Intelligence capital: The management of knowledge assets and development of adaptive capacities in the city of Arequipa

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Abstract

Purpose: The objective of this research is to measure the intelligence components and capabilities in the city of Arequipa, based on the Integral Intelligence Model (Carrillo & Olavarrieta, 2009). This model articulates the notion of Intelligence Capital, which allows components and capabilities to be developed in agents, thus promoting adaptation, knowledge management and quick responses in the optimal decision making by these agents.

Design/methodology: The Integral Intelligence Model proposed by Carrillo and Olavarrieta (2009) was taken as a basis, analyzing each of its components and capabilities in relevant agents or organizations in the City of Arequipa. This work identifies how the maturity level of these capabilities makes the operationalization of the Intelligence Capital (IC) possible. The information was obtained through direct interviews with decision-making agents of the institutions in the City of Arequipa (governors and top management of companies in the city), as well as from reports and secondary sources.

Findings: This research lays a solid foundation for the proper articulation of the IC as a fundamental element of Knowledge-Based Development (KBD). The results highlight the importance of fine-tuning internal processes for this type of development, the trade-off between the speed of response and good design, execution, development and evaluation of processes and the need to develop intelligence components in organizations, in order to operationalize IC and generate value.

Research limitations/implications: The study focuses on the first semester of 2020 in the City of Arequipa, a period characterized by the uncertainty and environmental risk caused by COVID-19.

Practical implications: The research reveals that in the City of Arequipa, there are potential intelligence capabilities or components that are consolidated in the design, planning, execution and evaluation of internal and external processes in institutions and organizations. However, the development of these capabilities is diminished by flaws in the identification and processing of information, resulting in only moderately agile responses.

Social implications: This research provides evidence that in the KBD model, social agents play a fundamental role in decision-making, as they are the ones who identify and interpret significant events in

the environment. This, in turn, allows effective, positive and adaptive responses to be issued that guide and drive the organizations.

Originality/value: This study presents a methodology that can be replicated in other cities, and which makes it possible to identify the intelligence capabilities of agents or organizations, in this case of a city.

To cite this article:

1. Introduction

Over time, economic science has been developed based on the processes of production, distribution, exchange and consumption of different goods and services. This represented the essence of classic economics (Uzawa, 1965), based on the relationship between supply and demand, which has reduced the importance of the motor that drives these processes: decision-making. The relevance of decision-making marked a change towards another focus aligned with evidencing the conflict resolution process through optimal responses to the demands of the global dynamics (Thaler, 2016). The approach presented by R. Thaler (2016) based on the behavioral sciences is backed by innovation and information processing, leading optimal decision-making to value breeding within an organization.

In context, this new approach led to knowledge-based economics, which incorporates it in the well-known production function. Knowledge is thus an intangible asset of vital importance in the existence and survival of any economic activity, as it is constituted based on the input of inputs and the essence or reason for being of any production chain, evidencing that the generation of value goes beyond the interrelationship of the physical production factors. In this context, knowledge has become the most important element of consumption and production in organizations and companies, both for its scaled growth of performance and for being an asset that is capable of generating progressive multidimensional value, both internally and externally (Carrillo, 2014a; Malhotra, 2003), which as it is administered, will give agents the capacity to make optimal decisions through effective, positive and adaptive responses.

This new paradigm challenges the judgment of classic scholars of orthodox economic theory who identify economics as an exact science, rationalizing the behavior of people and the course of action to be taken with foreseeable results. However, none of the classic economic theories adheres to the new knowledge markets that include the global articulation of tangible and intangibles components of the economy in knowledge networks, that constitute the new ways of creating value based on the mobilization of all assets in a society and that have been developed in recent years (Carrillo, 2014a). For this reason, decision-makers are currently asking how knowledge should be managed. To accomplish this, it is important to approach this type of management as an organizational and internal process that makes it possible to increase the tangible and intangible value of organizations. It is here where the Knowledge-Based Development (KBD) model comes into play, rendering tangible the creation of value in the development of a "whole" that is articulated in cities (Carrillo, 2014b). This model is based on the Capital System (CS), which is constituted as a new and holistic system of development, where categories of value or, as they are also called, capitals, are articulated (see Table 1), which permit internal and external value-generating capacities to be recognized and executed.

Within this system of value categories we find Intelligence Capital (IC), as a component of vital importance for developing the capacity for adaptation and achieving an optimal and agile response to the environment.

Embedding organizations as decision-making agents, which design, articulate, implement and execute intelligence processes and taking into account the uncertainty of the environment makes it possible to create opportunities that promote decision-making focused on value management. These optimal decisions that come about as the result of an intelligent process are the ones that become the driving force behind the development of a particular institution or organization.

