. Given the past system of arrangements for innovation in Azerbaijan, the logical place to focus such an effort is the Office of the President. In that connection, there already is precedence in introducing innovation for providing government services. It is through this higher-level coordination mechanism that Azerbaijan’s government has been able to set up applications available to citizens that span the operational boundaries of numerous ministries.

In the same way, an industrial intelligence system logically would be located at a level that is able to coordinate across numerous ministries, state organisations, and also with universities and representatives of the private sector. An additional factor is that, as will be seen below, an industrial intelligence system must by necessity have a significant number of international operations. After all, it is outside of Azerbaijan where the most crucial information and the most favourable opportunities will be found. Since funding is necessary at the national level to send abroad the army of specialists and others that will be needed, again this type of activity best can be coordinated only at the highest levels of the government. It cannot be left to any specific ministry, or to any specialized organisation.

Definition

Intelligence is defined as information that makes it possible to anticipate an event or development that has the potential of having a strategic impact on your organisation or country. For economic and industrial intelligence, this implies knowing about events or
developments that can have a giant impact on Azerbaijan’s economy and well-being. For business or development strategy, economic and industrial intelligence implies being able to identify opportunities far enough in advance to be able to leverage them in a way that is favourable for Azerbaijan.

To put this in context, we can refer to the classic intelligence cycle. See Figure 5 The Technology and Industrial Intelligence Cycle Component of the National Innovation Roadmap.

The most difficult challenge in collection and evaluation of technology and economic intelligence is inability to control or cope with the flood of information available. As discussed previously, in today’s world, the problem with intelligence is not that too little information is available, but too much. The consequence is that a crucial skill is narrowing down the collection of information to only the vital parts. This is possible only by the use of structured analytics.⁶

Below, we will review the components necessary for Azerbaijan to build and operate an effective industrial and economic intelligence system. Since any such system must collect the

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⁶ The use of structured analytics is crucial for any economic and industrial intelligence system. There is not very much literature available on this type of analysis for economic intelligence. However, a very useful overview of structured analysis is available. See (Heuer & Pherson, 2014).
bulk of its data and information from outside of Azerbaijan, but nevertheless analyse all of the incoming information according to the specific national economic goals of Azerbaijan, we have divided the components of such a system into two classes of components: External and Internal. See Figure 6 Internal and External Components of Industrial Intelligence System Supporting Roadmap.

The external elements are outside of Azerbaijan. Recent patent analysis has shown that Azerbaijan is producing very little innovation or intellectual property. It is not important to analyse why this is the case, only to make note of it. The practical implication of this is that in order to understand the overall trends in innovation and technology, Azerbaijan must look outside of itself, overseas to other places. It is these places that must be monitored and mined for inspiration and new business opportunities that can be exploited to grow Azerbaijan’s economy. Consequently, the industrial intelligence system be configured to monitor research and development, technology development, and the global pattern of manufacturing and coordination of innovation.

The internal elements of the system are located within Azerbaijan. These are the coordination mechanisms that will match national requirements to selection of innovation opportunities that are discovered by the industrial intelligence network. Most of the roadmap will be defined by the choices that are made in this process.
The overall system will operate as a giant filtering pipeline. It is reasonable to expect that out of 500 projects or ideas that are analysed and then submitted into the innovation screening part of the system, only 5 will emerge for careful consideration by the Government to receive priority funding. These numbers are only suggestive, but the general principle is that much is discovered, a subset of priority ideas are considered more carefully, and of those a very small number will make it all the way through the system to receive government support for major investment.

External Components of Industrial Intelligence System

Targets

The targets of the industrial and economic intelligence system can be divided into several classes.

Class I — Companies. Monitoring specific companies is crucial, particularly if they hold promise for collaboration with organisations within Azerbaijan, or as being a potential source of inward foreign direct investment or transfer of technology.

Class II — Technologies. Certain technologies may be identified as of interest for either acquisition, or investment. Technologies may be associated with more than one company or
entity (such as a university holding the patent), and thus may be monitored from a number of different directions.

**Class III — Production and industrial networks.** All technologies of interest to parties in Azerbaijan eventually will be integrated into a global industrial network. It is crucial to monitor and map any industrial network and all of its affiliated components (investors; companies; licensors, etc.) so as to be able to identify possible points of intervention or relationship-building with the corresponding party in Azerbaijan. For example, such relationships may be built by direct investment, joint ventures, licensing, or sub-contracting part of the global value-added chain of a technology. All of these options in order to be considered require a comprehensive knowledge of the global production and industrial network of the target technology.

