Differentiated Roles and Perceptions of the Controller Function: An Exploratory Study

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DRAFT WORKING PAPER

Abstract:

The purpose of this study is to explore the evolution and current state of management control systems (MCS) and the role of the controller in Chilean organizations. A sample of 147 Chilean companies was surveyed to identify changes in the role of the controller and provide insights into the perception of the role from different stakeholders. The results of this study will provide valuable information for organizations and controllers to improve their performance and decision-making processes and highlight the characteristics of outstanding controllers in the Chilean context. The empirical approach used in this study aims to address unresolved issues in the literature and propose a new perspective on the role of the controller and that of the stakeholders. Key questions addressed in this study include the existence and characterization of different types of controllers in Chile, the relationship between organizational context and controller role, factors affecting the satisfaction of the controller's work, and expected challenges for the future of the controller role.

INTRODUCTION

Over the past three decades, the evolution of control management and the controller's role has been well documented in the literature. From a traditional focus on accounting, the role has shifted towards business analysis and advising (Simons, 1995; Chenhall & Moers, 2015). This transformation has been driven by environmental pressures and facilitated by the implementation of Enterprise Resource Planning Systems (ERPs), which have streamlined administrative tasks (Hopper, Northcott, & Scapens, 2007) and allowed for the implementation of control systems that consider a wider range of interrelated factors (Chenhall & Moers, 2015).

The new role of business analysis and advising requires controllers to occupy a higher position within the organizational hierarchy and possess a more comprehensive set of knowledge and skills. This includes an in-depth understanding of the environment, the entire business cycle, the organization, its culture, incentives, strategy, and formal and informal information and management control systems (Nilsson, Olve, & Parment, 2011; Chenhall & Moers, 2015).The role of management control systems (MCS) in modern organizations has been a topic of ongoing research and discussion in the academic community. According to Bourne, Franco-Santos, Micheli, and Pavlov (2018), MCS play a decisive role in the development and success of organizations. They facilitate the efficient use of resources, support the implementation of strategy (Hyvönen, 2007; Banker, Potter, & Srinivasan, 2000; Chenhall, 2003), and improve decision-making at all organizational levels (Neely, 2005). Furthermore, MCS align the different areas of the organization (Maestrini et al., 2017).

The evolution of MCS has been influenced by the increasing complexity of organizations and the environment in which they operate. The role of MCS has changed over time, from being reactive control mechanisms based primarily on financial information, to serving as a support mechanism for decision-making by managers and executives, and finally as a support tool for senior management in fulfilling their mission (ICV, ICG, 2013).

At the beginning of the 20th century, MCS were mainly used for budgeting and planning processes, relying heavily on accounting information. However, by the 1980s, the limitations of relying solely on accounting information became apparent, and new multidimensional approaches to MCS emerged. In the 1990s, the advent of tools and systems such as the Balanced Scorecard integrated various aspects of strategy and budgeting (Franco-Santos et al., 2007).

EVOLUTION OF THE CONTROLLER ROLE

The role of controllers has undergone significant changes due to various factors such as shifting business market conditions, new organizational designs, technological advancements, and changing human resource management practices (Burns and Baldvinsdottir, 2005; Burns and Vaivo, 2011). In this evolving context, controllers must enhance their value to organizations.

One of the significant environmental influences is the implementation and evolution of ERP systems in companies. ERP has automated many of the routine responsibilities and duties of controllers, reducing their workload. Additionally, managers in other areas have become more proficient in generating and interpreting financial information, transforming the controller's role into more analytical work (Burns and Vaivo, 2011). This evolution has been driven by various factors, including changes in market conditions brought about by globalization, increasing complexity and risks, new organizational designs, innovative management philosophies, complex IT system implementations, and advancements in human resource management.

As decision-making becomes increasingly complex due to technology, regulations, and organizational complexity, managers and investors demand faster and more comprehensive management information (Byrne and Pierce, 2006). In response, controllers must possess a deeper understanding of the company's processes and departments and be able to collaborate effectively with other managers to distribute essential information at all levels of the organization.

This new approach to the controller's role has led to an expansion of responsibilities and tasks, including the role of a "business advisor" or "business controller" (Ahrens, 1996; Burns and Baldvinsdottir, 2005; Friedman and Lyne, 1997; Herzog, 1999; Mourtisen, 1996; Northcott and Scapens, 2007; Järvenpää, 2007; Zoni and Merchgant, 2007; Vaivio Kokko, 2006). This progression has resulted in a more significant role for the controller in management control, the development of predictive management accounting methods, and closer collaboration between accountants and managers (Byrne and Pierce, 2007).

However, some studies suggest that the controller may only sometimes reach the advanced strategic role expected by organizations (Morales and Lambert, 2013). In some cases, the organization may still confine the controller to a more traditional accounting function (Masquefa, 2008). Additionally, there is sometimes confusion about whether the controller is acting as a coercive or enabling control system (Adler and Borys, 1996).

DEVELOPMENT STAGES OF THE CONTROLLER

The development of the controller function has been documented in models that typically have four stages, moving from operational and accounting activities to the management, strategy, and implementation of management control systems. Graham et al. (2012) proposed a mapping of controller functions based on two criteria: the first criterion refers to the scope of the controller's management, ranging from a role similar to an internal auditor to becoming part of the management team, and the second criterion is the focus of their activity, which can be based on accounting up to a role based on strategy definition and implementation. These criteria lead to four types of controllers: the "counting controller" focuses on accounting, taxes, and budgets, the "patrolling controller" focuses on risk control, control system design, and stakeholder relationships, the "supporting controller" focuses mainly on reporting, and the "business controller" as part of the management team designs strategy and focuses on creating business value.

Graham et al.'s model (2012) is based on 95 job descriptions, 12 interviews, and 56 questionnaires. Similarly, models by Siegel et al. (2003) and Friedan and Lyne (1997) are based on the description of tasks and the time dedicated to them, but look at the participants from a macro perspective. Colton (2001) proposed a maturity controller model with three levels, "fiduciary," "operational," and "strategic," which is in many ways similar to the four level models. Research on the controller role has been conducted in countries such as the UK (Graham et al. 2012), Italy (Zoni and Merchant 2007), or France (Azan and Bollecker 2010), with similar results, showing that controllers tend to focus on more operational levels with limited added value in their tasks. These studies were conducted using questionnaires or interviews, emphasizing the activities developed and their time. Others, like Weber (2011), focus on the tasks created by controllers. Goretzi et al. (2013) stand out due to a critical factor, their focus on the micro-level of the change process, rather than macro-level or time dedicated to activity. This business case study shows how the function evolves through the four maturity levels, highlighting the actions, skills, and plans necessary for this progression. Other similar works, such as Ahrens and Chapman (2000) and Byrne and Pierce (2007), focus on internal factors in the evolution of the controller role. This research adopts the micro-level approach, linked to the models of maturity in the controller's function.

