

A knowledge management framework
for institutional research

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Abstract

This chapter presents a new conceptual framework of *Institutional Research* (IR). The framework refines previously studied dimensions of IR and integrates them into the higher order concept of knowledge management. Previously studied dimensions of IR were the institution's organizational sectors (e.g., Academic, Human Resources), the functions for which information is used (e.g., Operations, Strategic Management), and the resources supporting IR (e.g., Technology, Funding). The framework innovates by specifying what competencies are required to carry out IR activities and how to assign a level of development to each competency. This operationalization permits the creation of an assessment tool enabling us to move from general and intuitive statements about development to specific and behavioural levels which are actionable. The framework formulation was validated with a group of IR experts in Chile. The framework can be used to assess one institution, to compare an institution to a peer group, or to compare groups of institutions at the regional, national or international levels.

Introduction

An important mission of higher education worldwide is pushing back the current limits of knowledge through scholarly activities and research. Research about higher education itself studies a wide range of political, economic, social, and technological issues employing a variety of methodologies, and includes topics such as teaching, learning, course design, student experience, education quality, system policy, institutional management, and academic work (Tight, 2012).

Higher education research is generally conducted by specialists from various disciplines who have research as part of their academic or professional duties (Teichler, 2000; Altbach, 2014). However, there is a distinctive subgroup of researchers investigating higher education topics in the service of an institution's management (Teichler, 2014). These specialists convert data into information and communicate their analysis throughout the institution. As such, institutional research, sits at the junction of research and knowledge management.

This chapter is about refining our understanding of the nature of institutional research as it relates to the institution it serves and to the national system in which it operates. It is also about assessing the quality of IR

in a continuous development perspective. The focus is on the concepts and dimensions defining IR in a manner that can not only further our understanding but can also be used to measure and improve IR development.

The conceptual framework elaborated here is strongly influenced by the authors' direct experience in the Canadian context and by the vast literature available about IR in the United States. Nevertheless, a concerted effort has been devoted to create a modular system that can adapt to varying regional and national contexts via the relative emphasis placed on some of the functions. The framework is resilient to jurisdictional differences in historical, social and political factors modulating IR (Webber & Calderon, 2015) which is demonstrated by the reported validation and applicability in Chile.

Objectives

The main objective of the chapter is to present a developmental framework for IR and its potential uses. This work contributes to a theory of IR in that it delineates general principles to structure what is being studied. The framework articulates what are the main dimensions of IR (e.g., organizational sector, functions, resources and competencies) and identifies and defines the constitutive

elements of each dimension. The concepts provide the basis for a common language used to conduct empirical studies, to facilitate communication among scholars, and to understand the logic and performance of IR across a wide variety of competencies, content areas, and purposes.

The motivation to develop this framework was to organize and complement the existing concepts on the nature of IR in a more structured fashion, keeping the dimensions separate from one another before proceeding to assessment. In addition, a definition of the elements of quality of IR was required to evaluate their presence or absence. Finally, since high quality does not tend to appear fully formed but rather develops gradually, these developmental steps were also specified.

The validation process for the framework elements and its measuring instrument was accomplished using the Delphi approach in electronic format. This method brings together experts in a given field to discuss a topic with a view to build consensus. In this study, we gathered the expertise of a group of IR directors by first presenting them with initial written descriptions of the framework's concepts, and letting the experts discuss the appropriateness, completeness and/or limitations of these initial descriptions. In a second round, modified descriptions - to

take their comments into consideration - are submitted to the group for further comments. The discussion rounds continue iteratively until consensus is reached.

The Purpose of Institutional Research

Reichard (2012, p.3) traces the origins of the label *Institutional Research* in "(1) self-studies conducted on an ad hoc basis by individual institutions interested in investigating issues pertaining to their unique circumstances; (2) surveys conducted by external groups or associations across institutions; and (3) the establishment of specialized research committees, bureaus, or research-oriented offices in large public universities charged with investigating relevant issues on an ongoing basis". Certainly, the incorporation of the Association for Institutional Research (AIR) as a non-profit organisation in 1966 sealed the expression.

The practice of IR is now a recognized professional activity in the United States and in Canada (Howard, McLaughlin, Knight, and Associates, 2012) with corresponding professional associations, AIR and the Canadian Institutional Research and Planning Association (CIRPA). It is also present in Australia, the United

Kingdom, and European countries and growing in other regions (Calderon & Webber, 2015).

A widely-accepted definition of IR (Calderon & Webber, 2015; Howard et al, 2012) was proposed by Saupe (1990) and encapsulated the *nature and purpose* of IR with the statement: "Institutional research is research conducted within an institution of higher education to provide information which supports institutional planning, policy formation and decision making" (p. 1). The statement emphasizes the purpose (planning, policy formation and decision-making) but is essentially tautological about the nature of IR (... research is research...). Saupe's IR activities - the research - involve gathering quantitative and qualitative information about, for example, tuition, attrition, salaries, programs, student outcomes, enrolment projections, students' attitudes and opinions, alumni, the labour market, impacts of policy changes, operating costs, space utilisation, and reporting to government and all stakeholders, among others.

Which data gets collected and analysed depends on the question researched and its purpose. The main purposes identified in the definition statement are to provide information supporting: (1) institutional planning, (2) policy formation, and (3) decision making. The distinction

between the information itself and the purpose for which the information is gathered and managed is central to a clear understanding of IR. The same information (readily available or newly created) can be used to inform different objectives. Therefore, we will have a better understanding of the scope of IR activity and its role by separating the data itself from its use.

