

Mining Cluster Development in Peru: Learning from the International Best Practice

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Received: September 16, 2014

Accepted: November 24, 2014

ABSTRACT

In recent years, businessmen, researchers, and policy makers alike have become fascinated by clusters, as it is believed that clusters can play a noteworthy role in enhancing the well-being of poor communities by means of increasing national competitiveness, fostering employment specialization, improving innovation and productivity, and helping regional economies grow. Clusters in Peru are considered to be in the first stages of development; to the point that we can consider there are no actual functional clusters. Given that the mining industry in Peru represents one of the main economic sectors of the country, the main purpose of the present paper is to investigate the common critical factors of success of three mining clusters from three different continents, through case-based reasoning. As such, the paper highlights the key challenges and relevant policy implications for fostering mining cluster development in Peru, in the light of the evidence identified and within the pattern called “the Four Clover”. The findings of the present paper can be used to assist policy makers to design more agile mining cluster policies and strategies that will lead to the creation of mining clusters in Peru. Business managers will also benefit from the results in terms of improving their capability of making more informed decisions regarding the adoption of a cluster approach.

KEY WORDS: Clusters, economic structures, cluster-based development, competitive strategy, mining industry, developing countries

INTRODUCTION

The mining industry in Peru has been developing ever since the colonial times and is now one of the main economic sectors of the country. Just with the title of example, Peru is the world’s second-largest producer of silver and the second-largest producer of copper. Peru attracts huge amounts of foreign investments resulting in development of large field operations. The regions of Huancavelica and Cajamarca, for example, are best known for their mining activities. Paradoxically, though, these same regions, instead of experiencing more economic growth, are ranked relatively low in terms of regional competitiveness [1] and are recording the highest poverty rates in the country. It is not an exaggeration to say that every new report of investment in mining is almost always followed by a report on unrest in the local community. The mining industry in Peru faces several challenges, one among them being the cluster formation, an area that should be addressed if the country is to become prosperous and reduce its poverty rate.

The main purpose of the present research paper is, therefore, to investigate the driving forces of the mining cluster formation.

In consequence, the objectives are as follows:

1. Identify why the successful mining clusters in the world have emerged and developed as they have, identifying the character and interaction of the causal factors.
2. Identify the main drivers for mining cluster formation in Peru’s mining industry and identify what policy makers and community leaders can do to activate them.
3. Analyze and evaluate the role of the public sector and government in this process.

To this end, this research paper gathers evidence on the critical factors of success of three mining clusters around the world with the aim to extract valuable information regarding the enablers which would facilitate the creation and the strengthening of mining clusters in Peru.

Business managers can also benefit from the results in terms of improving their capability of making more informed decisions regarding the adoption of a cluster approach.

The academic value is added by means of incorporating knowledge about cluster creation in developing countries; it has been identified that in Peru, in particular, cluster research studies hardly exist and lack a solid base of research.

The remainder of this paper is organized as follows: The next section presents an overview of the economy of Peru, followed by an introduction to the country’s mining industry. Afterwards, the notion of

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cluster will be discussed. The methodology section is then presented, and the review of success stories of mining clusters around the world will provide a foundation for further discussion and introduction of the “Four Clover” model as a possible framework for cluster development in Peru. The last section concludes the paper and provides additional insights on the topic.

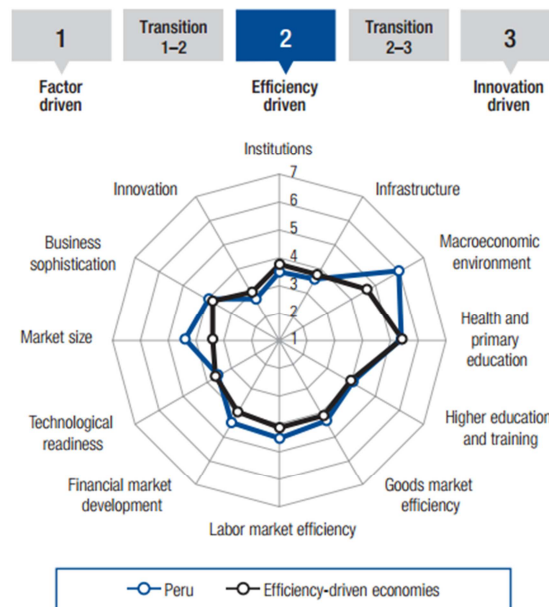
Overview of Peru's economy

Peru is considered to be one of the best performing economies in Latin America. According to [2], over the past five years, Peru has made great advances in its development, having achieved “high growth rates, low inflation, macroeconomic stability, reduction of external debt and poverty and significant advances in social and development indicators”.