RESEARCH GOALS

The previous section briefly describes two approaches in research on the evolution of controllers: a macro-level approach that focuses on activities and their perceived value and another micro-level approach that examines the evolution from within the organization as the controllers make it possible. This research combines both approaches, seeks to catalog the activities of Chilean controllers, and simultaneously characterize skills, profiles, tasks, knowledge, and results by level of maturity. The results should provide a complete controller profile based on the maturity of its function level, integrating activities, knowledge, and skills necessary to perform them. This is in line with Malmi and Brown (2008), which state that as the role of the controller advances in maturity and adds value to management, it must incorporate activities specific to the implementation of management control systems, including elements related to planning, formal, incentive, administrative, and cultural control. Indeed, ICV-IGC (2013) argues that being a business partner implies expanding the skills of the controller to include analytical skills, knowledge of control and measurement systems, communication skills, business knowledge, interpersonal skills, and steadfastness.

LITERATURE REVIEW AND HYPOTHESES

The literature finds high consensus built on three aspects:

a. First, there are different roles of controllers, ranging from the operational-accountable (bean counter) to the Business advisor or Business partner. They carry out very different tasks, and their valuable contribution to the organization and use of the MCS could be more balanced.

b. In his most evolved business role as an advisor or business partner, the controller is an excellent contributor to implementing and updating the strategy.

c. The controller in a business role partner " improves the performance and use of management control systems (MCS), as it positively helps to establish the structure of the organization, define the necessary skills of people, improve processes and seek the desired behavior through monitoring, feedback and communication of plans at all levels of the organization.

On this last point, Melek's work Eker & Semih Eker (2016) links the design of MCS and the execution of the strategy in 94 companies. The conclusion: “ The results support the postulate that the high interaction between the interactive control system (ICS) and the differentiation strategy (DS) is associated with a high performance of the company and that the high interaction between the control system of diagnosis (DCS) and the strategy of leadership in costs (CS) is associated with a high performance of the company. "

For his part, S., Baird, K., and Schoch, H. (2017) showed how MCS is essential from the perspective of the organizational life cycle, showing the relationship and role of MCS in people's behavior.

Further evidence supporting how the Controller and MCS support more effective and efficient strategy execution can be found in Chenhall and Langfield - Smith (1998) and in Ittner, Larcker, and Randall (2003). Furthermore, previous research on the relationship between MCS and the controller role is more comprehensive than competitive strategy. For example, Pondevillea et al. (2013) apply the MCS concept to environmental strategies and Arjalièsa & Mundy (2013) to the CSR strategy, finding favorable results in their interaction.

There is another line of research that, instead of observing the contribution of the controller to the organization and the strategy, goes into greater detail about the controller's role and the tasks it develops. One of the first, Hopper (1980), investigated the role of controllers focused on accounting issues and with little exposure to management or senior management. Later, Sathe (1982), Keating (1990), Stoner & Werner (1993), and Davis & Militello (1994), through field studies, detected an evolution from the " bean " profile counter ” towards a more integrated role in management. Also, Ray et al. 2006, and Goretzki 2013 show the evolution of the controller through the change in the tasks, positions, activities, and results they perform.

Zoni & Merchant (2007). Sorensen (2009), Järvinen (2009), Lambert & Sponem (2012), Eker, M., & Eker, S. (2019) show that some controllers evolve towards an integrated role with the management team, participate in activities with high added value for decision making, and are involved in or are in charge of the design, execution, and control of the MCS.

Ahrens 1996, Burns & Baldvinsdottir 2005, Friedman & Lyne 1997, Mourtisen 1996, Herzog 1999, Northcott and Scapens 2007, Bergmann et al., 2020. Vitale et al. 2020 also show the changes in the tasks, responsibilities, and activities that the role of the controller has experienced in recent years.

In summary, previous studies often define two separate functions for controllers: the bean counter or financial controller focused on accounting, and the Business Partner or Business advisor, where role focuses on helping and advising other areas, giving an opinion on different types of operational decisions, and even participating in strategic decisions (Järvenpää, 2007; Zoni & Merchant, 2007; Vaivio Kokko, 2006; Janin, 2017; Goretzki, 2018).

Research views the evolution of this role as positive and a step in the right direction. Even professional controller organizations (ICV-IGC 2007) view this role change positively. This progression means that the role of the controller plays a more significant role, generating more predictive management accounting methods, complementing budget process designs, implementing control systems more suitable for the organization, cooperating more closely with accountants and managers, and being a facilitator of strategic decision-making (Byrne & Pierce, 2007).

The financial and business support role, the evolution in the function of the controller, and its impact on MCS are well documented. However, there remain some areas where further investigation is possible. (Burns & Baldvinsdottir 2005, Byrne & Pierce 2018). The first area is the need for controller evolution. Some studies (Morales & Lambert, 2013) suggest that the controller must consistently achieve the role of advanced strategic support that organizations expect. However, sometimes the organization limits the controller to a more traditional and narrowly focused accounting function (Masquefa, 2008). Other times, there needs to be a clear explanation as to whether the Controller and MCS act as coercive control systems or enablers for users (Adler & Borys, 1996). Research by Siegel et al., 2003 identifies the barriers controllers face in delivering more relevant value through their role. The main challenges are lack of time, cultural barriers, or lack of support from top management. In addition, advances in information systems have only sometimes had the positive effect that is usually expected.

A second area is the differences in the controller role between countries (La Paz et al., 2020). For example, the role points to more financial tasks in the United States or the United Kingdom. Controllers avoid this task in some European countries, while in Germany, the focus is on quality and safety. In France, however, the role usually includes long-term planning.

A third area where more depth is needed is detailing the role of the controller and creating unique and clear definitions of each role. Some maturity models link different stages of the evolution of the controller and describe responsibilities and activities. However, too often, only a distinction is made between the financial and business controller (Janin, 2017). These models define two and four controller types. However, there needs to be unanimity and clarity about what defines the changes between roles (Lambert & Sponem, 2012).

Finally, the relationship on which controller profile best fits each organizational context is another of the pending issues, along with what dynamics, needs, and culture cause changes in the role (Goretzki, 2018), (Alharbi, Jamil, Mahmood, & Shaharoun 2022).

HYPOTHESES

The hypotheses proposed in this paper are as follows:

Part One: Validation and Replication

H1: Differentiated Roles of Controllers Exist

Previous research has explored the evolution of the controller function, which has changed from an accounting role to a role that supports strategic decision-making (Weber, 2002; Rouwelaar et al., 2008; Colton, 2001; Graham et al., 2012; Baldvin, Sdottir et al., 2009; Pasch, 2019). Theoretical models have been used to measure the progress of the controller function and classify its different roles, ranging from a distinction between bean counters and business advisors (Janin, 2017) to the classification of up to four roles (Weber, 2002; Lambert & Sponem, 2012; La Paz et al., 2020). The purpose of H1 is to verify the existence of differentiated roles of controllers.

H2: Different Roles Perform Different Activities

The literature has primarily focused on the controlling function rather than the actual tasks performed by controllers (Weber, 2011). The controller role has been classified using various criteria, including reactivity or proactivity (Järvenpää, 2007; Kaplan & Norton, 2008; Merchant, 1985) and technical skills versus the capacity for business vision and contribution to other areas (Baldvinsdottir et al., 2009; de Loo et al., 2011; Goretzki et al., 2013; Seal, 2006).

Classification is based on the tools, activities, and tasks performed, but most commonly used maturity models use the output of the function as their main criteria rather than the inputs, such as tasks, tools, skills, and activities (Hartmann & Maas, 2011; Lambert & Sponem, 2012; Weber, 2011,). The previous literature highlights the need to better understand the factors that cause variation between different maturity levels.