**Intelligence Components**

The intelligence components of the system are specific activities that should operate outside of Azerbaijan. Their purpose is to collect and assemble required information regarding specific technologies or companies that have been identified as being of interest. They also play an important role in identification of targets and trends that should be monitored.

**Internet Listening Posts**

Internet listening posts are small offices to be positioned in different parts of the world. They will be funded by the Government of Azerbaijan through a research foundation. Their purpose is to employ a small number (2-5) specialists who are skilled in harvesting economic intelligence through the Internet.

The sole task of these listening posts is to monitor developments and create regular reporting of interest to Azerbaijan’s national development. The tasking for these Internet Listening Posts should be directed from project groups or exploratory teams working inside Azerbaijan. (These teams are described below).

**External Venture Capital Funds**

The use of external venture capital is an important way to acquire new and emerging technology that might be crucial for Azerbaijan’s economic development. These funds will operate in a few crucial locations including North America, the European Union, and China.\(^7\)

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\(^7\) In East Asia, Japan and Korea have been left off of the list because historically, it is more difficult in those countries to engage in venture capital funding.
The purpose of the venture capital fund primarily is to collect economic and technology intelligence, and if necessary, make investments required to acquire crucial technologies.

1. **Collection.** Venture capital funds are constantly given the opportunity to review proposals for start-ups with new ideas and technologies. Without having to commit investment money, the constant review and systematic reporting of these new ideas is a crucial source of technology intelligence. It also enables the compilation of contacts and the building of a social network of creative innovators world-wide.

2. **Acquisition.** For some proposed start-ups, it may be judged that the innovation may have specific application in Azerbaijan. By participating in part of the funding, Azerbaijan’s Venture Capital Fund will be able to acquire the target technology, and to learn the confidential trade secrets of the innovation. Again, this will be crucial technology intelligence information that can be used in a number of ways.

3. **Partnering.** The Venture Capital Fund also can serve as a match-maker between the overseas emerging technology and potential partners within Azerbaijan.

4. **Industrial Network Integration.** If an emerging innovation foresees a global manufacturing or information processing (business services) system, then being part of the initial funding will put Azerbaijan into a position to take part of the global production chain and have the work done inside of Azerbaijan.

So as can be seen, the operation of a number of small overseas Venture Capital Funds will be a vital source of timely technology and economic intelligence.

*Joint Research Companies*

Joint Research Companies will operate in a way similar to the Venture Capital Funds. Their purpose is to provide some funding for research into important emerging technologies that will be of benefit to Azerbaijan. If a new technology or innovation is identified, then by engaging in joint research with an experienced overseas partner, the Azerbaijan team will be able to acquire crucial knowledge regarding the innovation process.

In addition, by placing Azerbaijan partners into these various overseas organisations, it will open up vast new sources of information that in the future might be crucial for understanding technology and economic trends.

Building a small relationship (in terms of financial expenditures), can yield a giant benefit in terms of obtaining information that otherwise would not be available. In general, by using the joint research company approach, the long-term effect will be to accelerate the transfer of technology and know-how into Azerbaijan.
**Expert Network**

An expert network is a grouping of specialists worldwide who are focused on a specific technology or problem. For example, in the IEEE system, there are a number of working groups that focus on different technologies. Many international organisations have such expert networks. In the ideal scenario, the Government of Azerbaijan through a subsidiary organisation such as the Academy of Sciences would create and fund the creation of such a network, and then go about recruiting membership on a worldwide basis.

The problem with this scenario is that the funding required would be substantial, and there already are in place a number of expert groups involved with tracking and developing standards for a number of technologies. For Azerbaijan to take advantage of the large number of expert networks already operating around the world, it needs to appoint a number of experts who already are affiliated with leading international organisations. It is crucial that these experts are given subsidies to participate fully in their assigned expert network. In practical terms, this means paying their membership fees, giving them secretarial assistance to coordinate their research activities, and providing research assistance for them to compose occasional papers for submission to conferences. Travel to international meetings should be given out based not on the performance of the expert, but on the priority of the technology or area of innovation being studied.\(^8\)

The task of these experts is not so much to participate in these various meetings and conferences, but rather systematically to collect information about emerging technologies, innovations and trends that might be of interest to Azerbaijan. These experts would be tasked with collecting information with a higher level of specificity than other collectors such as the Internet Listening Posts, and filing regular reports summarizing their observations.