Moreover, it is interesting to note the country profile published by the World Economic Forum in its now very famous Global Competitiveness Report for the period 2012-2013:

“Continuing its rise of the past several years, Peru climbs six positions in the rankings to reach 61st place. Further improvements to the already-good macroeconomic situation of the country (where it ranks 21st)—despite a rise in inflation—have buttressed this upward trend, while the situation in most of the other pillars has remained stable or slightly deteriorated. Overall Peru continues to enjoy the benefits of its liberalization policies that have supported the high levels of efficiency in the goods (53rd), labor (45th), and financial markets (45th). However, the country still faces important challenges for strengthening the functioning of its public institutions (118th), where government efficiency (100th) caused by excessive red tape (128th) and weak judicial independence are questioned. Moreover, the quality of its transport infrastructure (97th) needs to be improved. Furthermore, as the economy moves to higher levels of development and explores ways to diversify away from its large mining sector, its low quality of education (132nd), poor use of ICT (i.e., Information and Communications Technology) (89th), and low R&D and technological capacity (118th) work against developing the country's overall capacity to innovate and move toward higher-value-added activities.” ([3], pp. 33-34).

It is worth mentioning that, according to the same report, Peru is classified as an efficiency-driven country (see Fig. 1), which implies an increasing investment in infrastructure, strong investment incentives and better access to investment capital, business-friendly public institutions and a continuously improving skill base.



Source: Global Competitiveness Report, [3], p. 290.

Figure 1. Stages of development: The situation of Peru.

It can be argued that the great economic and social transformation of Peru started in the 1990s. Strong neo-liberal policies and reforms regarding fiscal consolidation, trade openness, exchange rate flexibility, financial liberalization, higher reliance on market signals and prudent monetary policy, have been promoted ever since [4]. The country experienced an economic boom in the 2000s. The results were, indeed, remarkable, as Peru was able to increase its per capita income by more than 50% over the past 10 years. The country registered an average GDP growth rate of 6.4% between 2002 and 2012, with a

growth rate of 5% in 2013 alone. The inflation rate in 2013 was 2.9%. Moreover, the country's sovereign debt of less than 20% of its GDP indicated a good environment for foreign investment.

But even though Peru has made great advances regarding its macroeconomic stability and has achieved certain level of development, there is still much yet to be addressed. Peru's competitiveness has deteriorated [1]. The economy is still dependent on capital intensive, natural resource-based exports. Public institutions lack credibility, and the general community is highly concerned about the low wages and poverty. In this regards, even though the rapid growth of Peru has helped decrease its national poverty from 48.5% in 2004 to 25.8% in 2012, disparities across the country remain high, particularly between rural (approx. 20% of the population lives below the poverty line) and urban areas (approx. 1.5% of the population lives below the poverty line). Moreover, the GINI index shows a high level of inequality, with a value of 0.45 [4].

The mining industry in Peru

Peru counts with abundant natural resources and its mining potential is impressive, the country being synonymous of mineral wealth. Moreover, it is believed that no other country in the region holds such a competitive advantage [5].

The latest figures [6] show that it is the second largest global producer of silver, holds the second largest known copper reserves in the world, and is the sixth largest global producer of gold. Other important minerals include lead, zinc, iron, cadmium, mercury, selenium. It is interesting to also point out that in the last 10 years, mineral exports account for about 60% of Peru's total shipments abroad.

The structural reforms, including the privatization of mines, carried out in the 1990s generated the modification of the mining codes to attract investment in this sector. The main changes consisted in eliminating the discrimination against foreign capital, providing free availability of the collected utilities, reducing the tax rates, and including facilities and incentives for the import of the needed machinery and equipment for mining and exploration, among others. And, indeed, given its strong mining potential and the legal and tax environment, Peru has been attracting the world's major mining firms to develop activities in the country. According to the Ministry of Energy and Mines [7, 8], mining investments reached U.S. \$ 9,723 million in 2013, representing an increase of 14.4% over the previous year. According to the same source [8], the contribution of the mining sector to the sustainable development of the country's provincial regions totaled U.S. \$ 2,235 million, amount which was primarily destined to improving the regional infrastructure.

The cluster concept

Clusters have always been subject of debate due to the fact that they are believed to be a critical instrument to increase national competitiveness [9], foster employment specialization and economic development [10], and improve innovativeness and overall productivity [11]. Moreover, a review of the existing literature highlights the relationship between cluster development and poverty reduction, as there are sufficient pieces of evidence pointing to clusters generating more and better paid jobs for the deprived communities in the developing world [12, 13].