The present study uses as the unit of analysis the organizations in the city of Arequipa, the second most important city in Peru, according to the 2020 Regional Competitiveness Index by the Peruvian Economics Institute. In addition, in the year 2017, the city of Arequipa was recognized by the World Capital Institute (WCI) an emerging knowledge city. This has meant recognizing in Arequipa knowledge assets that could model the development of the city, as seen from the KBD. However, the award also served to evidence the limitations that exist in the city of Arequipa in order to be a Knowledge City.

By means of the case analysis of the city of Arequipa, this study intends to characterize the role that IC plays within the framework of CS, and thus exemplify its operationalization as a tool to develop capacities of adaptation, which in turn would permit a better integration of the different agents that make up the system: individuals, organizations and society. This research is intended to contribute to recognizing the capacities or components of IC value in the city's agents, permitting them to be aligned and to attain KBD. To do this, primary data were used that were obtained from interviews with key agents, which made it possible to determine in a descriptive manner the degree to which the capacities or components of intelligence were present or absent, according to the described model.

2. Knowledge-Based Development: A proposal for city development

A knowledge-based economy gives traditional production factors a living, dynamic and changing element that understands economics as a social science. In it, the behavior of the actors (or agents) is characterized by its unpredictability and subjective interpretations. Decisions are made under a paradigm of uncertainty and are motivated by experience, perception and available information. For this reason, new frameworks are needed in order to understand and manage the perpetually emerging knowledge assets.

The instruments and industrial frameworks that currently exist obstruct the proper functioning of these new knowledge-based organizations. In many aspects, workers work with knowledge and they use their capacities as a means of production as compared to fixed assets, such as buildings or machinery, which are insufficient to create value (Carrillo, 2014a). In this context, the Capital System (CS) is the most appropriate framework of reference to systematize knowledge assets. Analytically, there are seven capitals or categories that permit the generation of value.
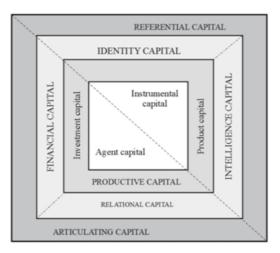

Figure 1. Capital System (Carrillo, 2002)

As illustrated in Figure 1, the CS works like a geared system of knowledge within organizations and allows them to act like complex, articulated, value-generating entities. It should be indicated that the CS (Carrillo, 2002) provides a comprehensive taxonomy of knowledge assets; as they develop an intangible value, knowledge assets require new frameworks that are appropriate in terms of their particular dynamics. Knowledge-based organizations generate value very differently from traditional production; for this reason, there is a need to reconstruct or reinvent the production function in terms of more complex components and interactions (Lucas, 1998; Osawa, 1965; Zheng, Yang & McLean, 2010).

Capital System				
Value orders			Definition	Attributes
CAPITAL *Universe of collective preference orders*	METACAPITAL Multiplicative (+) / Divisive (-)	REFERENTIAL *Structure: membership rules*		
		Identity *Self-significance*	Capacity to discern the value elements that contribute to the system and to guide the consequential action	*Integration*: degree to which the components of the unit refer unequivocally to membership references *Differentiation*: degree to which the unit is distinguished from others and to which it is possible to specify what does or does not belong to it
		Intelligence *Hetero-significance*	Capacity to identify the significant agents and events of the system	*Detection*: threshold of signal discrimination about agents and significant events *Interpretation*: possibility to make sense of the signals based on identity references
		ARTICULATING *Function: relationship rules*		
		Monetary *Exchange*	Capacity to represent the elements of value and facilitate their exchange	*Production*: possibility to generate inputs for the maintenance and development of harmony among all capital orders *Savings*: positive differential between the generation and expenditure of inputs that makes the investment in development possible
		Relational *Linking*	Capacity to establish and develop internal and external links with other significances	*Cohesion*: degree of integrative strength among the components of the unit *Linking*: degree of interactive strength with the external significances
	PRODUCTIVE Additive (+) / Subtractive (-)	Agent *Agency*	Capacity to execute the value-enriching actions	*Understanding*: capacity to comprehend the general relationships among the individuals *Action*: capacity to execute the acts derived from the understanding
		Instrumental *Mediation*	Capacity to leverage the value-enriching actions	*Adaptation*: correspondence between the specifications of the infra- and info-structure and those of the action they intend to enable *Process Capacity*: possibility of the instrument to enable precisely that which is intended to be achieved

Table 1. Capital System. Source: Carrillo (2014a)

The CS is characterized by: (i) integrating a homogeneous whole of value, denoting a culture; (ii) being a set that cannot be reduced down into any part (the financial aspect cannot express everything); (iii) each capital has value in and of itself and is interchangeable with the others through rules of correspondence; and (iv) makes it possible to obviate the distinction between tangible and intangible.