In addition to considering what are the various IR activities and why they are being carried out, Terenzini (1993, 2013) analyzed the skills required for institutional researchers to perform their duties. Terenzini (1993) conceptualized institutional research as comprising three tiers of organizational intelligence. The first tier consists of technical and *analytical intelligence*, requiring familiarity with basic analytical processes. The second tier consists of *issues intelligence* and requires knowledge of substantive institutional management in four areas: students, faculty, finances, and facilities. The third tier consists of *contextual intelligence*, requiring an understanding of the history and culture of higher education in general and of the campus on which one works. In 2013, Terenzini added to the identified skills the need to adapt to the rapid progress in information technologies; to be more aware and responsive to the changing regional,

national, and international educational and political scenes; to be more familiar with the research literature; and to possess subtler and more savvy political skills.

Saupe's identification of clear purpose coupled with Terenzini's intelligence levels highlight that IR analysts cannot simply aggregate numbers into tables; they must know why these numbers are needed and handle their potential impact inside and outside the institution. Thus, a solid understanding of IR requires a multi-dimensional approach in terms of information acquisition, management and communication.

Information management and developmental models for IR

Higher education institutions continuously face multiple priorities in an environment of limited financial and human resources (Goldstein, 2005). For example, internal institutional management processes as well as the demands from regulatory external agencies for accreditation and quality assurance require more and more information to measure and evaluate the efficacy of institutions (Goldstein, 2005). This evolution has been significantly influenced by the *New Public Management* (NPM), which attempts to increase the efficacy and efficiency of the public sector (Osborne & Gaebler, 1992) and which has

contributed to the institutionalisation of results-based management and accountability (Alexander, 2000; El-Khawas, 2007).

The accountability demands of the NPM movement, among other pressures, have been a driving force for the interest to obtain more and better information to contribute to an institution's decision-making. The focus to support decision-making based on the extensive use of data, and statistical and quantitative analysis to improve individual and organizational performance in higher education institutions, particularly when referring to academic management, is often referred to as *academic analytics* (Bichsel, 2012).

Although technological advances have made large amounts of data more readily available in digital form, academic analytics, accountability requirements and evolving technological infrastructures have placed greater demands on IR offices to produce information and on the institutions to introduce better and more performing information systems. It is in the context of technology and information systems that developmental models (sometimes called "maturity" models) were first introduced to evaluate the organizational capabilities of an institution (Röglinger, Pöppelbuß, & Becker, 2012). Maturity models stem

from the work done by the *Carnegie Mellon Software Engineering Institute* for the development of a model of software capabilities and are currently widely used to understand the implementation of a particular information technology (IT) or the implementation of business processes associated with IT. Gartner Inc. (www.gartner.com), for instance, is a leader in the development of such models.

In these models, maturity is defined as having reached a complete state of development. The maturity of a process may also be defined as a set of capabilities, i.e., competencies, that are required for a process to be excellent (Van Looy, De Backer, & Poels, 2011). To achieve this status, maturity models propose a series of levels or stages showing the anticipated path (Röglinger et al., 2012). Two primary objectives of maturity models are highlighted: (1) to provide information with which to demonstrate to stakeholders the value of moving towards the next stage of maturity, and (2) to provide a point of reference for any further assessment of a change in the level of maturity (Taylor, Hanlon, & Yorke, 2013).

Regarding maturity models and the levels of advancement of IR activities, earlier contributions emphasize technological infrastructure and the development of computerized administrative data systems (Goldstein,

2005), or focus on the complexity of analysis - from static reports to advanced predictions or optimizations (Goldstein, 2005; Davenport & Harris, 2007; Norris & Baer, 2013).

Norris & Baer (2013) add to maturity models, indicating that organizational capacity is a determinant of the success and the effectiveness of information management processes. To achieve a solid organizational capacity, the authors identify the following: (1) a good technological infrastructure, (2) clearly established workflow processes, (3) organizational behavior fostering a culture of performance and decision-making based on evidence, (4) the skills and values necessary to use the tools available in an atmosphere of receptivity to change, (5) a clear commitment from senior management to invest in tools, solutions, and practices, as well as in the change in organizational behavior.

Technological infrastructure and organizational capacity are just some of the requirements needed to support a good information management approach. Measuring advancement via the capacity of the IR unit is the approach behind the AIR surveys. In this approach, the relative maturity of an IR unit is assumed to relate to its location in the structure of the organization, on the number and

years of experience of its employees, and on the level of studies of the head of the unit and the staff. The expectation is that more advanced IR units report directly to senior management and that they have experienced staff with advanced degrees (Volkwein, 2008; Volkwein et al., 2012). This approach infers maturity from its inputs and does not measure it directly.

Focusing on functions, Volkwein et al. (2012) classify activities based on two factors: (i) their degree of complexity, and (ii) the degree of centralization in an IR unit. Using a rating system, the multiplication of complexity by centralization indicates the maturity of the activity undertaken. It is found that IR units with a greater degree of maturity tend to engage in activities with a more complex analytical character (Volkwein et al., 2012).

In a more recent study, Swing, Jones, & Ross (2016) confirm the great diversity of IR responsibilities. However, their results indicate that the impact of IR on the institution is not clearly related to IR capacity. The authors suggest that this variance could be explained by the extent to which the management style of the IR head, and the degree of comfort of senior management with the use of information for decision-making and the organizational

culture, have an influence on the working relationship between IR and other services, on whether the IR work is trusted, and on the ability of an IR office to influence decision making.

Taking a broader look at resources in general, the *EDUCAUSE Center for Analytics and Research* (ECAR) launched a study to understand what are the drivers of academic analytics (Bichsel, 2012). The following main contributors were identified:

- Culture/Process, that is, senior leaders are committed to using data to make decisions;
- Data/Reporting/Tools, that is, having clean and standardized data of the right quality;
- Investment or appropriate funding;
- Expertise, represented by specialized and skilled professionals; and
- Governance/Infrastructure, involving information security policies and practices.