The purpose of H2 is to associate the controller's maturity with their activities and link maturity to inputs (activities) rather than outputs (results), thus defining critical activities for each level of evolution.

Part Two: Determinants of the Different Roles

H3. The company's characteristics influence the differentiation of the controller role The characteristics of the company can influence the role played by the controller. The literature indicates that the company's size, sector, and ownership structure can affect the level of maturity of the controller function (Rouwelaar et al., 2008; Colton, 2001; de Loo et al., 2011; Graham et al., 2012). For example, the size of the company can influence the level of specialization and the development of the role of the controller (Weber, 2002). The sector can affect the level of influence that the controller has on the decision-making process (Janin, 2017). Finally, the ownership structure can influence the level of participation of the controller in the strategy definition (Fourné et al., 2018). H3 seeks to verify the influence of the company's characteristics on the differentiation of the controller.

H4: The Perception of Role Satisfaction Differs Between Stakeholders and Controllers

The purpose of H4 is to investigate the differences and similarities between the expectations of stakeholders and the actual role performed by controllers. The findings from this study may highlight potential barriers or challenges that may impede the progress and development of the controller function.

H5: A Significant Bias Exists Between Controllers and Stakeholders Regarding the Value Contribution of the Function

This hypothesis aims to examine any disparities between the perceptions of controllers and stakeholders regarding the value that the controller function brings to the organization.

H6: A Significant Bias Exists Between Controllers and Stakeholders Regarding Controller Input to the Strategy

This hypothesis investigates any differences in views between controllers and stakeholders regarding the involvement and impact of the controller function on the organization's strategy.

H7: A Significant Bias Exists Among Controllers and Stakeholders in Terms of Current Skills

This hypothesis examines any biases between the perceptions of controllers and stakeholders regarding the skills and capabilities of the controller function.

Part three: Controller’s Insight

H8. There exists a discrepancy in perceptions between controllers and stakeholders regarding the future contributions of the controller function. The role of the controller has evolved over time, and its future trajectory is a topic of ongoing discussion (Weber, 2002; Rouwelaar et al., 2008; Colton, 2001; Graham et al., 2012). Previous studies have highlighted the need for increased collaboration and integration between controllers and stakeholders (Baldvin, sdottir et al., 2009; Pasch, 2019). However, there may be disparities in the perceptions of controllers and stakeholders regarding the future role of the controller.

H9. There is a discrepancy in perceptions between controllers and stakeholders regarding the need for improvement of the controller role. In order to effectively support decision-making, the controller function must continually adapt and improve (Janin, 2017, Asiaei K., Bontis N. 2019). The maturity of the controller function can be measured using various criteria, including reactivity versus proactivity, technical skills, and business vision (Järvenpää, 2007; Kaplan & Norton, 2008; Merchant, 1985). Despite the recognition of the need for continuous improvement, there may be disparities in the views of controllers and stakeholders regarding the

H10: Different Needs Exist in Terms of Future Skills to be Developed by the Controller

The purpose of this hypothesis is to explore the varying requirements for future skills development among controllers. This aims to identify the specific skills needed to enhance the performance of the controller function.

H11: Unique Activities Define High Performance for Controllers

This hypothesis seeks to examine the distinct activities that contribute to high performance among controllers. This provides insight into best practices for the controller function to achieve exceptional results.

DATA

A survey of 147 Chilean organizations was conducted for the purpose of this study. Each of these companies was asked 156 questions that included information on factors internal to the company, related to the company's business, the company's culture, the role of the Controller, and the technology used to fulfill this role, as well as external factors related to the competition, the sector, and other factors that provide a global perspective of the role of the Controller within each of the organizations.

The survey converted the aspects of the framework into multiple-choice questions. Each individual was asked about their abilities, responsibilities, and agenda priorities, as well as information about their organization and position, such as company size, sales level, span of control, hierarchical level, participation in the company's strategy definition, years of professional and controller experience, and educational background. We gathered this data based on the findings of Rieg (2018), Rashid, M. M., et al (2020), and Vaz, S. L., et al (2022) who also emphasized the necessity for more research into the relationships between these factors and the kind of controller jobs.

METHODOLOGY

H1. There are different types of Controllers in Chile (Annex 1)

As the first step in the process of grouping the various Controller profiles, we have established a cluster analysis. According to Hair et al. (2019), cluster analysis is a "multivariate statistical approach" whose primary purpose is to link items based on their properties, i.e., their similarity. High internal homogeneity (inside the cluster) and high exterior heterogeneity are required for clustered items (between groups). The distance functions between the items may be used to determine the similarity of the objects, as nearby people must belong to the same group. (see Suwanda, R., Syahputra, Z., & Zamzami, E. M. 2020).

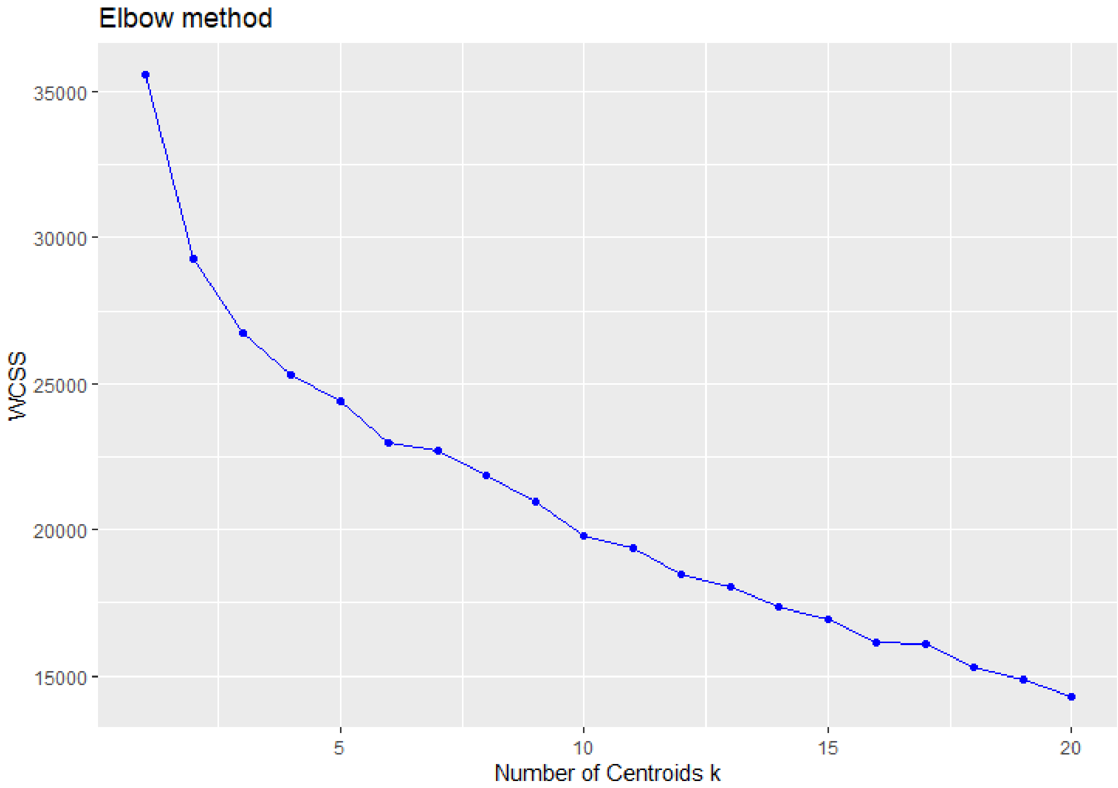
The metrics of distance or (dis)similarity reveal the degree to which each pair of items resembles and/or combines. These metrics will enable us to group the observations, which must be organized into groups. The Manhattan distance is the most resilient of the current measurements of similarity. In contrast to the Euclidean distance, it is less impacted by unusual data (outliers) since the Manhattan distance does not square the differences between the observations (see Faisal, M., & Zamzami, E. M. 2020; Prasetyo, H., & Purwarianti, A. 2014).