**Technology Ambassadors**

The highest quality collectors will take on the role of “technology ambassadors”. These persons would be supported by the Government of Azerbaijan, but would be tasked with spending 6 months to a year overseas placed within target companies. There are a number of ways to do this. One would be to use the internship program that many technology companies have already in place. Another way would be to use senior experts and ensure that they are placed in advisory or consultative positions with top management in the target corporation.

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\(^8\) The cost of such overseas collection operations would be modest. For example, if there were 7 sectors to be covered, with three experts per sector, and 4 overseas meetings per year, then the overseas costs for all of these persons would add up to only approximately $260,000 per year.
The task of the technology ambassadors would be primarily to look for opportunities leading to inward foreign direct investment, or to placement along the value added chain of selected global industrial networks. Like the collectors at the Internet Listening Posts, and the Experts working in various international organisations, the technology ambassadors also would be tasked with writing regular reports to be filed back to the concerned groups operating within Azerbaijan. It might be useful to re-task some persons already being trained in diplomacy and put them into this type of position, since they might have the necessary language skills.

**Subsidy of External Research**

A final information collection channel is the providing of subsidies to external research. This is done by systematically looking for research opportunities, and then offering to pay a portion of the research in exchange for having a first look at the resulting innovation.

It would not be necessary for Azerbaijan to pay for more than a small proportional share of an international research consortia in order to be able to take advantage of all of the results that are forthcoming. Again, selection of research projects to fund would be subject to national priorities for economic development, but assuming there is a match, participation in international research consortia will both allow for the collection of vast amounts of technical and business information, but also will sharpen the skills of the persons assigned to the work.

*Figure 8 The Tasking Cycle for Collection of Technology Intelligence (Blue Internal; Orange External)*
The secret in collection of information is to limit efforts to highly focused areas. See Figure 8 The Tasking Cycle for Collection of Technology Intelligence (Blue Internal; Orange External) which shows activities located external and internal to Azerbaijan.

Internal Components of Industrial Intelligence System

The internal part of the industrial intelligence system being put in place to assist Azerbaijan in traversing the technology roadmap is as important as the external efforts that are focused primarily on collection of information.

A number of specific components are needed to perform the processing of incoming information and to correctly formulate a national strategy for innovation.

In this connection, there are two classes of components. Information sharing activities are designed to absorb information that is arriving from the numerous sources. A second cluster of activities is more closely related to the preliminary analysis and screening of ideas prior to being placed under the more detailed scrutiny found in the innovation pipeline.

Information Sharing Components

Information sharing components analyse incoming data, but also work to weed out ideas that for all practical purposes either do not fit into Azerbaijan’s future, or do not fit immediate needs, given the level of Azerbaijan’s economy.

Scanner Scouts

The coordinative function within Azerbaijan will be populated by a number of special scouts with expertise in short-term research into an issue to answer a specific question. Scouts have a very specific personality and must be carefully selected for speed, and flexibility in their day to day activities. In some ways, the role of the scout is not unlike that of a journalist, only they are made available to important decision teams in case last minute information must be assembled.

A typical selection test for scouts is to provide then with a giant pile of documents, reports, and papers, and ask them to analyse the overall trends within 2 hours. By selecting only, the best scouts for these activities, it will be possible to guarantee that the information support provided to other components will be timely and accurate.

Patent analysis makes it possible to see 3-5 years into the future and is an essential skill in following a technology roadmap.
Patent Analysis

Patent analysis makes it possible to see 3-5 years into the future and is another essential skill in following a technology roadmap. The internal coordination effort also should be able to rely upon a systematic patent analysis of trends in technology.

It will require experts in Azerbaijan to go over a long learning curve in order to become effective at patent analysis. Depending on the sector, the work can be done only by skilled specialists.

1. **Pre-production Alert.** By monitoring the announcement of patents associated with certain companies, it is possible to estimate accurately when they will introduce the technology in the future. Companies always file patents ahead of time before committing to the market. By monitoring patents associated with specific companies, it is possible to see future trends.

2. **Relative Industrial Strength.** By analysing a sector according to clusters of patents that are arranged in the same or related fields, it is possible to determine the relative strength of nations, regions or companies in a particular technology family. This information is crucial in defining the placement of internet listening posts and other technology intelligence collection efforts.

3. **National and Regional Benchmarking.** Patent analysis also allows the benchmarking of Azerbaijan against its peers in the region. It also allows benchmarking of Azerbaijan’s state industries against their counterparts in other countries.