[14], for example, found that industrial clusters are associated with lower poverty rates in the United States of America. [15] and [16] indicated that clusters have the potential of eradicating poverty by decreasing the industrial isolation that small and medium enterprises face in developing countries. [17], on the other hand, underlined how technologically-superior companies tend to be more profitable and, hence, stand a better chance to eradicate poverty by means of providing jobs and higher incomes. There is also evidence suggesting that workers within clusters can acquire new and improved skills and competences which can lead to improvement in performance, hence, to higher wages [18, 19, 20, 21]. These are just few examples which can be found in the literature pointing to the potential that cluster development has to improve the living standards of the concerned deprived communities.

But what is a *cluster* after all? The concept of *cluster* was first coined in 1920 by Alfred Marshall, who analyzed the economic area around London, and came to the conclusion that organizations and businesses within were interconnected by three main factors. However, almost 100 years later and despite numerous studies conducted around the world, there is still no consensus over its definition. Furthermore, specialists in architecture, urban planning, regional economy and urban political science, among others, have made efforts to define the term. Urban planners, for example, believe that the city plays a key role in the formation of clusters and regional economy experts consider that economic factors, such as location/geographical proximity, transportation, infrastructure, and workforce influence the evolution of clusters (for more information, please see [22]).

The 1980s and 1990s were dominated mostly by the new approach introduced by Michael Porter, considered to be one of the most important experts in the field. [23] defined clusters as being "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related

industries, and associated institutions (for example, universities, standard agencies, and trade associations) in particular fields that compete but also cooperate” (p. 3). Moreover, he also described a “diamond of competitive advantage” to be the basis of any cluster. As such, [24] talked about four main determinants of cluster’s competitiveness:

- (1) factors of production (skilled labor, capital, etc.);
- (2) demand;
- (3) context for firm strategy and rivalry; and
- (4) related and supporting industries.

Though the definition of Michael Porter is the most commonly used nowadays, it does have, however, its detractors. As such, some researchers believe that the definition given by Porter is static and does not consider the dynamics of networking, for example [25]. Others researchers point out that Porter has contributed to the confusion over the meaning of cluster because at first he defined the cluster as a form of association between industries (within a country), and only after 1998 did he include the geographical proximity dimension [26].

Nevertheless, independent of the definition of a cluster, it is interesting to note that over the past ten years policy makers have started to recognize the potential of clusters in terms of the innovation they favor. According to [27], clusters foster innovation, strengthen entrepreneurship, enhance productivity, income-levels, and employment growth in industries, and also boost regional economic performance. Moreover, there is a consensus across literature that a cluster is more than a mere geographic concentration of firms within the same industry; it is about the synergy achieved between all of the stakeholders involved [28]. As previously shown, the literature on the topic has grown rapidly, and so did the number of public policies that create and develop clusters [29].

Perhaps in this regard it is worth mentioning the case of the European Union, where cluster policies implemented by the national and regional governments share a series of key characteristics [10]:

- (i) “The policies deal with broad issues, as they are seen as an instrument to promote economic development and structural changes.”
- (ii) “They are based on improved business co-operation and networking”.
- (iii) “They emphasize the linking of firms to the (regional) technological infrastructure”.
- (iv) “The policies emphasize the role of public or semi-public organizations and mediators in encouraging inter-firm networks and joint projects”.
- (v) “They underline the need to improve innovation capability, knowledge management etc. in firms by improving the interactive learning process between firms and their environment”.
- (vi) “They focus on the need to stimulate the creation of specialized factors, and specialized knowledge in particular”.
- (vii) “Some policies stress the need to reach critical masses of firms, regional organizations and regional co-operation”.

Taking into consideration the above-mentioned characteristics of a cluster, it is also interesting to note that in what concerns Peru, it seems there are no actual functional clusters. In this regards, a study points out that there are limitations for further clustering due to factors such as low technological capabilities and lack of capacity to generate innovations and transfer learning experiences [30]. Hence, the purpose of the present research paper is to investigate the critical factors of success of three functional mining clusters around the world with the aim to extract valuable information regarding the enablers which would facilitate the creation of mining clusters in Peru.

Methodological framework

The methodology employs the case-based reasoning, which, broadly defined, is the process of solving new problems based on the solutions of similar past problems. Or as [31] stated, “instead of relying solely on general knowledge of a problem domain, or making associations along generalized relationships between problem descriptors and conclusions, case-based reasoning is able to utilize specific knowledge of previously experienced, concrete problem situations (cases)”. Case-based reasoning is, therefore, a rich and knowledge-intensive method for capturing vital lessons from past experiences which can be used to solve complex, real-world problems more effectively.