According to Aldas and Uriel (2017), after computing the distance matrix between the various observations, it is important to build the groups; for this, the grouping technique must be picked, and the ideal number of plausible groups must be determined. data.

As previously stated, the first stage of the K-Means method is to choose the number of K clusters into which to split the data. There is no exact way for this, but multiple strategies, such as the Elbow Method, may be employed to determine the optimal number of clusters (see Hair et al. 2019). This approach employs the inertia values produced by repeatedly applying the K-Means algorithm to various cluster sizes. The inertia is equal to the sum of the squared distances between each cluster item and its centroid. [1]

$$Inertia = \sum_{i=0}^{n} |xi - yi|^2$$

After applying the procedure to values from 1 to N clusters and obtaining all inertia values, the results must be represented using a linear graph. This demonstrates how the value of inertia changes with the number of clusters. The purpose of this visualization is to determine where on the graph, or at what value of K clusters, a shift in the development of inertia may be seen.



Own elaboration based on collected data.

We shall witness a line that resembles the form of an arm and elbow; the point at which we recognize this "elbow" is where the intensity of the drop in inertia will diminish. This is the point from which we must pick the ideal value of K for the number of clusters. This project should use the elbow approach aesthetically.

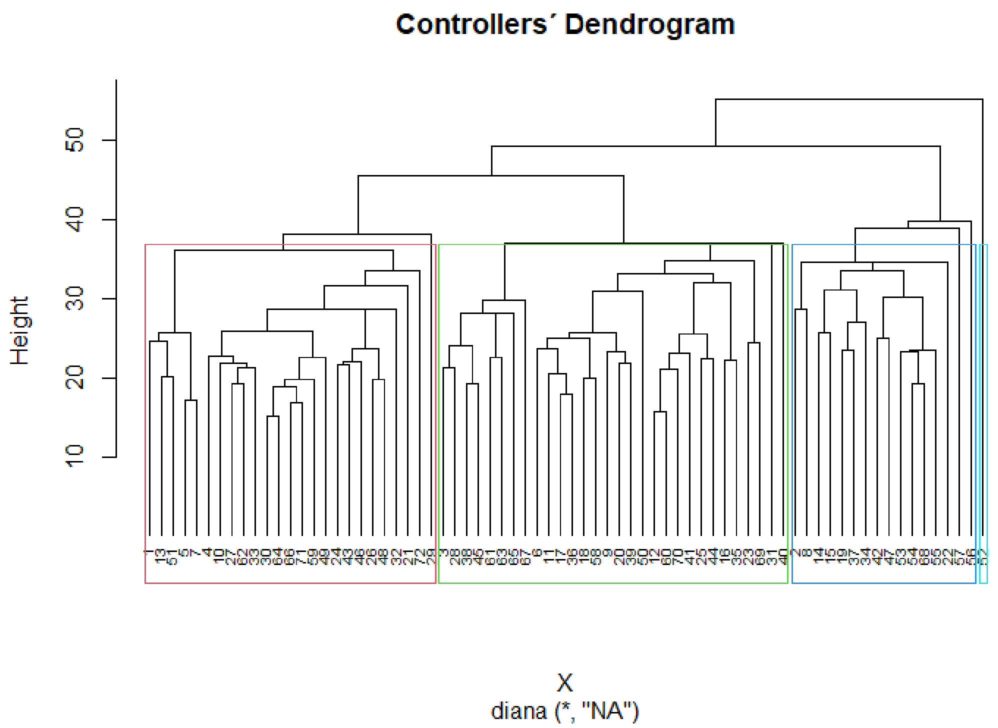
Therefore, the user should determine the appropriate number of clusters and provide the value to the K-Means algorithm in order for it to conduct an optimal grouping. On the graphs shown below, the elbow approach is shown on the left, while clusters chosen using this method are shown on the right.

To determine the feasibility of clustering the various Controllers, the unsupervised cluster analysis method was used. Using the "elbow approach" to estimate the number of clusters was the first phase of the procedure. On a visual level, it was recognized that the number of centroids may be three or four, since the improvement with five or more is minor. The outcome confirms that three kinds of controllers exist in Chile. A controller with a strong emphasis on accounting, another with a greater emphasis on strategy, and a third named Transformation.

Continuing with the analytic procedure, the following step is to comprehend in more depth how the various clusters and variables act. Dendrogram is a graphical depiction of a group of objects or data points' hierarchical structure. Dendrograms may be used in the realm of control systems to comprehend the various clusters of controllers and their performance characteristics. This may be accomplished by using clustering methods, such as hierarchical clustering, which groups controllers with comparable performance metrics based on their similarity.

The development of a dendrogram begins with the selection of the performance parameter or metrics that will be used to assess the controllers. Stability, transient reaction, steady-state response, and control effort are typical system measures. The next step is to gather data on the performance of a representative sample of controllers using the chosen metrics. This information may be gathered by modeling, testing, or observation in the actual environment.

After collecting the data, the following step is to conduct the clustering analysis. Calculating the similarity between each pair of controllers based on their performance data does this. Similarity may be stated as a distance measure, such as Manhattan distance or cosine similarity, and the resulting values are used to build a similarity matrix. This matrix is then used to construct a dendrogram, a tree-like structure that displays the hierarchical connections between the controllers.



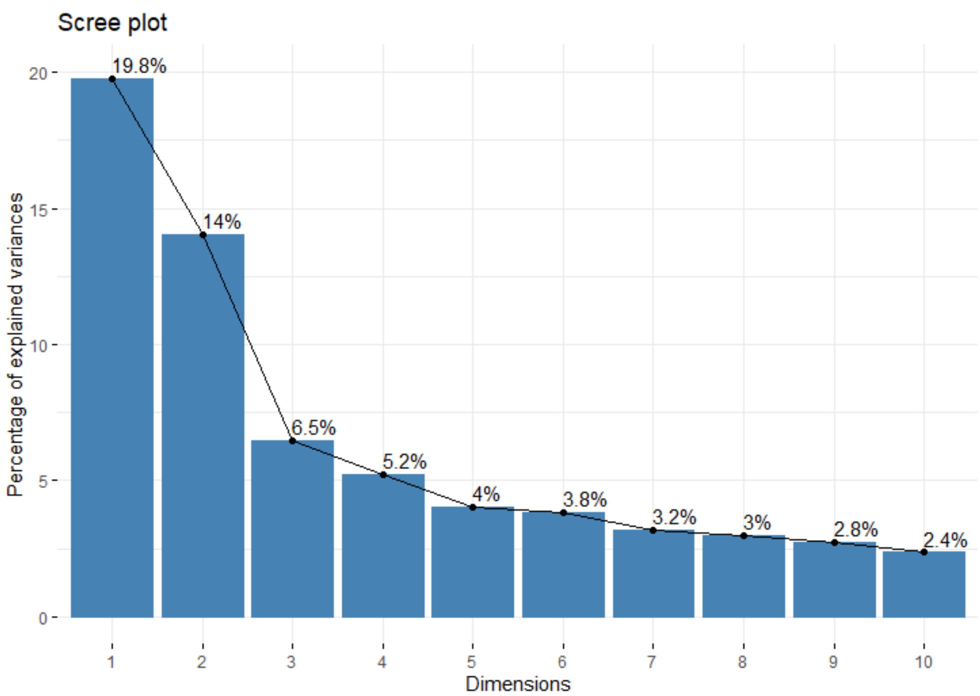
Own elaboration based on collected data.

