# Research Master in Computer Audit, a current need

## Maestría de Investigación en Auditoria Informática, una necesidad actual

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**Abstract**
The present study demonstrates the importance of the design and creation of a Research Master's degree program in Computer Audit, in the current context, with a preliminary study, considering that studies of this type are scarce and that there is a great demand for professionals in the area of computer science who demand a fourth specialty level. The research question is: Is the creation of a Research Master's degree in Computer Audit relevant?
**Key words**: computer audit, research master's degree in computer auditing, postgraduate program

**Resumen**
El presente estudio demuestra la importancia del diseño y la creación de un programa de Maestría en Investigación en Auditoría Informática, en el contexto actual, con un estudio preliminar, considerando que los estudios de este tipo son escasos y que existe una gran demanda de profesionales en área de informática que demanda un cuarto nivel de especialidad. La pregunta de investigación es: ¿Es relevante la creación de un Máster de Investigación en Auditoría Informática?
**Palabras clave:** auditoría informática, maestría de investigación en auditoria informática, programa de posgrado

## 1. Introduction

Currently, there is the problem of society and professionals in the computer area, in accessing knowledge of techniques and computer tools to apply and complement their technical training in order to analyze systems, computer infrastructure, analyze risks and add to management of the computer audit in organizations and companies an integral model such as development of computer systems and system facilities for optimal

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management of the quality of people's work, regarding the processing and use of the Information and Communication Technologies necessary to facilitate the decision making at the managerial level.

The most advanced countries are those that have developed and maintained permanent scientific research processes in all areas of thought. The world progressed thanks to the knowledge that emerged in places of study. The university is an academic institution where knowledge is generated, and provides technical and specialized training to society. And the most important thing is that a good part of science and knowledge born in universities are selfless contributions to society.

Knowledge and development are usually enhanced through research and the responsible transfer of knowledge, but for this to happen it is also necessary to ensure that advanced higher education (postgraduate) programs are competitive in time and in the context in which the one they are immersed.

This article is generated within the framework of a research project that aims to determine the relevance of a research master's program in computer auditing and the support of the research group called MODSIM of the National University of Chimborazo.

This article presents a summary and its keywords, an introduction followed by the contextualization and the corresponding legal basis, in addition to indicating the methodology and the results obtained with the authors' discussion, finally the conclusions and recommendations.

## 2. Contextualization

As for the challenges that the world demands, we can highlight greater democratization of information, the intensive use of computer technology, tolerance for diversity and immediate response to problems that affect the local, national and international. Faced with these challenges, the actions of the actors are necessary, which requires continuous training, collaborative work, shared leadership, interdisciplinarity, innovation and sustainability. In response to these trends, international organizations such as the World Bank (BM), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Organization for Economic Cooperation and Development (OCDE) and, in the In Latin America, the Inter-American Development Bank (BID) and the Economic Commission for Latin America (CEPAL), among others, have given direction and attention to a series of elements that must affect a central part of specialization and postgraduate studies: knowledge, innovation Technological and international competitiveness. These three elements can be the engine of economic development of society. (Garcia, 2011)

The complexity of higher education in the region, from now on and towards its future, is revealed in a series of historical and emerging trends, in its heterogeneity, in its inequality, but especially in the role that public universities and some can assume very prominent institutions of higher education, to build a new scenario that contributes to the substantial improvement of living standards for their populations, and provides the possibility of greater well-being, democracy, and equality from science, education, and culture. (Gazzola, 2018).

The appearance of the first postgraduates in Latin America dates from the mid-twentieth century, one of the initials was in Venezuela with the specialty of Medicine (1941)

In Latin America and the Caribbean, postgraduate studies have grown exponentially, however, it does not necessarily mean that they respond to the needs of the country or region of application. The programs offered are dissimilar even within the same country, the currics aula, linkage objectives even with knowledge generation vary considerably. (Castellanos, 2017).

Postgraduate or tertiary education is the basic mechanism of transmission of new knowledge, the product of research, in which the understanding of theories, academies, methods, and knowledge is sought, in order to

prepare students for future work, and improve their cultural and personality development (Guerrero, 2011). All this through formal courses, participation in seminars, forums, panels and, above all, for the development of projects and an original thesis. (Garcia, 2011)

The dynamic effect of research on the success of curricula and educational institutions has been confirmed in recent works, and in general in works on factors determining the quality of academic programs (Guerrero, 2008; Buela-Casal and Castro, 2008).

Similarly, the research training that is part of the academic master's and doctoral programs must be qualified curricular. Methodology courses must be complemented with profound educational acts that boost the creative power of students and allow them to appropriate good habits for study, discernment, and understanding, as a starting point to then pass levels of creation and innovation.

Supporting the change of the productive matrix is necessary to promote the transformation and diversification of production, thus, one of the policies of objective 5: Boosting productivity and competitiveness for sustainable economic growth in a redistributive and supportive way, is to "promote research, training, development and technology transfer, innovation and entrepreneurship, protection of intellectual property, to promote the change of the productive matrix through the link between the public, productive sector and universities". (National Development Plan 2017-2021 - A Lifetime, page 83).

The main objective of this master's degree is for the student to develop the skills necessary for research in a particular specialty. The master's degree leads to the elaboration of research work or thesis that could be deepened in the doctorate.