To this end, evidence of the common critical success factors of three mining clusters around the world, from three different continents, is gathered. Secondary information about these mining clusters from governmental and non-governmental sources is used, which includes periodic publications, websites, and official documents, among others. The stories depict contextual and functional information related to international experiences, the efforts that were attempted, and lessons to be learned from the cases.

It is to be remembered that the purpose of the case-based reasoning methodology is not to generalize the findings to all mining cases, but rather to shed light on some key lessons for the understanding of

what kind of strategies and policies could help to foster the creation of mining clusters in Peru which, in turn, would lead to greater local and national development. It is hoped that the present research paper will serve as a base for further inquiry and research in the area.

Learning from the international best practice

Successful examples of clusters can be found from both Latin and non-Latin American countries, as well as from both the mining and non-mining fields. Table 1 provides some examples in this regards, without the intention of being exhaustive. For additional information, the reader is referred to [32, 33, 34].

Table 1.Examples of successful clusters in the world.

	Non-mining clusters	Mining clusters
Non-Latin American countries	Silicon Valley (computer technology, USA); Hilversum (multimedia, The Netherlands); Napa Valley (wine-producing, USA); Bangalore (software outsourcing, India); Dhahran Techno-Valley (energy, Saudi Arabia); Silicon Vadi (wireless telecom, Israel); Aerospace Valley (aerospace, France); Casablanca Technopark (information technology, Morocco); Maritime Cluster (Singapore).	The Ontario Mineral Industry Cluster (Canada); The Western Australia Metals Mining Cluster (Australia); Mongolia's Mining Services Cluster (Mongolia); China's Mining Cluster (China); The Russian Mining Cluster (Russia).
Latin American countries	The Chilean Wine Cluster (Chile); The Mexican Chocolate Cluster (Mexico); The Plastics Cluster in Sao Paulo (Brazil); The Software and Services Cluster in San Jose (Costa Rica); The Colombian Coffee Cluster (Colombia).	The Chilean Mining Cluster (Chile); The Brazilian Mining Cluster (Brazil).

The following lines depict the experience of three successful mining clusters from three different parts of the world: the Chilean Mining Cluster, the Ontario Mineral Industry Cluster, and the Australian Mining Cluster.

The Chilean Mining Cluster

Chile counts with a solid comparative advantage, as of over one-third of the world's copper mine production are estimated to originate from this country [35]. In consequence, "an industrial cluster has grown around the extraction and processing of copper ore, such that the country internally supplies two-thirds of the inputs, 40% of the equipment, 70% of the engineering services, and accounts for 60% of the costs of input machinery and engineering services for goods and services produced by related industries" [36]. The great contribution of the Chilean Mining Cluster to the economy were the fiscal surpluses deposited into the Economic and Social Stabilization Fund, a fund which allows financing of fiscal deficits and amortization of public debt [37]. It is important to highlight that the revenues originated from the mining sector have been directed for education, for mine employment and related industries and the provision of finance for suppliers.

The critical factors for success are considered to be the competitive infrastructure and the highly trained mining workers, on one hand, and the social, fiscal and macroeconomic stability in the country, on the other hand. The mining development strategies have been designed in such a way that strong emphasis has been placed on literacy, education, and poverty reduction. Funding of social programs has also been on the national agenda for many years, which brought peace within the local communities. Foreign investment has also played a fundamental role for the growth of the mining industry in Chile. "Chile is not content, however, with the vast progress made so far. The ultimate goal is to expand or spinoff the mining industrial cluster into other activities that will become increasingly independent of mining—that is, to reach the final stage of a resource corridor. The objective of the Innovation Fund created in 2009, funded by mining taxes, is to identify and accelerate the development of dynamic comparative advantage in strategic clusters in Chile. Sixty percent of the funds are to be spent in mining regions." [38].

The Ontario Mineral Industry Cluster

Canada, a country with abundant natural resources, has achieved not only to make the mining sector one of its central economic activities, but also to evolve towards producing mining products with a high technological profile. The development was such that the mining clusters entered into their last stage of development which, according to the latest theoretical ground, is the globalization of the mining firms.