The dendrogram permits the visualization of clustering results and the identification of various groups of controllers. According to the research, each cluster consists of a collection of controllers with equivalent performance metrics. The dendrogram also enables the researcher to evaluate the optimal number of clusters by pinpointing the point when the distance between clusters begins to increase drastically.

After finding the optimal number of clusters, principal component analysis (PCA) is used to determine the performance investigation's most important components. PCA is a statistical technique that reduces the dimensionality of the data by transforming it into a new set of orthogonal variables known as principal components, which represent the most variance in the data.

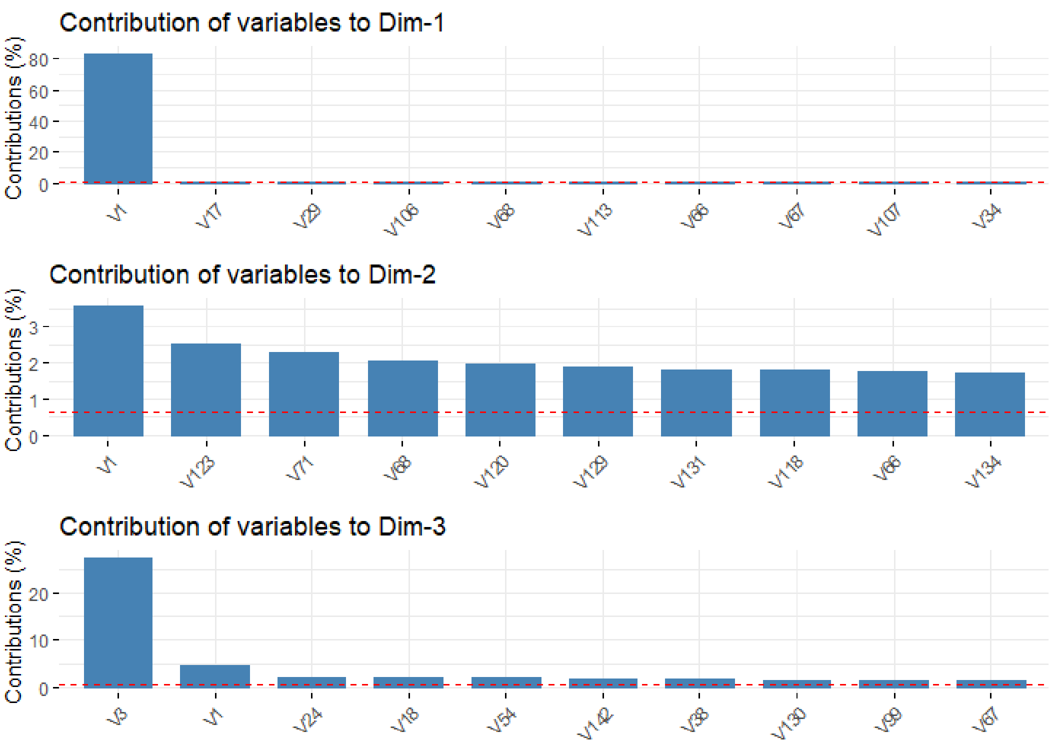
In the context of controller performance analysis, PCA may be used to identify the most important performance indicators for describing data variation (Germain, P., Bach, F., Lacoste, A., & Lacoste-Julien, S. (2016); Seldin, Y., & Tishby, N., 2010). The PCA results are shown as a scatter plot, where each point represents a Controller, and the axes indicate the principal components. The scatter plot makes it easier to assess the data by visually depicting the relationships between the controllers and the key performance indicators.

By combining the results of the dendrogram analysis with those of the principal component analysis, the researcher may get a deeper understanding of the different clusters of controllers and the primary performance factors driving data variation (CaliŃski, T., 2014). This information may be used to assess the strengths and weaknesses of the different controllers and to lead the development of new controllers customized to certain performance attributes.



Own elaboration based on collected data.

As can be observed, the DIM1 explains over 20 percent of the variance. In addition, DIM2 explains an additional 14 percent, whereas DIM3 explains an additional 6.5 percent. 40,3 percent of the total variation. Finally, each Dimension's (DIM) variables were evaluated. For characterizing the different types of roles, intuition and earlier literature were given the variables in descending order of importance. The greater the firm's competitiveness, the more advanced the role of the sector to which it belongs. Creativity is the controller's contribution to the firm and prospective solutions. In other words, the amount of maturity of a function is proportional to the degree to which its solutions and challenges need creativity. Participation in strategy formulation, environmental analysis, and product and service launch decisions results in less accounting function and a larger contribution to the organization. Participating in change management and contributing to the company's vision and objectives were other variables that distinguished the three groups of controllers found by the study.



Own elaboration based on collected data.

H2. The different roles carry out different activities (Annex 2)

In recent years, statistical inference methods have made amazing strides forward. In addition to the standard statistical models, there have evolved new machine learning models that make estimation work considerably simpler and more thorough. Even in recent years, the technique of merging several machine learning models has grown more widespread (Valpola, H. J.,2002).

Statistical inference analysis often employs machine learning ensemble models due to their many benefits, including an improvement in accuracy: Ensemble models integrate the results of multiple basic models to produce a model that is both more accurate and more resilient. Reducing variation and reducing overfitting: Combining several models reduces variance and prevents overfitting, which eventually increases the generalizability of the model. Due to the fact that ensemble models can handle a broad range of data kinds and structures, including complicated data, they are well-suited for applications that include a variety of data types and structures (Li, Z., Ren, K., Yang, Y., Jiang, X., Yang, Y., & Li, D., 2023).

The capacity of ensemble models to include several kinds of models and algorithms enables them to be very adaptable and flexible in a range of scenarios. Using techniques such as variable significance and visualization, it is feasible to get a clear explanation for the results (Chen, K. H et al, 2022). Interpretability: Despite the complexity of ensemble models, it is feasible to provide a clear explanation of the results by using these approaches.

The use of ensemble models for statistical inference has a number of disadvantages, the most significant of which are the need for careful selection of the models and algorithms to be included in the ensemble, the complexity of the models, and the difficulty of completely appreciating the models. repercussions in particular circumstances and/or settings

For the following phase of the analytic procedure, we will use a collection of ensemble models based on machine learning. These models will be based on the definitions of the PCAs validated in the preceding step. This will allow for a more precise statistical conclusion.