4. **Off-Patent Technologies.** Finally, by keeping a constant eye on expiring patents, it is possible for Azerbaijan to identify technologies that can be copied without violation of international intellectual property rules. This could be important for some areas of Azerbaijan’s economy where it would be acceptable to use older types of technology.

Patent analysis is an art that must be studied. See (Daim, Rueda, Martin, & Gerdsri, 2006).

Information Exchange Forum

At a higher level in the coordination mechanism is a forum designed to facilitate the exchange of information that hopefully will lead to synthesis of possibilities for trans-domain innovation. Information Exchange Forums also are a mechanism for synthesizing and conceptualizing the vast amount information that is incoming from Azerbaijan’s worldwide collection efforts.

Given the structure of Azerbaijan’s society and the arrangement of ministries and state enterprises, it is recommended that a separate information exchange forum be set up for each ministerial domain. The organisation of work of each Forum will be the same, and its conclusions and observations will be reported by a standardized electronic form submission.
Each information exchange forum should have an elected or appointed chair-person and back-up person who will then participate in a committee made up of representatives from each of the sectoral-specific exchange forums.

The recordkeeping of each exchange forum will be kept on a shared server that is dedicated to the overall technology integration effort. The purpose of the Information Exchange Forum is to coordinate the overall process of innovation and technology adoption for its sector. Each of these teams will play a major role in the evaluation and screening assessments of proposed technologies.

Ad Hoc Project Teams

Within each domain of innovation and technology absorption, Ad Hoc Project Teams will be placed in charge of specific innovation concepts (processes; technologies) that have been assessed to have potential for improving Azerbaijan’s economy if they are adopted. These teams are Ad Hoc in nature which means that have the following characteristics:

1. **Membership matched to technology and application.** The selection of members to participate in and make contributions to an Ad Hoc Project Team is determined by the technology or innovation being considered. They can be technology experts, process experts, or subject domain experts familiar with the target part of the economy where it is estimated the innovation promises to make the most difference.

2. **Use of non-committee experts as needed.** Depending on the technology, selected experts from around the country may be invited to contribute to a Project Team. Every effort should be made to find persons with the greatest insight into a problem, without regard to other factors. If the time dedicated to Project Team work for a person already working in an industry is significant, then as a matter of course they should be awarded travel and expenses and time off from their regular jobs as needed, yet still continue be paid. Participation on a Project Team should be recognized as being a special privilege. Successful participation on a Project Team might be recognized by a plaque or other award that will be displayed in the office of the volunteer once they return to their regular post.

3. **Timing.** Appointed when the technology is chosen for further consideration; then placed in charge of overseeing the entire technology adoption cycle of the incoming technology. Should the technology or innovation be screened out or otherwise eliminated at any point in the pipeline, then the Ad Hoc Project Team is to be immediately dissolved and its members assigned elsewhere.

4. **Part time.** Each person assigned to work on a Project Team is understood to be responsible for other work at the same time. It is therefore possible that a single
individual can participate in a number of Project Teams simultaneously. In addition, depending on the stage of screening and evaluation of the innovation, different persons may be rotated in and out of the Project Team.

In sum, the Ad Hoc Project Team acts as a type of “coach” or “manager” of a new technology or innovation that has been selected for deeper consideration to determine if it will be adopted into Azerbaijan’s economy. These teams are flexible, and custom-fitted to the particular technology or process being evaluated.

Communities of Practice (Technology Theme Group) Components

The Community of Practice (CoP) is a virtual organisation that remains focused on a specific domain. To put this concept in practical terms, we might say that one CoP may target milk production and all of the downstream and associated technologies that are emerging in this area including distribution, packaging, processing and branding. This example of the milk industry would be the same for all sectors, including ICT technologies or applications.

The CoP is the larger community of persons affiliated with the technology intelligence network that are specialized in a specific domain. In Azerbaijan, these individuals would be recommended by the appropriate ministry. They could be employees of the ministry, or experts or entrepreneurs from the private sector, academia, or the larger scientific or business community. It would be useful also to have some type of regional representation for the CoP so as to avoid having every major policy and decision made solely from the Baku perspective.

It is from the larger Community of Practice that experts are drawn to carry out the various other supervisory functions of the Industrial intelligence system.

Screening System

The purpose of the screening system is to sift through thousands of ideas, innovations and technologies for the purpose of identifying those ideas that might be potentially of further use to Azerbaijan. Since a large amount of information will be entering the industrial intelligence system, it is the screening system that helps the organisation avoid being over-burdened with detailed analysis of large numbers of ideas that in the end are found to be unsatisfactory.