The Ontario Mineral Industry Cluster was launched by the Ontario government, and it includes a large and diversified number of specialized members from the industry (exploration companies, mining

operators, suppliers, financial institutions, consultants, and trade associations), academia (training, research, and development institutions), government and local communities. The contribution of Ontario region alone to the Canadian mining industry is such that it counts for two-thirds of Canada's nickel and gold production, one-third of Canada's copper production, and 90% of Canada's platinum metals production, among others [39]. The Ontario Mineral Industry Cluster is what we may call a modern, innovative, and highly technologically intensive industry cluster.

According to [40], Canada is one of the world's best destinations in which to do business - the ease of doing business index is 19 as per [41]. Canada's critical factors of success are considered to be the openness to foreign trade and capital (we include here a strong banking sector, low corporate taxes, and a duty-free manufacturing tariff regime, among others), the high-quality infrastructure, and the proximity to the North American marketplace. It is interesting to note how Canada knew to transform its comparative advantage into a competitive advantage. As such, the country's main capabilities are as follows: a sophisticated and technologically advanced mining industry, a clear mineral development strategy, world-class infrastructure and top-notch research institutes and universities (advanced research and development capabilities), along with highly-skilled workforce (with expertise in geology, computers, robotics, and satellite imaging). It is definitely worth mentioning the emphasis which the Ontario government itself is placing on the development of new services and breakthrough technologies in the mining industry, which in practice has been translated into laws and regulations which foster a close collaboration between the research organizations and universities and the industry.

The government's commitment to the development of a sustainable mineral industry can also be seen in its corporate social responsibility programs and investment in environmental protection carried forward in conjunction with both the local communities and the concerned industry.

The industry's involvement in the communities has been measured mainly through the employment opportunities generated, to such extent, that it now employs Aboriginal people in its activities.

Universities, also, are offering specialized programs in relation to the mining industry and a Federated School of Mines has been created to meet the needs of the industry's increasing demand for a highly skilled workforce.

The great performance of the mineral industry cluster has led to the creation of a cluster of related and supporting industries in the Sudbury-North Bay-Timmins triangle. These businesses are active in the international market, where they export specialized equipment, services, and expertise [42].

The Australian Mining Cluster

Australia is another sophisticated story of success when it comes to the mining industry, which falls under the mineral and petroleum sector, which accounts for more than one-fifth of the Western Australia's economic activity with total export earnings in 2013 of approx. \$144 billion [43].

The mining industry is considered to be the pillar of Western Australia's economy. One of the first main capabilities of the country is considered to be its technological innovation power. To this end, companies (including supporting industries, as well) and local governments are constantly investing in new technology to innovate the mining techniques and practices and management processes [44].

It is also worth pointing out the increasing investments carried out to create a better and sustainable infrastructure that supports the mining industry. Mining infrastructure construction in Australia is booming. According to [45], "as for the construction leg of the mining boom, the summit is now approaching. Based on projects which are underway and committed, we are likely to see investment levels continue to rise in the short term." To this end, the policies set up by the government worked as a catalyst to encourage mining companies to invest in infrastructure. Efforts have been made continuously to foster collaborations between the state, the local shire councils, and the mining companies.

Another critical factor of success is the country's commitment to create the future skilled workforce for the industry, to which end universities have opened mining schools, one example being the Western Australian School of Mines.

Mining investment in Western Australia has kept rising pronouncedly, amounting to USD 21.7 billion in 2010. Major investments have particularly been made in iron ore and alumina. According to a study conducted by [46], Australia ranks amongst the top countries for mining investment, with positive remarks on seven pillars: economic system, political stability, social stability, mining permit bureaucracy, risk of corruption, currency stability, and tax risk.

Figure 2 encompasses those common factors that were identified from the review of the international experience as being critical to the successful development of mining clusters.

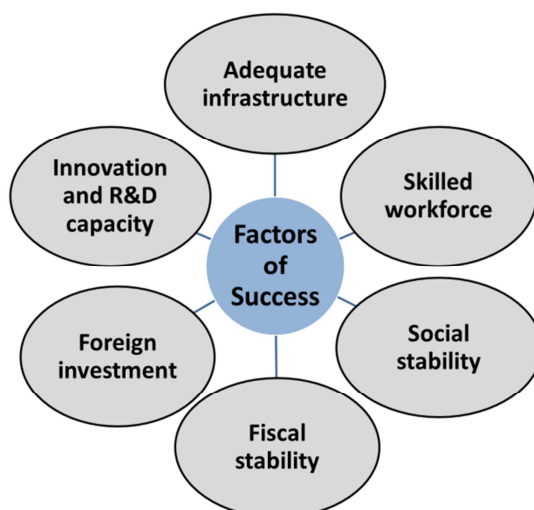


Figure 2. Critical factors in the development of successful mining clusters.