According to the most recent review of the literature on the topic (Carrillo, 2014a), the CS is redefined as the universe of the orders of collective preference in a human activity system. The set that is commonly identified as valuable at each level of analysis: individual, organizational and social. The CS in turn is disaggregated into progressive subcategories, each of which expresses a distinctive and complementary value function. Each can have a positive (asset) or a negative (liability) sign, as shown in Table 1.

The concept of the CS denotes a complete, integrated system that was developed in 2002 and which maintains a generic conception that was later developed and expanded upon in 2014 (see Table 1). In agreement with the reviewed literature, the CS identifies new production factors or knowledge assets, which can be formulated and expressed as indicated by the Equation (1):

$$Q = f \ (C1; C2; C3…; Ci) \tag{1}$$

where Q represents the amount of social production and Ci represents the capital level of i inputs where $i=1…n$ (e.g., identity, intelligence, financial, agent, etc.). In this function, the knowledge assets have a strategic nature, since to the extent to which they transmit the scope of the organization's capacity to adapt to its environment, knowledge gradually capitalizes upon itself. This characteristic makes it possible to make better decisions and increase production (Olavarrieta, 2012). Therefore, the following expression is proposed, as reflected in Equation (2):

$$\frac{\Delta \, Q}{\Delta \, Intelligence \ Capital} = Marginal \ Product \tag{2}$$

As can be seen, every time that the *Intelligence Capital* and the production (Q) increase, there is a marginal positive contribution to productivity (*Marginal Product*), which also increases, and considering that since they are equal, both increases are positive. As stated by Olavarrieta and Carrillo (2014), "*Intelligence Capital cannot be bought, but some parts of intelligence can perhaps be bought*" (p. 291).

2.1. Intelligence Capital

Within CS, Intelligence Capital (IC) is positioned as the most pertinent value category in order to understand the new dynamics of knowledge (Carrillo, 2009). IC is focused on the adaptive capacities of an individual, organization or society within a certain unit of analysis. One relevant characteristic of IC is that it aligns the other capitals, recognizing value references and integrating the capacities involved in decision-making and adaptation. In order to operationalize IC, Carrillo and Olavarrieta (2009, 2014) developed the Integral Intelligence Model, which makes it possible to measure the following value components:

- Value alignment: Capacities related to the recognition of values, definition and evaluation.

- Sensory component: Capacities related to sensor design, implementation and calibration.

- Experience: Capacities related to knowledge acquisition, recovery and validation.

- Decision: Capacities related to cognition, problem solving, modeling and choice selection.

- Action: Capacities related to the successful implementation of prior decisions and those related to value alignment.

Within the value categories of the CS, IC is positioned as a referential support for aligning social value, and as shown in Figure 2, it acts by promoting and driving the development of endogenous capacities inherent in

individuals, organizations and society, making it possible to integrate a series of components that include everything from the individual recognition of agents, followed by an analytic design of internal processes strengthened by an available knowledge base, to their deliberate and intelligent execution, which is capable of generating value. As such, the value alignment component, the sensory component and the experience component are internal processes that bring together the elements of "being, recognizing and knowing" and strengthen the capacity for decision and adaptation to the environment within the individual; in organizational language, as clients, suppliers and market; and in social terms, as the "interested parties".
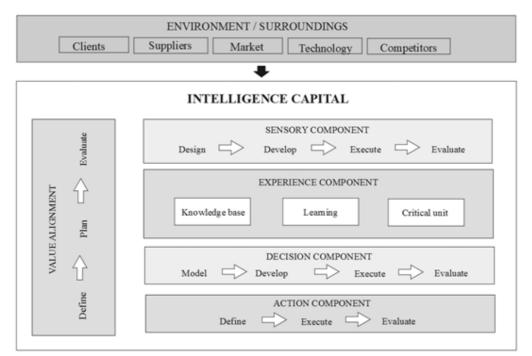

Figure 2. Intelligence Capital Model (Carrillo & Olavarrieta, 2014)

This model of KBD, unlike Deming's (1989) continuous improvement cycle (1950), which seeks to continuously and quantitatively optimize business activities, is intended to recognize and promote the capacity for adaptation in individuals, organizations and society in dynamic and changing environments, managing uncertainty on a social level. The development of IC within a social development system allows the organization to deploy and adapt in the uncertain environments denoted by the new era, generating both internal and external value and allowing the organization to diagnose opportunities and risks in the context.