Using a survey to characterize each of the aforementioned factors, a maturity score can be calculated for each. Since 2015, EDUCAUSE has integrated the work on maturity indices into a benchmarking service, that provides institutions

with a sense of their advancement in each of the five factors.

IR activities and their development, however, are not dependent only on resources. As mentioned before, the purpose of the information produced – its function – is fundamental in the understanding of IR's work. Taylor et al. (2013) propose a more advanced model that combines organizational intelligence levels (Terenzini, 1993) and IR functions (Volkwein, 1999, 2008, 2010) with levels of advancement. Five IR functions are identified (i.e., routine institutional management, strategy formulation, quality assurance and improvement, marketing/ competitive analysis, and independent research), and each is assigned a maturity level.

Despite being a very elaborate model, one of the difficulties with the operationalization of Taylor et al.'s (2013) approach is a certain confusion of variables since the concepts of outputs, resources and business processes are used to characterize the stages of maturity, without being clearly distinguished. In addition, when identifying a sub-function (such as report production under institutional management), it is not systematically defined at each level of maturity. Also, an expansion in the scope of work, i.e., starting with a focus on students but

expanding to include other topics, such as human resources or research, is also deemed a determinant of maturity level without considering that the area of interest may vary depending on the function.

A new knowledge management framework for IR

The models presented above focus on resources, IR functions, technological infrastructure, the depth of analysis, or a combination of factors. Given that each of these dimensions is important, these models can be considered complementary. Yet, none of the models is built accounting for all the dimensions, nor do they always define each of the levels of maturity in a measurable manner. In order to consider all the dimensions and to offer a measurement approach, Díaz, Mercier and Pinsent (2016) proposed a new framework to define IR and to assess its level of development. Yet, following Taylor et al. (2013), our model is not intended to provide an ideal development path but rather to help assess the different patterns of development and of scope of work.

The framework (Figure 1) considers the organizational sectors of work (e.g., Academic, Human Resources), the functions or purposes for the information (e.g., Operations, Strategic Management) and the available

resources (e.g., Technological Infrastructure, Funding). The framework does not explicitly indicate who uses the information because of the great diversity in the organizational structures of institutions. Information use is captured through the functions, as this approach allows to standardize the analysis for different types of institutions.

Regarding resources and their relationship to IR's mission, the framework purports that the appropriateness of resources is determined by whether an activity is predicated on the basis of the institution's chosen mission and functions, and on what resources are required to accomplish the necessary tasks efficiently.

The current version of the framework is more refined than the one initially proposed by Díaz, Mercier and Pinsent (2016). It was improved based on a validation exercise conducted in Chile, on the occasion of a research contract with the *Ministerio de Educación* to analyze information use at accredited higher education institutions nation wide (details on the validation process are presented below). This validation process allowed for a refinement of the definitions and for clarification of what each involves. It also permitted the identification of resources that had not been originally included. For

instance, during the validation, an expert mentioned that the concept of quality of information as defined by appropriateness of content, timeliness, accessibility and accuracy was not mentioned in the framework. Thus, quality of information was added as an element of the resource/factor dimension.

The definitions of each dimension and their elements are presented in Tables 1, 2 and 3, as well as the number of experts agreeing with the elements at the end of the final round of validation. Overall, all 11 experts agreed with the four dimensions of the framework. The vast majority (9 to 11) expressed agreement with the final definitions for each element.

In addition to those three dimensions, the framework introduces the concept of *competencies*. It proposes that what matters in IR is not so much the specific activities (e.g. counting graduations, tabulating average salaries, identifying the determinants of students' motivation) but the competencies required to perform the duties. The competencies are the capability to apply or use a set of related knowledge, skills, and abilities required to successfully perform critical work functions or tasks in a defined work setting (Bloom, 1956-1964). The IR

competencies and their definitions are presented in Table 4.

With the four dimensions clearly defined, the framework has the basis to establish what conditions should be in place to determine an IR unit's level of development. The following conditions are identified:

- Development increases with the number of organizational sectors on which data is produced (i.e., breadth of content);
- Development increases with the number of functions for which data is produced (i.e., breadth of use);
- Development increases with the advancement achieved in each of the competencies (i.e., depth);
- There is no level of development associated with the resources; rather, these work as modulators.

The analysis of depth in the competencies is guided by the approach set forth by the *American Productivity and Quality Center (APQC, Hubert & Lemons, 2015)* to study knowledge management. The APQC's approach is extremely relevant and useful to understanding the advancement of IR for three reasons. First, there is the core concept of

knowledge management, defined as “a collection of systematic approaches to help information and knowledge flow to and between the right people at the right time (in the right format at the right cost) so they can act more efficiently and effectively to create value for the organization” (APQC, 2017, p.1). This concept provides the proper level of abstraction to characterize IR in relation to its purpose rather than to the inventory of its activities/information. Second, the APQC specifically aims to study knowledge management as a process that evolves over several stages. Third, the APQC has already operationalized the different stages or development levels in a manner that can guide the creation of an assessment tool. We are capitalizing on the APQC to gain understanding and diagnostic capacity regarding the specific case of IR, enabling us to move from intuitive and general statements about IR development to behavioural and specific descriptions that become actionable.

Five levels of advancement are identified in the APQC approach.

Stage 1: Initiate. At this stage, the compilation, production, analysis and dissemination of information and knowledge occurs in an ad hoc manner, resulting in a

reduced impact on the functions and organizational performance.

Stage 2: Develop. At this stage, the organization establishes the first actions of a knowledge management strategy, which must be intimately linked to the overall strategic objectives of the organization. The processes and procedures that are implemented need to be documented to make them repeatable. This ability to replicate is the most important characteristic of this stage.