Peru: Main challenges

This section presents the current situation and the main challenges in the mining area that Peru faces, based on the critical factors of success identified from the review of the international experience. These include aspects related to social conflict, fiscal stability, the necessity of a strong skill base, the presence of research institutes as catalysts for research and innovation, the effective presence of the government in the mining zones, and the availability and quality of infrastructure, among others.

A modern and robust physical infrastructure.

Infrastructure is becoming increasingly important in the success of a mining cluster, as it helps reduce transportation costs while it facilitates the access to raw materials, skilled labor, customers, and suppliers. The lack of infrastructure increases development costs, limits growth, and delays investment. Though the investments destined for road construction in Peru are quite high, of more than USD 2.5 billion per year, the road network still remains highly insufficient, and its development is often hampered by the lack of regulatory clarity and red tape. Moreover, according to [47], for Peru just to maintain its current level of competitiveness, it would need an investment in infrastructure of USD 88 billion between 2012 and 2021. This is one of the first challenges that policy makers and business managers in Peru must tackle.

Skilled workforce.

It is well-known that workers who count with a set of appropriate abilities, capable to constantly upgrade their skills and adapt to the new challenges driven by an increasingly global economy, contribute to the success of a cluster [48]. This becomes even more important when it comes to a mining cluster, where rapid technological change and increased international competition require an increasingly skilled workforce.

However, it seems that people in Peru have difficulty entering the formal job market in this sector, mainly due to inadequate education or qualifications, and a lack of technical skills. As such, only in 2012 Peru received more than 35,000 foreigners with work visa [49] and it is interesting to note that many of the jobs were in the petroleum industry and mining. It is also interesting to note that the value-added activities, such as the processing and refinery of the minerals, are done not only outside the regions of production, but also and mostly, outside the country. It is, therefore, undeniable that the lack of a skilled labor force is a hampering growth aspect in Peru and investment to increase labor productivity indicators becomes imperative.

Social stability.

Unfortunately, it seems that the relationship between local communities and mining companies is characterized by distrust. It is not an exaggeration to say that every new report of investment in mining in Peru is almost always followed by a report on unrest in the local community [50]. In consequence, social conflicts originated from the mining industry have increased by 300% between 2008 and 2012 only [51]. In this regards, it is worth mentioning that “the main concern of the government towards mining conflicts appears to be focused on the maintenance of public order and the prevention of protests discouraging mining investment. The most common issues in mining conflicts are the environment, right of access to land and water, and the distribution of economic benefits. Also, most mining projects in Peru are

developed in Andean departments where substantial agricultural activities are located. The opening of new mines inevitably reduces local and sometimes regional levels of water. These situations cause depletion of water sources in some communities” [52]. According to the [53], improvements are needed in government transparency and management so that communities can benefit from the mining revenues and in civic participation so that communities can have their concerns heard.

However, it also becomes imperative that concerned parties understand that the complexity of the social conflicts in Peru is determined not only by the number of actors involved (local communities, the government, mining companies, non-governmental institutions, and so on), and the economic-driven relationship existent among them, but also by socio-cultural aspects. Take, for example, the cult of Pachamama, a Quechua word meaning “Mother Earth” (the goddess of agriculture and sustainer of all life in the Peruvian mythology). For most of the local communities, their land is sacred and resettlement of their community for mining purposes is seen as both an invasion and a sacrilege. The veneration these communities have for their lands should be considered by concerned parties in their action plans.

Fiscal stability.

Fiscal stability could be seen from an economic point of view and/or from a normative point of view. In the first case, it refers to national economic accounts also known as macroeconomic indicators. Frequently, the main highlighted statistics by governments and international organizations such as the International Monetary Fund (IMF) and the World Bank are the Gross Domestic Product, National Income, National Spending, and Public Debt. In the second case, it refers to the grade of commitment and compliance with agreements (contracts and laws) the Government has with different stakeholders, especially with relevant enterprises that significantly invest in the country in the long term. The strict compliance with those contracts and laws evidences the relative safety of the investments against potential negative junctures. Both perspectives, economic and normative, are, therefore, addressed in the following lines in relation to the Peruvian reality.