Figure 3 shows the contribution of IC to knowledge management. It also evidences that the operationalization of said capital in organizations facilitates optimal decision-making. The environment mentioned in Figure 2 is made up by external agents that constantly issue signals and signs as a result of the global interaction. These signals must be identified and properly interpreted by the agents through the development of the IC, with the aim of issuing a quick, positive and effective response (development of the capacity for adaptation). This feedback and agility of response by the IC contribute to a systematic management of knowledge (Carrillo, González, Elizondo, & Correa, 2014).

In its administration, the IC must be supported by an external perspective to develop the adaptability to the environment, while in its internal perspective, it must maintain an awareness of the capacity of reaction to external events (Nespolo, 2019). Accordingly, there are agents and institutions that recognize and identify these signals, and even some that anticipate them, in order to make decisions that will be accompanied by uncertainty and risk. To the extent that this response is effective, positive and adaptive, it can be said that the agents of a certain city have developed the IC (Carrillo & Olavarrieta, 2014).
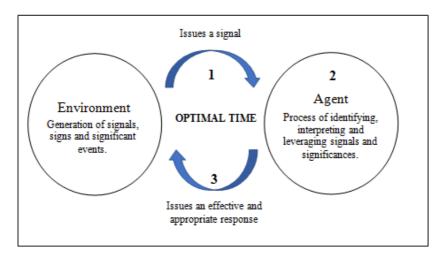
Figure 3. Contribution of IC to knowledge management

3. Methodology

The present research involves an applied case study, as it is intended to deploy the knowledge and theoretical evidence, and the results will allow a contribution to be made to building new knowledge. Its design makes it a non-experimental analysis, since it does not require any laboratory analysis or modification of variables; regarding its focus, it is qualitative, interpreting reality in a subjective and inductive manner, ensuring the principle of neutrality on behalf of the researcher in order to avoid the qualification or partialization of the investigation (Hernández, Fernández & Baptista, 2014). The information has been obtained through a field study, with a direct examination and interaction with the study subject, directly through observation, the recording of phenomena and the use of focal groups and interviews (López-Roldán & Fachelli, 2017).

In 2017, the city of Arequipa (Peru) was recognized by the international center for analysis and thought, the World Capital Institute (WCI), in the Emerging Knowledge City category, awarding it the MACKI prize from the World Capital Institute, a group of foreign experts interested in promoting the understanding and application of knowledge as a tool to achieve economic and social development in cities. This recognition reveals the gap that exists between a Knowledge City and an Emerging Knowledge City; the same one that constitutes notable interest on the part of the research team for interpreting which components and capacities have been developed in the city of Arequipa; among them, the IC is one of the metacapitals from which the other value categories are derived.

According to the literature presented, it is very interesting to use the Integral Intelligence Model (IIM) proposed by Carrillo and Olavarrieta (2009) as a base to analyze each of its components and capacities in agents or business and governmental organizations. Furthermore, the IC was also considered within the CS as a referential and value-generating asset. It is therefore important to identify the adaptive capacities of the social agents that have among their functions economic and social management, as well as the responsibility for promoting the development of the city, identifying the level of maturity of these capacities, making the operationalization of IC possible in the city of Arequipa.

For this study, interviews were conducted with decision-making agents from the most important institutions with the greatest economic impact due to their production, economic and social capacity, including governmental leaders and executive directors of major companies in the city among the profiles of those interviewed. Table 2 presents the population considered in this study.

Decision-making agents for the development of the city			
Governmental institutions	**No. of people**	**Private institutions**	**No. of people**
Mayor of the Provincial Municipality of Arequipa	1	Chamber of Commerce and Industries of Arequipa	1
Mayors of the District Municipalities of the City of Arequipa	29	Financial Cooperation for Development (COFIDE)	1
Central Reserve Bank of Peru, Arequipa branch	2	Chamber of Commerce of Lima	1
Representatives of the agenda for the development of Arequipa: a) San Agustín National University b) Santa María Catholic University c) San Pablo Catholic University	9	Businesses in the city: a) Industrial Category b) Textile Category c) Mining Category d) Agricultural Category	10 2 6 12
Judicial Branch	6	e) Tourism Category	4
Directors of offices linked to the national government	5	f) Services Category g) Construction Category h) Financial Category i) Miscellaneous	6 2 15 14
Regional government bodies	2	Non-profit organizations	3
Subtotal of people	48	Subtotal of people	74
Total number of people (N)		**122**	