Stage 3: Standardization. The practices and processes identified in the previous stage begin to be used more comprehensively. Standardization is important because it allows the organization to benefit from economies of scale, to learn from experience, to establish common performance measures, and to emphasize the development of competencies which can be adapted to different circumstances. At this stage, there is also a clear appearance of teamwork and collaboration.

Stage 4: Optimization. At this stage the organization leverages the processes and approaches already standardized, and adapts them to all sectors of the organization. The emphasis is on the search for mechanisms to optimize the activities which have been made repeatable and standardized.

Stage 5: Innovation. Because of the standardization and optimization from the previous stages, resulting in effective and efficient work, resources can now be released to invest in innovation. The innovation relates to the acquisition of new information or to the analysis of existing information in new ways to answer questions that still have not been addressed or resolved.

This framework offers a definition of the level of development for each competency, characterized in the form of descriptive statements. These statements are the basis of a questionnaire - the objective measurement tool used to determine the level of development attained - which assigns a level of development to each competency in each organizational sector. As an example, the statements describing the levels of development of the competency *Designing reports* are presented in Table 5. The statements describing each of the competencies were presented for validation to the group of experts, with the vast majority (89% to 100%) agreeing to the final version of the descriptors, as illustrated in Table 4. Table 7 presents examples of the levels of development for a few competencies in a matrix format to help visualize how the parts combine. It also clarifies how this conceptual framework aligns with and builds upon Terenzini's levels of

intelligence, while allowing for a diagnosis of the advancement of IR at a more granular level. For instance, descriptions of the levels of development for the competency *Analyze Data* dovetail with Terenzini's first tier of intelligence where technical and analytical skills range from basic to very advanced. An advantage of the framework is that the levels of development within analytical intelligence are more fine grained: the different analytical skills required are clearly identified and their levels of development are described in more detail with operational descriptions of each. This information would allow an IR Director to more specifically diagnose the current status of each competency and to identify what actions would be required for further development, resulting in greater overall analytical intelligence.

The assessment of competency development separately for each organizational sector corresponds to Terenzini's issues intelligence. Greater levels of advancement in different organizational sectors directly feed the IR office's knowledge of distinct institutional management areas. Furthermore, the framework explicitly combines analytical intelligence with issues intelligence, as the

levels of development of the competency are embedded within the organizational sectors.

Finally, Terenzini's third tier of intelligence corresponding to more political savvy in the conduct of IR is reflected in the framework's treatment of the functions of IR. Compiling, creating or analyzing data to inform strategic management and planning, institutional positioning, or relations with groups of interest, require much more social-environmental sensitivity than similar activities to inform internal operations or quality assurance. In that sense, the greater and more complex the functions that are addressed by the IR office, the greater its need for contextual intelligence.

The questionnaire resulting from the framework also offers a description of each of the resources in the form of a series of statements, so their presence or absence can be assessed. An example of such statements for the resource *Organizational culture* is presented in Table 6. The descriptive statements for all competencies and resources were validated with the team of experts as described below. The extent of agreement regarding the statements associated with the resources is documented in Table 3.

Framework validation

The IR framework was validated in the eyes of a group of experts, to ensure its applicability to the reality of higher education in Chile. The instrument to quantify the level of development of IR competencies was also validated at the same occasion.

Eleven directors of IR from Chilean higher education institutions were invited to participate. These were selected to ensure both an adequate distribution by type of institution (state universities, traditional private universities, other private universities, professional institutes and technical training centers) and by geographical location (metropolitan area, north, south and central Chile). The validation was performed using the *Calibrum™* platform implementing the eDelphi method. This platform allowed the experts to provide their input without revealing their identity to the other participants and to participate from their location.

Following the Delphi approach, the validation proceeded in stages and in rounds within stages. The first stage served to validate the organizational sectors and the functions. The second stage served to validate the resources/factors, the competencies, the levels of development, and the statements depicting concretely

situations and behaviours characteristic of each level of development. The number of rounds within each stage was an iterative process where modifications to the texts were made based on initial comments and re-examined by the experts. The discussion was finalized once consensus was achieved.

Application of the framework to measure development

The framework is the basis of a questionnaire identifying the organizational sectors and functions for which information is produced and, using the statements about competencies and resources, provides an assessment of the current level of development in an institution. Using the questionnaire, a director of IR can validate whether or not each of the statements is true at their institution thus identifying a level of development from initiation to innovation.

The compiled data can be summarized for each sector and presented in a radar chart as in Figure 2. In this fictitious example, the IR unit has reached a level of standardization for the *Designing reports* competency in the Academic sector, meaning that the highest statement reported as true was that they use common definitions for the variables of interest. The highest statement reported

as true on average by the peer group is that they develop reports containing original content, possibly targeting new audiences, indicating that they even innovate.

The level of development can also be added across sectors to produce a single development index per institution. However, given that institutions will focus on different sectors and functions depending on their mission and priorities, the presentation of results focusing on the levels achieved by sector is encouraged.

If data from peer institutions has been collected, benchmarking becomes possible. When the performance deviates from the group, one can identify the main sources of deviation by returning to the statements describing each competency and decide on corrective actions if necessary. A similar exercise could be done by function.

This is a comprehensive framework which can capture the resulting situations widely despite jurisdictional differences in historical, social and political factors that modulate IR (Webber and Calderon, 2015). Although there are differences in the contexts in which IR has emerged, there are commonalities across jurisdictions regarding the activities, competencies, sectors, and functions of IR, all of which are captured in the proposed conceptual framework. Not all countries are involved in all

aspects of IR and the extent of involvement in any given aspect varies; there are also variations observed within countries. The framework can capture this diversity by identifying the level of development of competencies, and the different organizational sectors and functions for which IR produces information. In the end, the framework offers a comprehensive definition of all that is IR while recognizing that the actualization of IR does not always include all the possible components due to variations in institutional choices, resource availability, or social-environmental influences.