Gatekeeper System

Gatekeepers are top experts who are appraised of all developments in their respective domain, and then select those ideas or innovations that should be considered more fully as to their relevance to development in Azerbaijan, but also to push away and filter out the vast majority of ideas that will not have any immediate application.
Since the gatekeeper is placed in such a highly responsible position, there may be a tendency for the government to adopt a policy that in order for it to supply investment in any particular innovation it would need approval of the gatekeeper and perhaps go through the deeper evaluation as to its suitability. To adopt this policy would be a mistake if it were allowed to have a society-wide dampening effect on innovation. All potential investors in Azerbaijan including the government or state-owned enterprises and organisations should be able to place their resources into any project that they believe is worth the effort. Therefore, we should see the gatekeeper as an essential component of the overall industrial intelligence system, but not as a type of control over who is able to innovate.

Gatekeepers should be appointed for each major domain of work and economic activity in which Azerbaijan wishes to innovate and make strides towards a state-of-the-art economy. Given the size of domains, such as ICT, it is reasonable to assume that more than one gatekeeper might be appointed for each domain, or that within each domain of economic activity, multiple gatekeepers can be used to handle different aspects of the domain. For example, in the ICT field, one gatekeeper might be assigned to manage all incoming telecommunications-related innovations; another might be assigned to manage all incoming innovations associated with large-scale computing.

*Exploratory Group*

Exploratory groups are set up to handle in greater detail clusters of innovations or ideas that need further detailed study so as to determine their potential applicability. An exploratory group is ad hoc in nature, but of necessity must remain established for the full amount of time necessary to evaluate a system of innovations. Gatekeepers are concerned with evaluating and screening specific ideas and innovations; exploratory groups are assigned to look at incoming ideas in greater detail, including the performance of a complete financial analysis of the potential impact of the innovation.

The exploratory group needs to have a clear understanding of how the new innovation works, but also must appreciate in great detail how such an idea might be integrated into Azerbaijan’s economy and organisational infrastructure.

*Part 2 – Innovation Screening System*

The innovation screening system is at the heart of the roadmap process for building Azerbaijan’s economy and planning overall strategy. The three levels of the screening system are found in Figure 10 Three Levels of the Innovation Screening System.
It should be noted that a crucial part of the screening process is a system of standard documentation (electronic forms and workflow) that are used to manage the entire process. This ensures that ideas are considered in a careful way, but also makes it possible to revisit older ideas that have been considered. There should be a specialized form (online form that interfaces to a database) for each phase of the screening system.

**Defining Strategic Objectives**

Ultimately, the entire purpose of the industrial intelligence system is to feed ideas into a selection system that will ensure that government investments are made in precise coordination with strategic national objectives. These strategic objectives might be defined as:

1. **Growth of Non-Oil Economy.** It is predicted that oil and gas revenue for Azerbaijan gradually will decline, and consequently other parts of Azerbaijan’s economy must be available to take up the slack. If this is not done, then the country as a whole will decline in economic activity, leading long-term to marginalized sovereignty.
2. **Informatisation.** Substantial efforts are being made to use ICT to revolutionise the efficiency in the government, and to make provisioning of government services to citizens as efficient and transparent as possible. This process also is being designed to improve education and communication across all of Azerbaijan’s society.

3. **Agriculture.** Strong growth in agricultural exports and development of all aspects of the food production and manufacturing system. This is particularly important to serve the market of the European Union, and surrounding countries.

4. **ICT Startups.** Because of its low cost of entry, a national effort is being made to facilitate the number of IT related start-ups, primarily on the software side.

5. **Manufacturing.** It is a national priority to develop domestic manufacturing of as many large products as possible.

All of these strategic objectives have a strong influence on the type of policies that must be adopted.

**Selecting Priority Targets for Detailed Evaluation**

The first level is simply to screen out the vast number of ideas that will flood into the system. This is the level where most of the incoming ideas will be rejected even before they are subjected to a detailed evaluation. The screening manager is in charge of this part of the process. They do their work in cooperation with any advice they need from any other party that might have some knowledge important for the decision. This would include persons that are closely related on a day-to-day basis with the domain of the incoming innovation.