Table 2. Constitution of the statistical population

Once the study population was identified, it needed to be established what sample was necessary in order to estimate statistically significant results with the least possible amount of sample error. For this calculation, following the method used by Scheaffer, Ott and Mendenhall (2007), we determined the expression of Equation (3):

$$n = \frac{k^2 qpN}{e^2(N-1) + k^2 pq} \tag{3}$$

where N represents the populational quantity or the universe, e indicates the margin of error for the responses obtained, k represents the level of confidence of the study (95% k value = 1.96), p is the probability of success as a proportion of those interviewed in the population with a specific characteristic, and finally q represents the probability of failure of individuals who do not have a specific characteristic, which is determined as (1-p). According to the research purposes and once the populational quantity was determined, the quantity of the finite sample was obtained, as shown by the Equation (4), with a sample n resulting equal to 93.

$$n = \frac{1.96^2(1-0.5)(0.5)*122}{0.05^2(122-1) + 1.96^2(0.5)(0.5)} \tag{4}$$
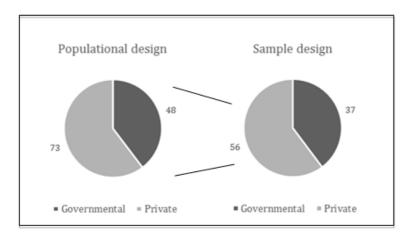

Figure 4. Sample design

Once the sample number was determined (see Figure 4), we proceeded to identify the agents to be interviewed. First, the interview design was established (see the Appendix with the details of the questions). The structure of the interview was designed by the research team, and was later reviewed and approved by a multidisciplinary evaluation team from the Research Department of the College of Economics at San Agustín National University in Arequipa. The review department has methodologically structured the instrument with holistic and deterministic social and emotional components, as well as those perceiving and qualifying internal processes of the institutions.

It is imperative to note that the motivation behind this research is the capacity to interpret the CS and operationalize IC in both governmental and private organizations, in order to thus be able to make proposals for improvement and achieve the ultimate objective of making the city of Arequipa a city based on and developed in knowledge. It is expected that the results will allow agent institutions to recognize and strengthen their adaptive capacities, creating within them an agenda of activities in favor of the development of the city, region and country.

4. Operationalization of the IC in the city of Arequipa

In order to determine the process of the operationalization of the IC, in accordance with the delimitation of the present research, it is necessary to rely upon the soundness of the institutions that exist in the city of Arequipa, which have already been mentioned (see Table 2). These institutions have the capacity already installed to identify environmental signals and signs and thus make effective, positive and adaptive use of them in the environment for appropriate decision-making (as illustrated in Figure 3).

These institutions are vitally important, not only because of the responsibility for their functions, but also for their primary role in the construction of the city's development process. In this regard, the exchange of points of view in a collaborative environment among institutions (companies in the private sector and the public sector), is configured as a key aspect for the knowledge, experiences and innovative solutions that are articulated for the benefit of society (Weiss, 2019).

Table 3 includes the list of organizations that have been considered to be the most important for inclusion in this study, since they are those responsible for the promotion, management and evaluation of the policies implemented on a local level, and thus have a greater impact or prominence in the management of city development.

Public and/or private institutions generating knowledge
Regional Government of Arequipa, Provincial Municipalities, Local Municipalities, Judicial Branch, Arequipa Court of Justice and Offices connected to the Ministries
Central Reserve Bank of Peru – BCRP
National Institute of Statistics and Computing – INEI
National Center of Strategic Planning – CEPLAN
National Intelligence Department – DINI
Economic and Social Research Consortium – CIES
National Council on Science, Technology and Technological Innovation – CONCYTEC
National Commission of Aerospace Research and Development – CONIDA
Financial Cooperation for Development (COFIDE)
Research, Development and Innovation Network
Arequipa Chamber of Commerce and Industries
Lima Chamber of Commerce and Industry
Regional public and private universities
Regional technical training institutes and centers

Table 3. Public and/or private institutions generating knowledge

In order to analyze and interpret the development of these capacities or value components in each of the organizations, the research team conducted a total of 93 interviews during the months of March to June 2020 via a website platform with those decision-making agents from the organizations (managers and directors) listed

in Tables 2 and 3. These interviews lasted for approximately 45 minutes and consisted of a dialog between the research team and the interviewees, based on nine questions. The interviews were structured and organized based on three key components that operationalize the Intelligence Capital in the study, according to the following terms:

    i.   The sensitivity of the signals: This is demonstrated by the capacity for adaptation of the individual or organization to society and the dynamic and changing environment.

    ii.   The interpretation of meanings with reference to the value system itself: It refers to the management of knowledge and the understanding of the system.

    iii.   The agility in issuing proper responses to said system: This refers to the operationalization of the IC in its own right.