Conclusion

This new framework for IR presents several advantages.

First, it incorporates the different dimensions of IR in a comprehensive unit while keeping them separate from one another to avoid confounding.

Second, it adds a new dimension specifying what competencies are required to carry out the activities of IR instead of relying on a detailed inventory of the activities themselves. This higher level of abstraction of the competencies dimension is more synthetic, more comprehensive, and more resilient to environmental changes making some activities come and go.

Third, the framework clarifies how the competencies can exist at different levels of development in accordance with the concept of knowledge management. This provides specificity and measurability. The framework specifies that exercising competencies in more sectors and for more functions also represents further development because each addition entails a more comprehensive expertise. While sectoral development can be treated as additive because the competencies are evaluated for each, it is currently unclear how to treat the multiplicity of functions in a quantitative manner because there is overlap of competencies and sectoral content across functions. This is the subject of future work.

A fourth advantage of the framework is that it enables comparisons of individual institutions to peer groups, across types of institutions, and at regional or international levels.

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Figure 1. A knowledge management framework for IR

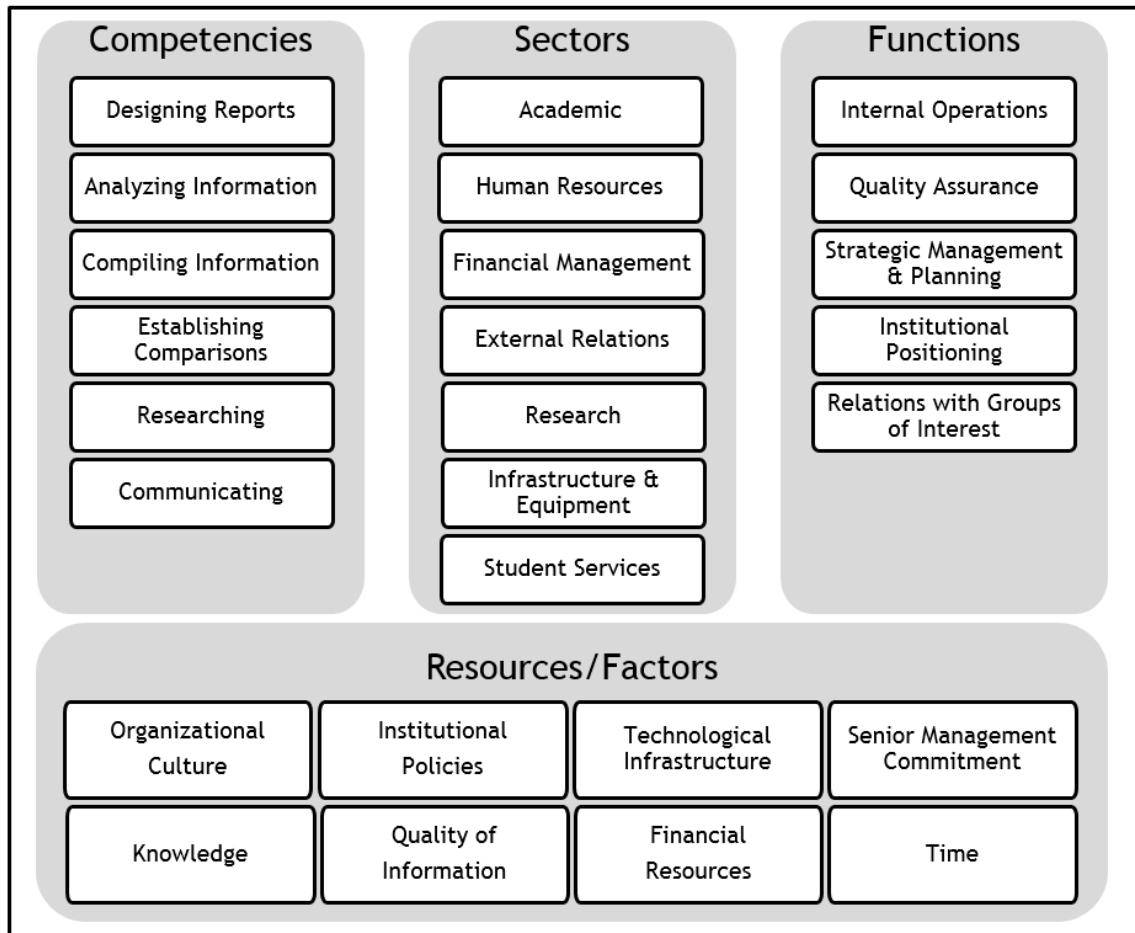


Table 1. Definitions for the organizational sectors and validation ratings

| Organizational Sector | Definition | Number of experts who agree with definition | | |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--------------|--------------|
| | | Strongly Agree | Agree | Total |
| Academic sector | Includes information on undergraduate and graduate students, such as the income profile (e.g., type of school, socio-economic characteristics prior to entrance, demographic information), admission (e.g., admission average, academic career prior to admission, application and selection), adaptation programs (e.g., diagnostic and remedial enrollment, attrition, academic achievement (e.g., attendance, qualifications) and obtaining the degree (e.g., graduation, time to graduate). | 6 | 5 | 11/11 |
| Human resources | Includes information about faculty (e.g., academic degree, training and development, career and professional activities, performance and its evaluation, academic rank or categorization, career path, work plans (hours devoted to teaching, research, extension and management), recruitment, | 8 | 3 | 11/11 |