In terms of documentation, the incoming document for the gatekeeper is prepared by anyone who believes that the potential innovation will be useful for consideration. As the gatekeeper makes their evaluation, various decisions and recommendations are documented in detail on a more sophisticated electronic form. All of these documents are filed into the information system and can be viewed or reconsidered at any time.
It is expected that only a few of the many incoming ideas will get through the first screening. Ideas can be rejected for any number of reasons and will be. However, for those ideas that get through, the next stage of this work is yet more detailed evaluation and selection. Although these are not the final level of screening analysis, it should be enough to determine if a significant number of resources should be allocated for further detailed consideration. It is customary to make these selections at a monthly meeting. Again, it is expected that a number of innovations or ideas will be rejected at this stage in the process, and only a few will be sent to the next stage for detailed consideration.

The final level of consideration takes the innovation idea and subjects it to a highly detailed analysis. This level of screening examines more specific questions such as number of resources to be consumed, the probabilities of success, the quantitative effects on investment and on the economy as a whole, and how exactly the innovation will be incorporated into economic activity for Azerbaijan. The purpose of this last stage in the process is to create a detailed proposal that then can be considered.

The proposal document is not a general idea, but instead represents a significant amount of work to examine all resources that will be involved in bringing the idea to realisation, the timing involved, and the potential impact on Azerbaijan’s economy. The proposal is a complete document that anticipates as many of the challenges as possible. It ensures that when a
decision is made on the proposal, there will be little or no remaining work to design what will happen. The proposal at this stage is similar to the architectural design for a building – all of the details are complete.

**Using Evaluation Metrics and Scoring**

The forms used in the evaluation process have two components. First, there is written commentary regarding the innovation being considered. This provides a detailed explanation to any reader who wants to see the reasoning in the evaluation. It is crucial to keep this part of the documentation. Second, there is an empirical scoring system. Scoring systems should be considered to be advisory in nature. They are not as precise as they seem because ultimately a qualitative factor is being transformed into an empirical measurement. In cases where the scores are close, any selection should be based not only on the scores, but also on reading through all of the materials that have been provided in the commentary.

Nevertheless, the assignment of empirical referents throughout this overall process will go far in helping to create summary statistics on a quarterly or annual basis helping to evaluate the success of the overall system.

**Part 3 – Government Support and Investment – High Speed Reaction Time**

After the innovation screening system has gone through its highly complex and careful work, there is a high probability that it will have made the right decision, and a very low probability that after all of that consideration the innovation and its integration into Azerbaijan’s economy will fail. Failure will be very improbable simply because the entire process leading up to this point is designed to consider every possible opportunity, but also to consider every possible down-side to an innovation. In fact, the entire purpose of the industrial intelligence system and its innovation screening system is to find the best opportunities and make sure they will work before any resources are allocated to their adoption or utilisation. Now that an opportunity has been vetted, considered and re-considered from every possible angle, it is time for action.

Azerbaijan is fortunate in that the track record indicates its government is able to take very fast action when necessary, at least as fast as any other government in the world. Below we review a few of the classic tools that can be used by the Government of Azerbaijan in order to exploit an opportunity for innovation.
Using a Cooperative Internal Market to Stimulate Innovation

The first strong stimulus the Government of Azerbaijan can use is exploitation of its internal market. Even though Azerbaijan is not a large country, the number of resources controlled or significantly influenced by the government are vast. As a consequence, it should be possible to put in place policies that will guarantee utilisation of a specific innovation in its internal market. There are many ways to do this. For example, the government can place large orders for the new product or service. Or it could phase out an older technology or system of working simply by changing the standards for government purchasing, including purchasing by state-owned corporations or even business entities that do significant business with the government.

Employing Direct Government Funding of Innovation

In a number of scenarios, there is an assumption that investment funds will be made available from the Government of Azerbaijan. These investments can be made either in domestic organisations or projects, or overseas, as discussed earlier. Studies indicate that the capital markets in Azerbaijan are not particularly strong, and the implication of this is that the primary source of significant capital for major investments is the government itself, not other entities. Every effort should be made therefore to ensure that once a project or innovation has gone through the screening process, then there is no delay in assignment of adequate capital investment to bring the idea to realisation.

This can be done by ensuring that throughout the screening process, there is careful assessment of required capital investments, and that the information is coordinated with those parts of the Government of Azerbaijan that assign the capital for these investments. The money required for any investment, indeed, is one of the key criteria that is incorporated into the evaluation of an idea. As a benchmark, Azerbaijan should work towards having the required capital for investment “ready on Day 1”. To any extent possible, all supplementary resources (construction; permits; contracts) also should be in place as soon as possible, including much work that should start as it becomes clear that an investment opportunity is looming on the horizon.