With respect to the macroeconomic stability, according to [2], Peru’s GDP has risen from USD 121,382,746,565 in 2008 to USD 202,295,635,536 in 2013, which implies a 66.66% growth. Also, between 2012 and 2013, Peru’s GDP went from USD 192,636,058,714 to USD 202,295,635,536, or a 5% growth. The Current Account Balance (as percentage of GDP) reflects, according to the Central Bank of Peru [54, 55], a deficit of -1.9% in 2011, -3.3% in 2012, and -4.5% in 2013. [4] forecasts a deficit of -5.7% in 2014, -5.6% in 2015, and -5.1% in 2016. With regard to the national income and spending (as percentage of GDP), in the first case BCRP reports 17.8% in 2011, 17.9% in 2012, and 18.6% in 2013; in the second case, 18.8% in 2011, 19.1% in 2012, and 18.9% in 2013.

Considering fiscal stability in a sense of the accomplishment of contracts and agreements with most important mining companies, the law that regulates the mining sector in Peru is called “Ley General de Minería” or General Mining Law. Such regulations regarding the mining industry have been delegated to the president by the Congress and the Council of Ministers authorization. In it, law n° 27342 contemplates the “Convenios de Estabilidad Jurídicos” or Legal Stability Agreements [56]; however, the description is general because it concerns all companies which want to access such regime of stability. Before postulating to the mentioned regime, and especially if the investment will be significant, officials of the Ministry of Mines and Energy and the main responsible managers of the company or project have to negotiate to achieve an agreement. Both parties then specify the terms and conditions which will result in a specific law/contract. It is opportune to say that constantly Peru’s mining regulation is compared to Chile’s since it represents a direct competition.

Foreign investment.

Mining investment in Peru has kept rising pronouncedly from 2008 to 2012. In 2008, the investment was of USD 1,708 million, in 2009 of USD 2,771 million, and in 2012 of USD 8,549 million [57]. However, since 2012, it has been reported that the sector is stagnant and, according to the former minister of economy, this is due to an increase in tax charges which affects almost in 20% the internal rate of return (IRR) of the big mining projects [58]. Also, according to the Proceedings of the National Academy of Sciences (official institution of the U.S. National Academy of Sciences), delays caused by community and social conflicts could increase costs by USD 20 million weekly for world-class projects valued between USD 3,000 and USD 5,000 million [59].

Innovation and R&D capacity.

Though two separate activities, innovation (i.e., product or process development) and R&D (i.e., development of new products or processes) are inter-related and their presence is vital for mining cluster formation. As a matter of fact, clusters are an immediate application of the non-linear innovation model.

Unfortunately, Peru is one of the most laggard countries when it comes to research and development matters in the Latin American and the Caribbean region. Its spending on innovation, research, and development is near 0.1% of the GDP [60]. According to the National Strategic Plan for Science, Technology, and Innovation for Competitiveness and Human Development elaborated by the Ministry of Education, the main problem is that the multiple economic agents all over Peru are not articulated so it is difficult to develop a national strategic plan that identifies the present demands, necessities, and challenges [61].

The cluster model for the Peruvian economy

Following the previous discussion, it becomes quite clear that the state should be actively involved in designing programs which foster collaborations between the different research institutes (universities, non-profit organizations, among others) and the different economic actors and local authorities, in a context in which collaboration in business is no longer a traditional concept [62]. In this regards, the state should create a powerful platform which would allow the interaction between the state and the multiple stakeholders who can contribute with their experience and ideas to the creation of a sustainable mining cluster. Figure 3 depicts the actors involved in the cooperative-competitive environment of a cluster, within the famous Triple Helix structure [63]. In this model, the capitalization and transfer of knowledge is defined by the relationships between three important actors: education, government, and business. It is obvious that the actors within the model have different contributions and interests, which have to be harmonized. The contribution of the academia would involve up-to-date applied research and know-how transfer, while, on the other hand, would benefit from new research labs sponsored by the industry and which would lead to continuous learning materialized through the updated curricula; companies would learn how to cooperate and enhance their capabilities while gaining a comparative advantage and delivering goods and services with an increased added value; governmental institutions, as previously mentioned, would act as process mediators and provide direct support while having access to the research results. As such, we need to seriously re-think the relationships that exist in this framework, given the fact that each of the actors of this platform would serve a dual role of competitor and collaborator to the solution of the mining cluster development. One thing is certain though: government support is critical for cluster creation [64].

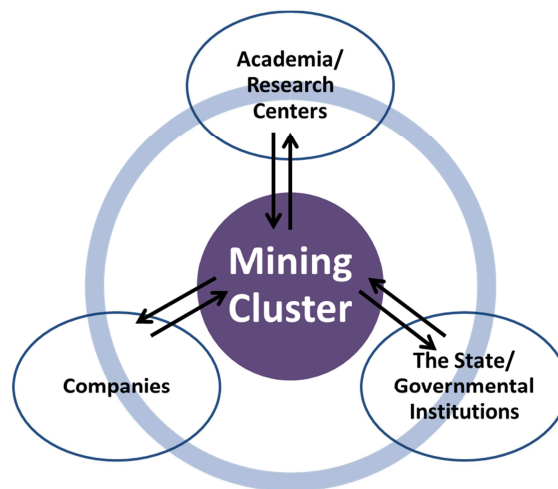


Figure 3. The dual role of the stakeholders within The Triple Helix Structure.