We used the R caret package. The caret package contains functions for consistently and efficiently training machine learning models.

The train function is used to fit each of the six models. The first argument to the train function specifies the response variable V30 and the predictor variables V1, V17, V29, V106, V68, V113, V123, V71, and V120. The second argument data = X specifies the data frame X to be used for fitting the models.

The method argument specifies the type of model to be fit, with the following options:

- "lm" for linear regression
- "glm" for generalized linear regression
- "rpart" for decision tree

- "rf" for random forest
- "svmRadial" for radial support vector machine
- "xgbTree" for XGBoost decision tree.

The trControl argument specifies the control parameters for training the models. In this case, method = "cv" specifies that 25-fold cross-validation should be used to evaluate the models, and number = 25 specifies the number of folds.

Each of the six models is fit using the same predictors and response variable and is stored in the modelsEst list. The names of the models in the list are "lm", "glm", "tree", "Random Forest", "SVA", and "XGBoost".

```
Call:
summary.resamples(object = resultsEst)

Models: lm, glm, tree, Random Forest, SVA, XGBoost
Number of resamples: 25

MAE
                   Min.   1st Qu.    Median      Mean  3rd Qu.     Max. NA's
lm            0.3221053 0.7382318 1.0433714 0.9734276 1.114550 1.784105    0
glm           0.3964201 0.7127961 0.8409503 0.9747902 1.160165 1.667029    0
tree          0.3364598 0.6883117 0.8627451 1.0291558 1.416667 2.186508    0
Random Forest 0.3423778 0.7431000 0.9588889 1.0214969 1.297956 1.984267    0
SVA           0.2617127 0.8890638 1.1406229 1.1472175 1.397576 2.429320    0
XGBoost       0.2728053 0.5886029 0.7614422 0.9096135 1.153455 2.234454    0

RMSE
                   Min.   1st Qu.    Median     Mean  3rd Qu.     Max. NA's
lm            0.3305031 0.7438710 1.1163452 1.122770 1.357434 2.206935    0
glm           0.4283626 0.8012086 1.0688444 1.125988 1.341846 2.248705    0
tree          0.4046354 0.8547527 1.0379794 1.204243 1.529782 2.902424    0
Random Forest 0.3682247 0.7905317 1.0575601 1.154201 1.452251 2.162989    0
SVA           0.3186476 0.9839890 1.2431396 1.302718 1.521948 2.477019    0
XGBoost       0.3222488 0.6537971 0.9551362 1.067221 1.327884 2.703206    0

Rsquared
                      Min.   1st Qu.    Median      Mean   3rd Qu. Max. NA's
lm            0.0241112173 0.6415108 0.8936139 0.7224409 0.9862273    1    0
glm           0.0232420867 0.4025416 0.8132257 0.6667804 0.9624000    1    0
tree          0.2500000000 0.7500000 0.8928571 0.8191945 0.9992520    1    4
Random Forest 0.0001640681 0.5835308 0.9124796 0.7325821 0.9946918    1    2
SVA           0.0006300288 0.3081280 0.7093243 0.6115785 0.9704237    1    1
XGBoost       0.0051015247 0.7374090 0.9565583 0.7933905 0.9916666    1    3
```

Own elaboration based on collected data.

As we can see in the analysis, all the machine learning models, and the classical models have a good ability to infer the behavior of the three different Controller profiles. At the level of errors (for the case illustrated in the previous figure) the median of MAE and RMSE tells us that the best model to estimate is XGBoost, while at a higher R^2 level, XGBoost is also the model with the best performance.

Considering the limitations that machine learning ensemble models have for interpretability, and in some case for overfitting with small data set, we decided to use a logistic regression model to draw conclusions. One of the benefits of using logistic regression is that it can handle non-linear relationships between the predictor variables and the outcome variable. Logistic regression uses a transformation, called the logit function, to model the relationship between the predictor variables and the outcome variable. This allows for a more flexible modeling of the relationship compared to linear regression, where the relationship is assumed to be linear Xu, W., He, H., Guo, Z., & Li, W., 2022).

Another benefit of using logistic regression is that it can handle both continuous and categorical predictor variables. This makes logistic regression a versatile tool for modeling complex data structures, where multiple types of predictors are present.

Once the logistic regression model is fit, there are a variety of ways to evaluate its performance. An important aspect of logistic regression is interpreting the coefficients. In logistic regression, the coefficients represent the change in the log odds of the outcome variable for a one-unit change in the predictor variable, holding all other predictor variables constant. This makes the coefficients easier to interpret compared to the coefficients in linear regression, where the interpretation can be more complex.

In addition to evaluating the performance of the model, it is also important to check the assumptions of logistic regression. These include linearity of the log odds, independence of errors, homoscedasticity, and normality of the residuals. Checking these assumptions can help to ensure that the logistic regression model is appropriately fitting the data.

Based on the results of the cluster and PCA analysis, for the following analysis we have theoretically developed three different Controller profiles. The "Accountant Controller", the "Strategic Controller" and finally the "Controller in Transformation"

Based on the results obtained from the sample, the "Accounting" controller stands out in activities, generated value, and skills closely linked to the accounting, technical and legal aspects. Therefore, variables 17, 19, 42, 44, 73, 83, 86,125, 140, 142, and 143 are highly significant in their definition[1][2].

Variables 17, 73, 83, and 86 refer to the activity, support, and focus on budgeting and financial evaluation of investments, which is usually a very prominent activity at this point in evolution—likewise, variable 44 points to the focus of internal control as one of the main activities.

[1] The dictionary of variables that was used is presented in the repository.

[2] As shown in the analysis code, the assumptions of linearity of the log odds, independence of errors, homoscedasticity, and normality of the residuals are shown to have been met.
https://github.com/DiegoVallarino

Variables 42, 125, 142, and 143 indicate skills and knowledge highly focused on accounting, legal, and regulatory areas, which definitely supports their role.

Additionally, variable 19 refers to the non-existence or failure to implement the balanced scorecard, an eminently strategic tool.

The second type of Controller, the "Strategic Controller" has some relevant characteristics. The analysis shows how this controller has some functions typical of the controller with profile Accounting, but new explanatory variables appear with a high weight. This fact invites us to think that the controller does not neglect certain functions, such as the preparation of budget processes, but rather adds new functions, roles, and activities to its function.

In this way, the model shows how the Strategic Controller is reflected in the variables 8, 9, 14, 17, 19, 35, 42.44, 73, 83, 86, 125, 140, 142, 143. However, unlike the accounting in the Strategic controller, we observe the following:

Variables 17, 83, and 86 indicate how the controller continues to be in charge of the budget process and advice; however, the expertise in accounting issues (v.42) and the focus on internal controls (v44) show a negative correlation, which leads to thinking that this role remains in other parts of the organization or has been automated, ceasing to be the main one. Additionally, he continues to have high legal and accounting knowledge (v 125, 142, 143).

What is significant in this role is the appearance of variables related to participation in the strategy (v8) and assistance in the role of Business Advisor (v35). These variables did not exist in the previous role. Variables 9 and 14, non-existent in the previous role, correlate negatively, which implies that this is a very involved and participatory controller in strategic issues. For the above, the analysis capacity (v140) is remarkable in this role.