5. Results

This section presents the extended responses that were obtained in the interviews conducted with decision-makers in the city of Arequipa. First of all, it was considered whether the institutions to which the interviewees belonged demonstrated the capacities or components of intelligence that allow optimal decision-making to occur. The responses gathered indicated that 80% of those interviewed, based on the experience and institutionality over the years, believe that the development of structured institutions was attained with principles of good corporate governance. This was reflected in the implementation of a process structure that allows optimal decision-making, which in turn, has made the evolution of the organizations possible over time, with important participations in different markets and sectors, through the generation and application of strategies linked to objectives aligned with the institutions.

Secondly, questions were asked about the design, development, execution and evaluation and of the processes in the institutions, based on decision-making. 75% of those interviewed expressed the opinion that, thanks to the structure and installed capacity in each of the sectors, the administration or senior management interacted internally with active participation through the development of software that made it possible to qualify the appropriate management of inputs. Also stressed was the importance of training multidisciplinary work teams that regularly get together and are oriented towards managing the institution, the human capital and monitoring, and with evaluation at the start, during and at the end of each process. Likewise, those interviewed assessed the accessibility of software that makes it possible to quantify asset and liability management within an institution, in a coordinated manner with the human team and the available systems. It is then that, internally within the organizations, control exists over the established procedures and the focus is placed on specific processes in knowledge management as a whole, articulating the making of certain optimal decisions.

In their responses, 60% of those interviewed who belonged to administratively independent institutions added that it is important to involve the entire staff in the dynamics of process feedback, which tend to be cross-cutting and one-way. From this, it can be deduced that the coordination, interconnection and articulation of the different areas is necessary, which will make it possible to identify risks and opportunities for improvement at different levels of the organization (managerial, production, administrative, commercial, etc.). This, in turn, implies reformulating the strategy to be implemented, managing a re-engineering of processes, innovation and improvement of products and services (Nonaka, 1991).

As a third matter to be discussed in the interviews, the organizational experience and information were considered as factors for developing IC. 86% of those interviewed indicated that, indeed, information is crucial for carrying out activities in the institution, highlighting the importance of establishing channels that make it possible to monitor and access information generated on a daily basis by the market. This information must not only be accurate and transparent, but also appropriate. For this reason, it is crucial to be constantly attentive to receiving information about events, facts or occurrences that take place in these markets. In order to achieve this objective, the mechanisms of access to relevant information must be considered, as well as the processes for the proper administration of information.

The fourth question dealt with the process identifying external value references. 65% of the responses obtained were aimed at identifying value chains in certain products and services. Another important aspect is the identification of the needs of small micro-entrepreneurs in the region, linked to a production process and a specific reality in the area. Furthermore, the key components must be identified, such as the smart infrastructure and technical staff qualified in the management capacity. A common problem encountered in the responses is the lack of good management on behalf of the public administration. This shortcoming is evidenced by the staff rotation and the lack of training. Both shortcomings are critical in order to ensure proper knowledge management, as they are marked by excessive bureaucracy in administrative proceedings, along with weak values training for most staff members in the public sector.

The fifth question had to do with the processes that are carried out in order to issue a response to the changing dynamics that arise. 72% of the responses indicate the identification of production chains and the analysis of a possible problem in the sector or one that could affect it, which causes the production process to form bottlenecks, or risk distribution methods that evidence the need to appropriately categorize the problem in order to design and implement a strategy that addresses particular needs. Thus the design, development, execution and evaluation of strategies are intended to produce the generation of value that represents minimal exposure to risks for the institution. For example, the risk caused by the magnitude of the quarantine decreed by the Peruvian government in response to the health crisis represented a threat to the entire financial and economic system. But the great problem is how it could have been avoided, and the extent to which the strategies that are designed, developed and executed are those that are necessary to adapt the system, taking into account the articulation of intangible values aligned according to the intelligence capacity of the agents.

The sixth question referred to the fact that, according to the previous question, the agility of appropriate response by the institution was specified. 85% of the responses collected indicated the importance of responding appropriately, which has been a latent problem, due to the existence of uncertainty and risk factors. It is no wonder, then, that the interaction among institutions in Arequipa is a complicated process. It is usually not efficient, due to the lack of a common interpretation of the environment, as well as to the existence of governmental bodies that prolong the process of providing an agile response in the private sector. This has meant the weakness of opportunities in value generation through moderately agile responses from the agents.

Another question up for debate was whether the information managed by each agent develops value based on the knowledge inside and outside the institution. All the responses obtained were affirmative, since the value that they generate allows the company to engage in strategies that identify needs and expectations from a series of external agents. This also makes it possible for support to be provided in areas such as social responsibility, for example, this making it possible to promote certain sectors. Thus the information, as well as the development and application of strategies and policies, permit a multiplicative effect. Their sum total generates value in the city of Arequipa.