Nevertheless, Peru's tradition for general cooperative activities, for deliberate public-private collaboration and for industry-university cooperation as drivers for economic development suffers such distortions that voluntary cooperation is considered to be an exception. In Peru, experience has shown that the three actors of the Triple Helix do not naturally cooperate; neither they know how, nor have the initiative. This leads to the need to adapt the model and transform it into a Four Clover model (see Figure 4). In this new setting, a fourth partner is involved, namely, the catalyst institutions, such as technology transfer and innovation centers, consultancy enterprises, and chambers of commerce, which are needed to promote the dialogue and coordination. Their contributions would also involve know-how transfer and dissemination of research results at national and international level. In turn, they would benefit from networking and amplification of their market share by means of gaining new clients. As such, the local

context indicates that the Four Clover cluster model would be a much better choice to foster mining cluster development in Peru.

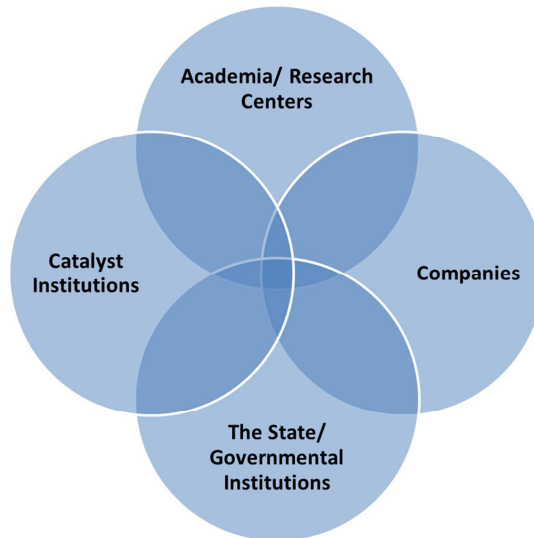


Figure 4. The “Four Clover” model.

Final remarks

Mining in Peru has enabled only a small portion of the potential welfare that the country and the society at large could benefit from. The development of mining clusters can help in this regards, as it can address a series of economic and social problems, such as national competitiveness, employment, innovation, and productivity. However, there are still many hindrances to face, especially because of the local political, economic, and social dynamics. It should be pointed out, however, that mining clusters and their associated policies should not be seen as universal remedies, simply because they cannot solve all the economic problems of the country. The present paper proposes the development of mining clusters in Peru as a potential means to improve the overall economic setting, within which poverty is a key aspect.

In addition to the above analysis, it is also worth pointing out that a great percentage of the mining activity in Peru is either informal or illegal and this has had an upward trend over the last decade. Illegal mining is present in 21 of the 25 provinces of the country and it generates revenues of approximately USD 3 billion [65]. The main reason behind this situation are the socio-economic problems present in the country, such as the lack of employment possibilities in the rural areas, the increasing price of the metals, and also because many of the mining companies operating in the area are taking advantage of the inaction of the State. As such, the central government faces the challenge of regulating the informal mining sector and eradicating the illegal mining activities. There is a need for a more effective interaction and collaboration between the different stakeholders involved, as previously mentioned. There is also a need for policy makers and business managers to create initiatives to increase formalization in the sector.

In this research paper, three stories of success of mining clusters from three different countries from three different continents were analyzed, in an attempt to identify the common factors which led to their performance. However, it is to be noted that although the present analysis highlighted the interconnection of the common factors and their effect on the development of the clusters, “the economic theory has not yet provided a model that allows both the analysis and the definition of a process for implementing a successful cluster” [66]. Nevertheless, it is believed that these success stories can provide invaluable support to policy makers and business people in their endeavor to promote a favorable environment for cluster formation in Peru. It is also hoped that the present paper facilitates the initial step towards a better understanding of mining clusters in Peru and sets the pavement for further research in the area. Due to the complexity of the economic, political, and social relations and environment that define a cluster, it is necessary to continue research from both the theoretical and practical perspectives.

Acknowledgements

The author is grateful to the Editor-in-Chief and the anonymous reviewers for their valuable comments and suggestions made on the previous drafts of this research article.

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