The last one, the controller in the transformation phase, intermediate between the accounting and the strategic one, has the lowest R^2 but shows explanatory variables that none of the previous profiles show. In this case, the main explicative variables are 28, 50, 60, 64, 67, 68, and 152.

Variables 28, 50, 60 and 64 refer to the implementation, improvement, and contribution of management reports (reporting) to the areas. An area that abandons its sole accounting role generates value for the organization by distributing value information to management.

Variables 68 and 152 points towards understanding the environment and the future implementation of the Balanced scorecard as a strategic management tool, which reaffirms its transformation role.

H3. A more strategic role generates greater satisfaction in the organization (Annexes 3 and 4)

As the role evolves and generates better outputs for the organization, it is expected to have greater satisfaction measured by the perception of value generated by the management control area.

At this point, we find two aspects that undoubtedly require further investigation. The first is that there is a very marked difference between the correlation of the perception of value between the accounting controller (correlation equal of 7.8%) and the Transformation and Strategic Controllers with a correlation of 29% and 30% respectively.

Although the result is as expected, the greater the maturity, the greater the satisfaction, and the low correlation between perceived value and maturity at the Transformation and Strategic levels is striking. Unfortunately, we cannot judge this value because we do not have benchmarks or previous studies.

Analyzing in detail (Annex 4) this perception of value by areas concerning future perspectives of the function and current and expected abilities of the controller, no valid conclusion can be reached.

H4. The greater/lower satisfaction with the role is associated with different skills (Annex 5)

Through the correlation between the perceived satisfaction of the role (V156) and the rest of the variables related to abilities, skills, and activities, it can be seen how among the nine explanatory variables there are three that mainly help the role to be perceived better. These variables are support and use of technological tools, ease of contributing/collaborating with the strategy, and decision-making support. Significantly, satisfaction comes from having technological tools that facilitate the access and analysis of the information and the role of the "Business adviser " of the controller. At this point, the role is a link between the pairs, the strategy, and the alignment in decision-making (Vitale et al. 2020; Chapman 2009).

H5. The perception of satisfaction with the role differs significantly between stakeholders (Annex 6)

Differences in how stakeholders and controllers view the function may help shed light on the challenges that must be overcome for the role to mature inside the company and establish some of its defining qualities. In the context of this hypothesis, answers from controllers and stakeholders are disaggregated so that levels of satisfaction with their respective roles may be compared. At this time, it has been noted that the controller is only 14% satisfied with the job that the rest of the organization has completed, which, to put it another way, is an overestimation. In the assumptions that follow, we shall examine which features they pertain to.

H6. There is a significant bias between controllers and stakeholders regarding the contribution of the value of the function (Annex 7)

Using the same technique as in H5, the objective here is to identify the difference in value perception that the controller has for each of the stakeholders. Once again, there is a self-overestimation of the value that the controller feels it provides to the other regions, and this time it is 22 percent higher than the actual value.

H7. There is a significant bias between controllers and stakeholders regarding the controller's contribution to the strategy (Annex 8)

This answer is similar to the previous one. The controller overestimates his contribution to the strategy by 21% compared to the stakeholders. Considering that decision support and the ease of contributing to the strategy are critical aspects in the satisfaction of the function, H6 and H7 show a field for improvement by controllers and their function and/or communication. This is especially worrisome when comparing the perception of the controller to that of the CEO. At this point, the contribution to strategy difference reaches 47%, implying a high perception divergence between the controller and the CEO.

H8. There is a significant bias between controllers and stakeholders in terms of current skills (Exhibit 9)

When correlating the skills from the most operational to the most strategic, a difference between stakeholders and controllers of 24% appears again. Controllers again overestimate their skills, tending to perceive that they are more strategic than the rest of the organization perceives.

H9. There is a bias between controllers and stakeholders regarding the contributions of the function in the future (Annex 10)

At this point, there is an almost perfect coincidence. Both stakeholders and controllers trust thre the function will focus on more strategic tasks in the future so that financial-budgetary control will lose weight. The difference in perception is 1%.

H10. There is a bias between controllers and stakeholders in need to improve role maturity (Annex 11)

The H10 is an expansion of the H9. Although H9 indicates a very high coincidence in the improvement of maturity, H10 shows that the challenges for the function are perceived in the same way by the entire organization, with a difference in perception of 1%. In addition, they highlight the challenges related to the implementation of tools for strategic monitoring, the automation of reports, and value-added comments/advice.

H11. There are different needs in terms of future skills to be developed by the Controller (Annex 12)

On this point, there is a high coincidence (discrepancy of 13%). Again the controller is overrated. The future skills most demanded by stakeholders are mainly soft business, business, global vision, analysis and synthesis capacity, generating strategic alignment, leadership, integrity, communication, influence, and conflict resolution. There is much agreement that these are the skills to develop. It might be the brakes on the show at present.

DISCUSSION

The results of the study provide valuable insights into the perceptions and biases between controllers and stakeholders in Chile, and the implications for the future of the function. The findings show that there is a need for improvement in the maturity of the role, and the development of future skills, to meet the changing demands of the business environment.

The results also highlight the importance of specific activities in defining high controllers' performance. This suggests that organizations in Chile should focus on developing the necessary skills and abilities to enhance the role and contributions of controllers in the future.

Moreover, the results of the study indicate the presence of biases between controllers and stakeholders, which may lead to a misalignment in expectations and the desired outcomes. Therefore, organizations should work to bridge these gaps through effective communication and collaboration between controllers and stakeholders.

Future Research

Defining the skills that a controller must have in the future can help to delimit the definitions of controller maturity and eliminate certain obstacles to its evolution and fit in different organizational contexts.

Therefore, it is essential to ask ourselves which machine learning model allows us to better predict the behavior of a "new generation" Controller (V30) with a more strategic than accounting vision. At this point, prediction model options and their associated performance are presented.

Through applying a “Tree Model, "Random Forest, Naive Bayes, and SVA Model, the Random Forest offer a higher r2, so it is the chosen one.

CONCLUSION

The results of this study provide valuable insights into the perceptions and biases between controllers and stakeholders in Chile, and the implications for the future of the function. The findings suggest that there is a need for improvement in the maturity of the role, and the development of future skills, to meet the changing demands of the business environment. The results also highlight the importance of specific activities in defining high controllers' performance and the presence of biases between controllers and stakeholders, which may lead to misalignment in expectations and desired outcomes.

REFERENCES

Alharbi, I. B., Jamil, R., Mahmood, N. H. N., & Shaharoun, A. M. (2022). Exploring the Relationships Between Organizational Culture, Management Control System and Organizational Innovation. Global Business Review, 23(3), 662–675.

Arjaliès, D., & Mundy, J. (2013). Management control systems, corporate strategy, and performance: An empirical study. International Journal of Accounting and Information Management, 21(1), 1-19.

Asiaei K., Bontis N., (2019) Translating knowledge management into performance, Management Research Review, Volume 43 Issue 1

Adler, R., & Borys, B. (1996). Two-and-a-half decades of controllership: An assessment of its evolution, current status, and future prospects. Journal of Management Accounting Research, 7(1), 1-47.

Ahrens, T. (1996). The changing role of management accountants. Journal of Management Accounting Research, 7, 1-18.

Ahrens, T., & Chapman, C. S. (2000). The development of the management accounting function: A comparative study of management accounting change in UK and US companies. Management Accounting Research, 11(3), 327-350.