The next-to-the-last question considers the qualification of the Intelligence Capacity of the institution. The responses obtained indicate that 65% of those interviewed have a certain level of control over processes, and therefore there are certain factors and capacities that should be improved in terms of resources and systems. It is very important to bridge some gaps and refine internal processes for this type of development, with there being a trade-off between speed of response and good design.

Finally, it was asked whether the institution effectively and positively adapts to change, and in particular, whether it anticipated uncertain phenomena. 70% of those interviewed were of the opinion that the institutions were guided by and evolved according to needs, market development and governmental necessities. The topic of evolution was discussed with reference to the cutting-edge infrastructure of innovation, which permitted the best intelligence capacities to be developed. Globalization and economic development also allowed value to be generated in the agents. However, it is important to stress that the optimal making of agile decisions in the presence of changing events is still a pending challenge that prevents the transformation and reinvention of intelligent processes capable of managing adaptive and optimal responses.

The analysis of the previous responses is revealed in the logical operationalization shown in Figure 5, using the generic structure from Olavarrieta, Carrillo and Rodríguez (2013) proposed at the 6th Global Summit on Knowledge Cities, expressly stating that "intelligent behavior is based on intelligent decisions" (p. 03). Adaptive intelligence includes a decision-making model that codifies knowledge and experience, as well as comprehension of the entire system. Based on this decision-making model, the organization can generate several options for each problem and classify them according to value elements. Each choice can have a different impact on the value elements.

The aim of the decision component is to maximize the creation of value. Therefore, for each decision made, an implementation plan should be developed, requiring a feedback circuit for value alignment. This component is focused on evaluating the entire intelligence cycle, from the definition of value up to the creation of real value. The asset component is connected to the rest of the capitals (knowledge assets) in order to implement decisions.

For the case study in the city of Arequipa, experience and institutionality, the identification of value chains through the sensory component and the interaction of external agents in changing environments have allowed a structure of internal processes to be implemented, as acknowledged by the interviewees, which has constituted the knowledge base. This knowledge base gives decision-making agents the capacity to align value according to an effective and positive process of adaptation, developing for it agile deliberation processes as alternative solutions, in light of the external references that have been identified.

As shown in Figure 5, the procedures are articulated in the consolidation of the IC and in the value-generating capacity in the city of Arequipa. These processes can lead to the city developing as a Knowledge City, if it achieves in the immediate term the synergy of agents and external references, together with processes generating internal value. On that horizon, the physical and virtual environment will provide the most consolidated signals. Thus, the agents with a foundation based on experience and knowledge would need to make deliberated decisions, aligning value and acting with the best operating, deliberation and information management criteria in mind.

As has been evidenced, the framework of CS (Figure 1) is used to identify categories of knowledge assets (i.e., human capital, relational capital, instrumental capital and intelligence capital). Each category has a specific function within the system, Accordingly, IC focuses on collecting information from the environment, detecting it and providing the appropriate response, from which a model of Adaptive Intelligence is derived, which according to the results obtained in the city of Arequipa, has made it possible to identify processes, which are interconnected and generate value.

To construct an Adaptive Intelligence System (Olavarrieta et al., 2013), it is necessary to recognize that the entire system is dynamic. The components of IC are then identified (Figure 2). The value alignment component is related to the strategic vision of the senior management of the organizations. Within this component is a set of capacities that allow the organization to define value and design a strategy to maximize it. One of the most important capacities of this component is the effectiveness with which this change in priorities is communicated, and how the weights of the key performance indicators are adapted to the new context.

Next, the sensory component is defined. This component focuses on the gathering of information from the environment. It is important to identify and select what information is relevant, because effective intelligence is not a matter of the quantity of data, rather their quality. The most important institutions in the environment identified for private institutions are clients and competitors, while for governmental institutions, they are national and foreign companies, policies and international relations, among others. For both, the recognition of the environment and the knowledge of the agent is the most important intangible asset. Developing the sensory component means developing a set of capacities to acquire knowledge from the environment; for the city of Arequipa, two possible sensors were identified: physical and digital.
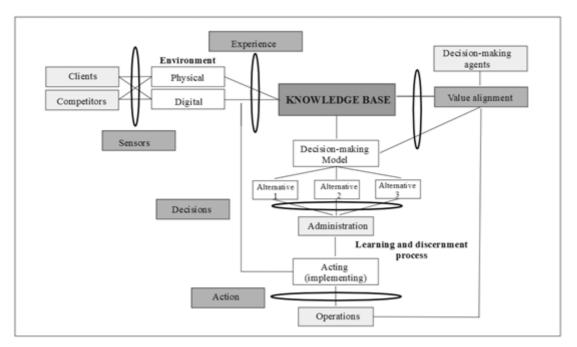
Figure 5. Adaptive Intelligence in the City of Arequipa. Based on Olavarrieta et al. (2013)

The third element is the experience component, which receives the sensory information and stores it in a knowledge base (which is very useful for future recovery), in order to capitalize on previous experiences. This knowledge is codified based on the value alignment component, which means that the experiences are expressed and linked to elements of value.