Putting in Place Government Policies that Stimulate Capital Accumulation in the Private Sector

Apart from direct investment of funds, many governments adopt policies that allow the rapid growth of capital in the private sector. This accumulation comes from having a protected market. In Brazil, for example, the market reservation system for ICT products and services ensured the rapid growth of the sector. The higher prices that domestic Brazilian companies
were able to charge for their services due to the guaranteed market reservation served as a type of indirect subsidy or capital investment that otherwise would have been possible to source only from the government.

In Azerbaijan, similar policies can ensure that domestic corporations are able to accumulate capital because they are shielded from competition.9

Using Government Funding for Formation and Operation of Industrial Network Nodes

In cases where the strategy is to build a node for a global industrial network, the government funding to get this done should be provided as soon as possible. Azerbaijan already has in place an industrial park that was designed to help integrate Azerbaijan into the world’s economy, but the overall activity at this site has been sparse; it is a good example of what happens when ideas for innovation are not subjected to rigorous evaluation and screening.

Getting this type of deal done will require government assistance probably in overseas locations. In consequence, the Government of Azerbaijan should have in place training and skills in its diplomatic corps to assist in these matters.

Attracting Inward Foreign Investment Using Government Subsidies

In scenarios involving inward foreign direct investment (FDI), the Government of Azerbaijan should be able to rapidly accommodate the set-up of the operation. In order to do this, it might consider having a special team or ombudsman (very senior person) who is able to make all of the local contacts necessary to rapidly stand up such an operation. Time is of the essence, and all focus should be on speed and prioritisation of operation. Skilled “can do” project managers should be selected for this part of the work.

Again, in order to shorten the government reaction time needed to respond to this type of emerging opportunity, the Government of Azerbaijan should be monitoring the innovation screening system in real time in order to predict when a new innovation will be approved.

It also should be noted that as part of screening consideration the price and financial implications of any such project is evaluated, so the need for rapid government action never should be a surprise.

9 These government actions must be taken with due regard to the international trading regime and the rules that Azerbaijan may have promised to follow as part of its international commitments.
Scenarios for Global Integration

The Government of Azerbaijan faces a number of challenges in defining how it will license or enable economic interactions with the global economy and its millions of potential actors. The reality is that Azerbaijan is a relatively small country geographically and as measured by GDP and population. Its economy operates only within the larger context of the world’s economy.

Since it is not possible to survive economically in isolation, Azerbaijan must make choices regarding the means and methods of integration. Below we discuss a few approaches that might be used by Azerbaijan’s state-owned enterprises and private sector as a whole in order to increase the amount of value they are able to generate for Azerbaijan’s economy and people.

Joint Ventures Both Inside Azerbaijan and Internationally

A joint venture is formed with the initial investment or provisioning of other resources (personal, plant, equipment, raw materials, etc.) into a business entity that is formed for a dedicated purpose. In the most common formulation, a foreign entity wishing to set up business in Azerbaijan makes an arrangement with a “local” company so as to gain access to the market. This access then becomes easier because the local company, now part of the new joint venture, if chosen correctly, will have in place numerous contacts throughout Azerbaijan’s society including government contracts, private sector contacts, and other relationships. These connections perform the important function of providing information that leads to discovery of possibilities for sales or distribution of the product or service being created by the joint venture, or in actually helping build an influence network via important local actors who then can promote the business.

The influence network is crucial to any joint venture because it will help to ensure a market for the goods and services being produced.

A second type of joint venture also should be considered. In this scenario, it is the Azerbaijan company that seeks to engage in joint ventures in foreign markets. For example, under this scenario, an Azerbaijan company will seek investment opportunities in joint ventures that are located in the European Union or North America. Even if the share in the overseas joint venture were minority in nature, the benefits will be great.

1. **Access to market.** The first benefit will be access to foreign markets. This access will provide a return for either the investment of capital itself from Azerbaijan, or for the additional value-added obtained from processing and onward sale of raw materials or initial products sourced in Azerbaijan. For example, if the manufacturers of fruits or
jellies in Azerbaijan were to invest in an overseas joint venture in the same field, this would give them a permanent and long-term access to the foreign market.

2. **Access to intelligence.** By participating in an overseas joint venture, the Azerbaijan company or organisation will be able systematically to obtain important industrial intelligence regarding developments in the field, the emergence of new technologies and innovations, and the strategic actions of competitors or potential future partners. The banking sector from Lebanon for decades has engaged in this type of activity and even though very small, has managed to set up networks of relationships in many countries around the world.

3. **Learning of best practices.** Long exposure to the best practices of foreign entities in the same field inevitably will translate into transmission of these innovations back to Azerbaijan itself. In this connection, it is important that all overseas personnel assigned to work in these joint ventures be disciplined enough to compile regular reports summarizing best practices and discussing the potential application within the economy of Azerbaijan.