| Organizational Sector | Definition | Number of experts who agree with definition | | |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total |
| | wages and benefits) as well as about the staff, such as managers, professionals, administrators and technicians (e.g. career path, hiring, salaries). It also includes information on the satisfaction of staff (surveys). | | | |
| Financial management | Includes information on budgets and budgetary control, program costing, financial statements, income sources, accounting, medium and long term financial assessments, projections of revenues and expenses, management of strategic projects as well as other financial information of the institution. | 9 | 2 | 11/11 |
| External relations | Includes all information about activities involving the community or through which the institution contributes to society, as well as all information contributing to the analysis and understanding of its environment. It also includes information on relations | 5 | 6 | 11/11 |

| Organizational Sector | Definition | Number of experts who agree with definition | | |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total |
| | between the institution and other organizations (partnerships and relations with the government, relationship with accreditation agencies, relations with the media), linkages with the production sector (private or public undertakings, employers), international relations, relations with other institutions (other higher education or secondary schools), follow-up of alumni (job placement, surveys) as well as academic, cultural and sports extensions, continuing education and social services. | | | |
| Research | Includes both academic and applied research, as well as innovation and experimental development activities. Information on research projects, internal funding, public or private funding, research centres and research products is considered (e.g., publications, patents, enterprises or | 8 | 3 | 11/11 |

| Organizational Sector | Definition | Number of experts who agree with definition | | |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total |
| | other relevant products that enable the dissemination of knowledge). | | | |
| Infrastructure and equipment | Includes information about facilities (rooms, laboratories, workshops or other specialized learning rooms, green spaces, sports or cultural areas), availability, habitability and ease of access of the facilities, the library (collection, access, computers), the technological infrastructure (information systems that support the management of data, infrastructure for distance education or other practical activities, bandwidth) as well as information about the equipment to support teaching, research, or other functions (availability, quality). | 6 | 5 | 11/11 |
| Student services | Includes information on scholarships (internal or external, distribution of funds), co- and extra-curricular activities (sports, social, cultural), academic support services (peer students, psychoeducational support) | 7 | 4 | 11/11 |

| Organizational Sector | Definition | Number of experts who agree with definition | | |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total |
| | food services, other services to students (funds for student entrepreneurship, clubs and organizations) as well as student surveys (satisfaction, participation). | | | |

Table 2. Definitions for the functions and validation ratings

| Organizational Sector | Definition | % experts who agree with definition | | |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total |
| Internal operations | Refers to information used in the operational management of the institution, both administrative and academic, including management of application, registration and graduation activities. It also includes management of personnel and resources, and other activities that contribute to management control. | 7 | 4 | 11/11 |
| Quality assurance | Refers to information used for internal activities of quality management (processes of self-evaluation, evaluation of academic programs, evaluation of academics), continuous improvement processes and external evaluations (accreditation that covers topics such as academic and institutional management), as well as any measurement of the impact of quality assurance processes. | 6 | 5 | 11/11 |
| Strategic management and planning | Refers to information used for strategic management and planning such as scorecards, organizational goals and performance indicators. | 9 | 2 | 11/11 |

| Organizational Sector | Definition | % experts who agree with definition | | |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total |
| Institutional positioning | Refers to information about the relevance of the institution's academic offer with respect to the needs of the country (at the level of programs and institutional accreditation), to the status of demand and to changes in supply and demand over time. It also includes information on the institution's comparative status with peers, obtained through benchmarking and networking exercises, among others. | 8 | 3 | 11/11 |
| Relations with groups of interest | Refers to information used for relations with the environment (government, accreditation agencies, media), with the production sector (private or public undertakings, employers), with other educational institutions, with alumni, as well as to internationalization activities. It also includes all the activities involving interaction with the community, such as academic and cultural extension, continuing education, social service. | 5 | 4 | 9/11 |

Table 3. Definitions for the resources and validation ratings of both definitions and descriptive statements used in the measurement tool.

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| Organizational culture | Organizational culture contributes to information management if it harnesses its power, fosters a culture of performance evaluation, and encourages transparent decision-making where evidence is taken into consideration and analyzed in accordance with the reality of the decision which must be taken. Once the production of reports to meet regulatory requirements has been accomplished, the institutions are encouraged to prioritize | 5 | 5 | 10/10 | 2 | 8 | 10/11 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | the production of additional reports that contribute to the improvement of their performance and decision-making. It is also a responsibility of staff at all organisational levels to promote a culture of evidence. | | | | | | |
| Institutional policies | Policies are an important facilitator of IR. Even when a lot of excellent information is available, it cannot be leveraged if the institution does not have established processes and workflows such that the knowledge generated in the institution can be fully used. Workflow leverage permit that required | 9 | 2 | 11/11 | 3 | 6 | 9/10 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | actions and interventions be identified in time, which allows for adjustments to be made with minimal lags or risks. | | | | | | |
| Technological infrastructure | The characteristics of the available technological infrastructure, as well as the tools and applications of different levels of complexity, are decisive for the availability of information. The objective is to develop and acquire the technological tools to increase the complexity of the information available, either with | 10 | 1 | 11/11 | 5 | 4 | 9/10 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | regard to the sophistication of the analysis or with respect to the integration of different areas of interest in a more comprehensive view. | | | | | | |
| Senior management commitment | Senior management commitment is crucial since it ensures organizational alignment to invest in practices, solutions and tools, as well as facilitating the required changes in organizational behavior to promote information management for decision-making. | 7 | 3 | 10/11 | 5 | 5 | 10/10 |
| Knowledge | Knowledge refers to the characteristics of the staff who both participate in the | 6 | 4 | 10/10 | 5 | 5 | 10/10 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | <p>decision-making based on information and in the creation of this information. Depending on the area of responsibility, staff must have the experience and skills required to participate actively in the information management process. They must have a clear understanding of the information with which to work and its interpretation. In addition, to incorporate this information in decision-making, staff requires corporate knowledge as well as experience in the main</p> | | | | | | |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | processes in higher education. | | | | | | |
| Quality of information | Quality of information refers to the institution's ability to access reliable, relevant and timely information for decision-making. It is also having the necessary processes to ensure its accuracy and veracity. | 9 | 1 | 10/10 | 5 | 4 | 9/10 |
| Financial resources | Financial resources refers to the financial support required to support a culture of evidence, including a commitment to making the necessary investments in the long term. Financial resources are dedicated not only to the | 5 | 5 | 10/10 | 4 | 6 | 10/10 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | implementation of appropriate databases and information systems, but also to the provision of training for staff so that they can use data to make decisions appropriately. Also, it is necessary to have the resources to adequately address equipment and software obsolescence. | | | | | | |
| Time | Time an important element in the evolution of information management activities and a potential explanatory factor of development. For example, a recently created institution or one where resources have only recently been dedicated to information | 7 | 2 | 9/10 | 2 | 5 | 7/9 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with instrument | | |
|-----------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | management can only manifest an emergent level of development. As such, time is a control factor in the analysis of IR. | | | | | | |