Azan, Y., & Bollecker, A. (2010). The evolution of the controller function in France. International Journal of Accounting, Auditing and Performance Evaluation, 6(3), 223-240.

Baird, S., Schoch, H., & Schmidpeter, R. (2017). Organizational life cycle, management control systems, and behavioral implications: A review of the literature. Journal of Management Control, 28(2), 125-146.

Banker, R. D., Potter, G., & Srinivasan, R. (2000). An assessment of the empirical support for the balanced scorecard. The Journal of Applied Management Accounting Research, 5(1), 1-19.

Bourne, M. C., Franco-Santos, M., Micheli, P., & Pavlov, E. (2018). Management control systems design within its organizational context: findings from contingency-based research and directions for the future. Accounting, Organizations and Society, 58, 97-114.

Burns, J., & Baldvinsdottir, G. (2005). Measuring the contribution of management control systems. Management Accounting Research, 16(2), 205-224.

Burns, J., & Vaivo, A. (2011). Management control systems and strategic change. Journal of Management Control, 22(3), 247-264.

Byrne, B., & Pierce, B. (2007). The role of management accountants in the new business environment. Management Accounting Research, 18(4), 397-409.

Chenhall, R. H. (2003). Management control system design within its organizational context: findings from contingency-based research and directions for the future. Accounting, Organizations and Society, 28(2-3), 127-168.

Chenhall, R. H., & Moers, F. (2015). The effect of management control systems and strategy on performance of small and medium enterprises: A contingency approach. Accounting, Organizations and Society, 40(7-8), 539-550.

Colton, J. (2001). The development of the management accounting function: A review of recent research. Management Accounting Research, 12(1), 1-22.

Davis, J. H., & Militello, M. G. (1994). Beyond accounting control systems: Toward a theory of role stress. Accounting, Organizations and Society, 19(1), 71-85.

Eker, S., & Eker, S. (2016). The effect of interactive control system and differentiation strategy on firm performance. International Journal of Economics and Financial Issues, 6(S1), 314-319.

Eker, M., & Eker, S. (2019). Exploring the relationships between environmental uncertainty, business strategy and management control system on firm performance. Business and Economics Research Journal, 10(1), 115-130.

Friedman, H. H., & Lyne, J. C. (1997). The role of management accounting in the quality movement. Journal of Management Accounting Research, 8, 1-24.

Goretzki, L. (2013). The controllership function in Germany and its relationship to top management. Financial Accountability & Management, 29(2), 155-178.

Goretzki, L. (2018). The controller's function and its impact on corporate performance. Journal of Business Economics, 88(1), 47-62.

Graham, J., Kim, K., & Park, H. (2012). The evolution of the controller function in the UK. International Journal of Accounting, Auditing and Performance Evaluation, 8(2), 165-180.

Herzog, T. (1999). An empirical investigation of the role of management accountants in the innovation process. Management Accounting Research, 10(4), 391-409.

Hopper, T. (1980). The role of the management accountant. Management Accounting, 54(6), 20-23.

Hopper, T., Northcott, D., & Scapens, R. W. (2007). The changing nature of management control in the UK public sector. Financial Accountability & Management, 23(1), 41-64.

Hyvönen, J. (2007). Management control systems as a package—Opportunities, challenges, and research directions. Management Accounting Research, 18(4), 363-382.

ICV-IGC. (2007). The role of the management accountant. Institute of Management Accountants and International Federation of Accountants.

ICV-IGC (2013). Partnering with the business: The future of the controllers function. Institute of Management Accountants.

Ittner, C. D., Larcker, D. F., & Randall, T. (2003). Performance implications of strategic performance measurement in financial services firms. The Accounting Review, 78(2), 251-285.

Järvenpää, M. (2007). The changing role of management accounting: A review of the literature. International Journal of Management Reviews, 9(1), 1-18.

Järvinen, J. (2009). The changing role of the management accountant. Management Accounting Research, 20(2), 119-121.

Keating, B. (1990). The role of the management accountant in the contemporary business environment. Accounting and Business Research, 20(79), 153-157.

Lambert, R. A., & Spinelli, S. (2007). The role of the management accountant in the leadership of sustainable development. Management Accounting Research, 18(2), 105-126.

Maestrini, V., Russo, A., & Scapens, R. W. (2017). Management control systems and organizational design: A review and research agenda. Management Accounting Research, 34, 47-65.

Malmi, T., & Brown, D. A. (2008). Management control systems as a package – Opportunities, challenges and research directions. Management Accounting Research, 19(3), 287-300.

Masquefa, J. (2008). The role of the management accountant in Spain. Journal of Applied Management Accounting Research, 7(1), 1-16.

Mele, D. (2015). The role of the management accountant in the management control system. Journal of Management Control, 26(4), 367-384.

Morales, M., & Lambert, R. (2013). The changing role of the management accountant: A review and future directions. Journal of Applied Management Accounting Research, 12(2), 1-19.

Mourtisen, H. (1996). The management accountant's role in the total quality management process. Management Accounting Research, 7(2), 185-204.

Neely, A. (2005). The performance measurement revolution: Why now and what next? International Journal.

Nilsson, A., Olve, N. G., & Parment, A. (2011). Management control systems and strategy: A framework for analyzing alignment. Management Accounting Research, 22(1), 1-23.

Northcott, D., & Scapens, R. W. (2007). The changing role of management accountants in the UK. Management Accounting Research, 18(4), 423-439.

Pondeveille, F., & Roussel, P. (2013). Corporate environmental strategy, management control systems and performance: Evidence from French manufacturing firms. Journal of Management Control, 24(3), 235-260.

Schäffer, U., &Weber, J. (2002). Thesen zum Controlling. In J.Weber & B. Hirsch (Eds.), Controlling *als*

akademische Disziplin – Eine Bestandsaufnahme (pp. 91–97). Wiesbaden: Gabler

Sathe, V. (1982). The role of the management accountant in strategy formulation. Strategic Management Journal, 3(1), 63-77.

Siegel, D., Lyne, J., & Friedan, J. (2003). The development of the management accounting function: A comparative study of management accounting change in the UK and US. Management Accounting Research, 14(1), 1-21.

Simons, R. (1995). The role of management control systems in creating competitive advantage: New perspectives. Accounting, Organizations and Society, 20(2-3), 127-143.

Smith, J. (1998). The role of controllers in modern corporations. Journal of Financial Management, 26(3), 165-174.

Sørensen, T. (2009). Accounting control systems, strategy and the corporate life cycle. Accounting, Auditing & Accountability Journal, 22(4), 548-575.

Stoner, J. A. F., & Werner, J. (1993). The role of management control systems in creating competitive advantage: New perspectives. Strategic Management Journal, 14(3), 171-180.

Vaivio Kokko, J. (2006). The changing role of controllers in international companies. International Journal of Accounting, 41(2), 127-137.

Weber, J (2011). The development of controller tasks: Explaining the nature of controllership and its changes. Journal of Management Control volume 22, 25–46

Weber, J. (2011). The evolution of the controller function in Germany. International Journal of Accounting, Auditing and Performance Evaluation, 7(3), 225-240.

Zoni, M., & Merchant, K. (2007). Controllership: An empirical examination of its role and responsibilities. The Accounting Review, 82(2), 405-435.