The fourth element is the decision component, which is understood under the premise that intelligent behavior is based on making intelligent decisions. Adaptive intelligence includes a decision-making model that codifies knowledge and experience, as well as comprehension of the entire system. Based on this decision-making model, the organization can generate several alternatives for action for each problem and classify them according to the value elements. Each choice can have a different impact on the value elements and the aim of the decision component is to maximize the creation of value.

Finally, the fifth element is the action component, which can be defined as the implementation of the decision. For each decision made, an action plan should be developed, and a feedback circuit is required to align the values. This component is focused on evaluating the entire intelligence cycle, from the definition of value up to the creation of real value. The action component is connected to the rest of the capitals (knowledge assets) in order to implement decisions.

6. Conclusions

The IC is one value component of the CS, which provides the capacity to align and adapt, allowing an organization to act as a strategic force in order to articulate the remaining value categories. Since the IC in the city of Arequipa is still in development, optimal social production has not yet been reached. As the scope of the intelligent capacities of organizations within the city is strengthened, knowledge will be gradually capitalized upon, with a marginal positive contribution observed on productivity, which will also positively affect the city's development.

In the specific case of the city of Arequipa, upon measuring the components and capacities of intelligence, using the Integral Intelligence Model as the basis, important capacities were found, based on realities and perspectives, and the design and implementation of processes (internal and external). However, there are still barriers to the identification and optimal processing of the information from the environment, in spite of the fact that the city has components to operationalize them. The existing organizational and institutional capacities must serve as a

referential and articulating support to develop the IC components. This leads to uncertainty and important events or problematic situations potentially being processed in a reasonably agile manner, but issuing responses that are not necessarily effective and adaptive, thus rendering it impossible to operationalize the IC in the city of Arequipa.

This study presents a situational diagnosis of the behavior of the agents in the city of Arequipa, obtaining as a result the level of maturity of its capacities for alignment, the sensory component, experience, decision-making and action, with each of these being important components that must be optimally developed, strengthening the value and social production in this city. In order for this city to be considered a Knowledge City, it must develop intentional strategies with the aim of intensifying the production, transfer and application of knowledge, strengthening intelligence components and attempting to incentivize a collective learning and knowledge management culture among all actors (citizens, public institutions, companies, etc.). In addition, it should be kept in mind that there are different paths to achieve this approach, according to the resources available and the strategic options that are chosen.

There were two main types of limitations found when conducting this study. The first limitations have to do with the structural conditions of the maturity of the knowledge bases with regard to the relevant IC components or capacities. The second refer to the atypical context generated by the disruption of activities and social confinement derived from the COVID-19 pandemic. However, it can be reasonably inferred that the results obtained have not been substantially affected by these circumstances, since both were properly identified and the necessary measures were taken.

It is suggested that further research delve more deeply into several aspects of the model in terms of its characterization, with regard to both the competences of the individual agents and their institutional and developmental capacities. This will permit, in turn, the progressive maturity of the capacity for adaptation of the intelligence processes.

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Appendix: Questions asked during the interviews

According to the three key components mentioned, these contemplated: the sensitivity of the signals, the interpretation of the significances and the agility in issuing a response.

1. Do you believe that the institution you belong to has the intelligence components that allow it to make optimal decisions?

2. How do you design, develop, execute and evaluate the processes based on the intelligent decisions made by your institution?

3. Do you believe that the organizational experience and information are factors when developing the Intelligence Capacity?

4. What processes do you carry out to identify external value references?

5. What are the processes or criteria that you implement to issue a response to the changing dynamics that occur?

6. According to the previous question, could you comment more on the agility of appropriate response by your institution?

7. Do you believe that the information you manage develops value based on the knowledge inside and outside your institution?

8. According to the answers you gave, rate the capacity of your institution according to the following levels:

   a) Initial level: Capacity at an embryonic level, in other words, the capacity has not yet been developed;

   b) Development; Capacity is developed in a deliberate manner;

   c) Administration; Capacity to be operational and under control;

   d) Optimization: Capacity to be fully functional and to systematically improve;

9. According to all the above responses, do you believe that your institution effectively and positively adapts to changes, and in particular, anticipates uncertain phenomena?