Table 4. Definitions for the competencies and validation ratings of both definitions and descriptive statements used in the measurement tool.

| Resources | Definition | % experts who agree with definition | | | % experts who agree with statements | | |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| Designing reports | It is defined as the ability to create and produce reports from a basic level with static data on individual organizational areas, evolving to the production of reports with pre-established procedures, and culminating in the creation of reports on data that had not occurred previously. As IR advances, there is a progression to facilitate self-directed access to the data and to user-friendly designs and visualizations that facilitate understanding of the information. | 6 | 3 | 9/9 | 6 | 3 | 9/9 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with statements | | |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| Analyzing information | It is defined as the ability to analyze data using quantitative or qualitative methodologies, which allows to describe a situation, to make comparisons or, at a more advanced level, to develop models (explanatory or predictive), of institutional phenomena, in order to contribute to the resolution of problems. The ability of analysis is usually related to team work, and the knowledge and experience of the participants. | 5 | 4 | 9/9 | 3 | 6 | 9/9 |
| Compiling information | It consists of the different skills needed to get the information necessary to prepare reports or studies. It includes the collection of data from surveys of | 4 | 5 | 9/9 | 3 | 5 | 8/9 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with statements | | |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | different interest groups (ranging from a basic level where the IR professional keeps abreast of the existence of certain surveys, through the participation in ongoing surveys, and culminating in the elaboration and implementation of new instruments if necessary), the collection of data with other qualitative methods (focus groups, key informant interviews), or extracting data from administrative databases. Data from the host institutions or from other organizations may be compiled. | | | | | | |
| Benchmarking | It consists in identifying ways to measure and compare the performance of different | 4 | 5 | 9/9 | 5 | 3 | 8/9 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with statements | | |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | institutions using consistent criteria of comparison. It is a distinctive competency given that it requires the compilation of external data not always pre-structured for comparisons purposes. It starts with a basic level of simple awareness of the existence of this type of processes, through the implementation of existing studies, culminating in the development of new benchmarking initiatives. It can also refer to groups of institutions that wish to compare among themselves and excludes external rankings. | | | | | | |
| Researching | Includes the development of academic and/or applied research skills. It seeks the development of innovative | 3 | 5 | 8/9 | 3 | 5 | 8/9 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with statements | | |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | studies that generate new knowledge or generate innovative solutions to practical problems. It can refer both to the improvement and innovation of educational practices at the institution, as well as to academic studies, presented at conferences or submitted to peer reviewed publications. The emphasis is not on repeating existing practices, but rather on innovating. | | | | | | |
| Communicating | It facilitates the use of the knowledge generated. At the most basic level, communication is reactive in providing basic information when it is requested. The competency evolves to a proactive level of distributing timely | 5 | 3 | 8/8 | 5 | 4 | 9/9 |

| Resources | Definition | % experts who agree with definition | | | % experts who agree with statements | | |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------|-------|-------------------------------------|-------|-------|
| | | Strongly Agree | Agree | Total | Strongly Agree | Agree | Total |
| | <p>information on an ongoing basis. Communication skills includes the ability to identify the audience as well as the purpose of reports/studies to take them into account in the communication design. Eventually, it seeks to open new channels of communication, to reach different audiences and to generate greater impact.</p> | | | | | | |

**Table 5: Levels of development and descriptive statements
for the Competency *Designing Reports***

| Level | Statement |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-Initiate | <ul style="list-style-type: none"> • The majority of reports are produced on request. • Most of the reports that are produced contain information about a single organizational sector. |
| 2-Develop | <ul style="list-style-type: none"> • There are established processes to produce repeatable reports, continuously. |
| 3-Standardization | <ul style="list-style-type: none"> • The majority of the reports are standardized in terms of content (common definitions, clearly identified audiences). • The use of common definitions for the variables of interest allows the integration of various organizational sectors in the reports. |
| 4-Optimization | <ul style="list-style-type: none"> • Most the reports are produced according to a pre-set schedule. • The production of most reports has been standardized. • Users can have access to reports via interfaces with self-service capabilities. • Most reports allow the possibility of obtaining details (drill-through). |
| 5-Innovation | <ul style="list-style-type: none"> • Developing reports that contain original content and which are directed to new audiences. |