In sum, the mode of the joint venture might be considered as an important part of the strategy for many of Azerbaijan’s sectors. There are many benefits, and the opportunities it will open up will pay for themselves many times over.

**Business Process Outsourcing as a Component of National Strategy**

Business Process Outsourcing (BPO) takes place when specific functional elements in an organisation, usually a multinational enterprise, are removed from their original location of work and transferred to a third party who performs the same functions, but for a small fee. In the West, many large corporations have taken advantage of BPO in order to lower their costs of operations.

For example, many banking and finance companies have moved much of the call centre activity to third parties located in venues such as India. Although there are many security and operational problems associated with BPO, nevertheless on the whole it has proven to be of economic benefit on both sides. For the multinational enterprise, it is able to lower both short- and long-term costs; for the nation able to get the BPO contract, it means both jobs and profits as well as the opportunity to amass long-term learning regarding state-of-the-art business processes and their management. Korea has developed a similar industry in creation of animated cartoons. Azerbaijan might be able to do the same with processing of chickens, yet there are many possibilities that should be carefully considered.
It would be unrealistic to imagine that Azerbaijan will be able to copy India’s success in BPO operations of call centres in the financial sector. India has many English speakers, and an abundant labour pool with employment rules allowing the outsourcing organisation to drive down wages and withhold benefits to the most minimal level. Azerbaijan does not have these factor endowments, as discussed above.

Nevertheless, BPO can involve a number of different processes involving not only information work, such as call centres, but also manufacturing sub-contracting or other activities.

It is recommended that Azerbaijan put in place a national study committee to identify and examine every possibility in this respect. The ability of Azerbaijan and its business organisations to integrate themselves with the global economy through BPO can be a significant strength, even though for the time being, the solution is not obvious.

The pursuit of Business Process Outsourcing opportunities should be a national priority because this approach has been so successful by other nations seeking to extend the range and depth of their economy.

**Example: Specialized Analysis Services Such as Genomic Screening**

If Azerbaijan is going to engage more deeply into the world’s economy, then it should make every effort to pick the most advanced technologies to target. In Figure 11 Hierarchy of Business Process Outsourcing Opportunities for Azerbaijan we have displayed a suggestive hierarchy of opportunities.
Although a number of countries have chosen the medium and lower-levels of sophistication in the technologies and processes they are providing, it is recommended that due to the size of Azerbaijan’s economy and the restraints on human resources, Azerbaijan should focus on the very top of this hierarchy. For example, genomic sequencing has become very important for research into drug discovery and treatment of disease. Although the price of sequencing the genome of a human being has decreased by orders of magnitude, nevertheless the equipment involved as well as the training involved to do this work is high level. The basic equipment is pricy, and extraordinary skills are required to operate it properly. China has seized this opportunity by purchasing a large number of sequencing machines and placing them in a geographic cluster. The objective of this is to become a world leader in providing this service to researchers around the world. Apart from the large fees that may be collected, having access to all the resulting information will put China in a great position to participate in technological innovation in the future. This is an example of adopting a strategy for development that emphasizes the highest-level of technology requiring the most sophistication and training in human resources. It is only by choosing this path that a country is able to obtain the highest return on its investment.
Summary

Given the factor endowments of Azerbaijan, its roadmap to success in both ICT and other important domains in its economy lies in following a path that has been proved successful by small and resource-constrained countries for hundreds of years.

In practical terms, this means maintaining a sharp focus on education of its people, and a constant focus on monitoring and discovering all opportunities that emerge in order to integrate Azerbaijan into the world’s economy.

Success will come from adoption of the highest value-added innovations and technologies, providing Azerbaijan takes the steps necessary to open up its economy to the world of opportunity before it, and this can be done through a number of different integration scenarios.

Although the path is not easy to discern, and ultimately may take a few unexpected turns, by putting in a world-class industrial intelligence system, Azerbaijan will be able to navigate the rapidly changing landscape of emerging opportunities. But merely studying innovations is not enough, instead, Azerbaijan must put in place a systematic method of identifying and then screening every single opportunity that comes before it.

Azerbaijan and its dynamic people have proven that they can innovate and make rapid changes in their society and economy. By building up a more sophisticated method of collaboration and decision-making, one that takes advantage of the vast range of talent available, Azerbaijan will be able to move even further and even faster than at any time in its history over the past quarter of a century.
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