Table 6: Descriptive statements for the resource

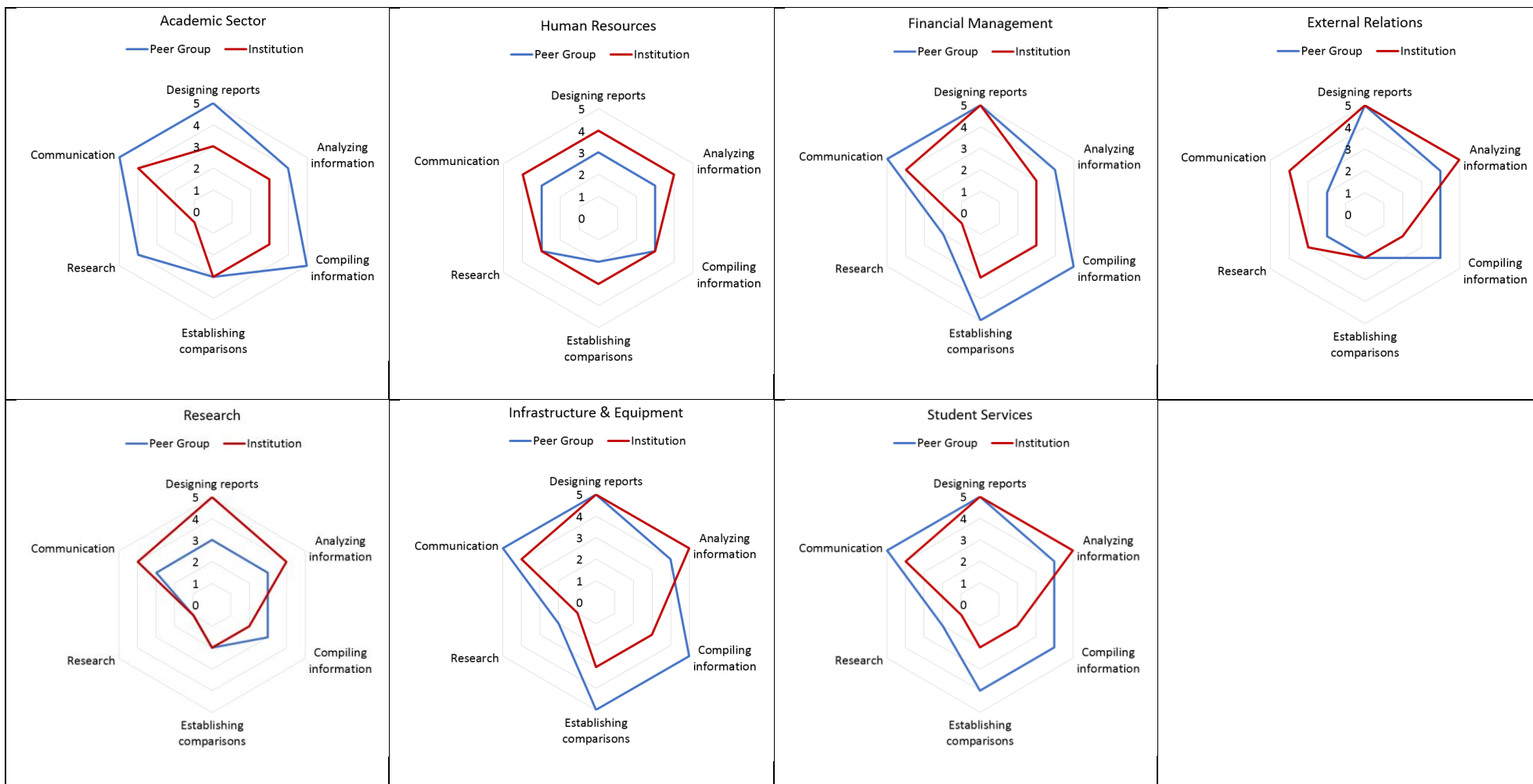
Organizational Culture

| |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none">• At my institution, we have an organizational culture that promotes the use of information and evidence for decision-making; we do not base decisions on anecdotal information, practical, or intuition. |
| <ul style="list-style-type: none">• At my institution, we have identified a series of results (e.g., improve student dropout rates, reduce operational costs) which we are seeking to achieve with the most appropriate use of information. |
| <ul style="list-style-type: none">• Senior management (President, Deans, others) often consider the information and evidence for their decision-making. |
| <ul style="list-style-type: none">• Managers (directors, others) often consider the information and evidence for their decision-making. |
| <ul style="list-style-type: none">• Faculty members often consider the information and evidence for their decision-making. |

Table 7: Sample development level descriptions by competency

| | Initiate | Develop | Standardize | Optimize | Innovate |
|----------------|-------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|------------------------------------------------|--------------------------------------------|
| Design reports | Mainly data reports | Some narrative is added | Common definitions used | Coherent narrative across the institution | Continuously search new content |
| Analyze data | Unidimensional descriptive statistics | Multidimensional descriptive statistics | Multidimensional and multisectoral analyses | Projections | Hypothesis testing |
| Collect data | Keep abreast of existing surveys | Participate in at least one survey for a given sector | Undertake surveys in collaboration | Improve quality using validation techniques | Lead or develop new surveys |
| Benchmark | Keep abreast of existing benchmarking processes | Participate in benchmarking | Collaborate with others to improve data comparability | Automating production of data for benchmarking | Lead or develop new benchmarking processes |

Figure 2. Fictitious results for the development of competencies



Endnote

ⁱ We are grateful for the permission to publish the validation results presented in this paper, work which was carried out in the context of a research contract awarded to Díaz Pinsent Mercier Research Inc. by the Unidad de Análisis, Departamento de Financiamiento Institucional, División de Educación Superior, Ministerio de Educación, Gobierno de Chile under the direction of Roxana Acuña Molina. The authors also wish to thank Pablo Opazo Bravo, Associate Consultant, who acted as coordinator and contributed to the compilation and analysis of the data.