The major problem that the participants experience in terms of attendance to the graduate courses is the distance between the school and the university. The biggest crux of this problem is due to the fact that the city where they work and the city where they take undergraduate education are different cities. It is also seen that the conflict between their schedule in the school and their schedule in graduate education causes problems in terms of attendance. (Çalisoglu,2019)

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has mobilized worldwide reflection on the new role of education and to look for mechanisms to guide institutions to put it into practice(Morin,1994), Lozada It highlights the usability of applications based on technologies without controls similar to MS-Kinect, and its support in teaching-learning processes, this being a little-explored field, since, in the case of new users, it is essential to analyze the cognitive abilities of these users when taking on the challenge of designing applications in the educational field. This analysis must be carried out with the purpose of not underestimating or overestimating the users in terms of their capabilities. (Lozada, 2019)

According to regulations of the Council of Higher Education (CES) of Ecuador, there is only specialization, masters and doctorate in the level of postgraduate training. To date, master's programs that are valid for receiving new students in most Ecuadorian universities and polytechnics are being offered, but none of them have as a postgraduate academic offer a Master's Program in Research in Computer Auditing.

From the field of Research Projects developed in recent years, there are multidisciplinary research groups that are developing several research projects, this project is supported by the ModSim group, Modeling and Simulation Research.

The realization of Postgraduate Programs in Education in Ecuador is one of the most felt needs for the harmonious development of the educational system, since it is during the fourth level or postgraduate in which specialists from the different areas that a country requires are trained In this context, the need to promote

research, and training is necessary to carry out interdisciplinary and transdisciplinary studies in computer research, with the intention of generating knowledge and tools that allow establishing appropriate and specific mechanisms in computer audits. The importance of Information Technology (IT) in our day to day is undeniable. Therefore, it is vital that software systems are properly audited, which is a fundamental task to save costs and achieve high levels of productivity. Those with a Research Master in Computer Audit will be IT professionals who can perform audits by establishing and analyzing controls to avoid risks in the use of IT.

The instrument for the preparation of postgraduate projects is based on the provisions of the Regulations for the Presentation and Approval of Degree and Postgraduate Programs and Programs of Universities and Polytechnic Schools, through Agreement No. CES-CPPSO.036-No. 147-2014, issued at the Thirty-Sixth Regular Session of the Permanent Postgraduate Commission of the Higher Education Council, held on Thursday, August 21, 2014. And updated by Agreement ACPP-SE-010-No.100-2016, issued at the Tenth Special Session of the Permanent Postgraduate Commission of the Higher Education Council, held on October 24, 2016.

Ecuador is committed to the development of human talent and educational quality as key principles for moving from a primary economy to a new one based on knowledge. In this context, the Ecuadorian university faces the great challenge of being a source of change for being in a privileged place, to be able to influence people and contribute to the reform of thought that is required to consolidate a society of good living, (Larrea, 2014)

In this sense, the principle of relevance acquires a new dimension and becomes an articulating axis of the essential functions of the university; In the same way, it is essential to establish the connection points of these functions with the so-called nuclei that enhance good living, which, as the name implies, "energize local and national realities through the integration of three components: knowledge, development contexts and stakeholder participation […] "(Larrea, 2014)

This article seeks to identify the relevance of the Master's Degree and Research in Computer Audit and is justified by the demand it has for professionals graduated from the careers of the computer area of higher education institutions in Zone 3 and the need for a program Fourth-level master's degree that transmits scientific and technological knowledge, with social responsibility, as a result of a dynamic articulation with the actors at the service of the community contributing to the development of Ecuadorian society.

## 3. Legal base

Fourth level training in Education in Ecuador is a felt need in terms of overcoming gaps and transforming educational quality: a challenge posed by the National Plan for Good Living. (Castellanos, 2017). With the creation of organizations such as the Higher Education Council (CES) and the Higher Education Quality Assurance Council (CACES), it positively influences the approval of postgraduate programs in accordance with compliance with current regulations.

In Ecuador, the legal regulations indicate that a master's degree is an "academic degree that expands, develops and deepens the theoretical, procedural and procedural study of a complex or multidimensional professional or scientific field, organizing knowledge with applications of disciplinary methodologies, multi, inter and transdisciplinary. The master's degrees can be professional or research. (Regulation of Academic Regime - - RRA), also defines as a Research Master's Degree that "deepens training with theoretical and epistemological emphasis for research articulated to institutional research programs or projects. To pass from a professional master's degree to a research one, the subjects or their equivalents in the field of advanced professional training may be homologated and courses in the fields of advanced research training and epistemological training must be approved; as well as develop the thesis ". Additionally, it is indicated that a time load between 2,640 hours and 2,760 hours is required, with a minimum duration of four semesters or other periods, equivalent to sixty-four

weeks, with full-time dedication. This type of master's degree may be qualifying for admission to a doctoral program, prior to the fulfillment of the additional requirements established in the Doctoral Regulations.

Regarding the degree aspect, 800 hours will be allocated for the purpose and the work of the research master's degree must be submitted to public defense, which can only be carried out when the student has approved all the subjects, courses or its equivalents and meet the other requirements established in the program, the degree work will be the thesis, which must have a basic or applied research component of a descriptive, analytical, explanatory, comprehensive or correlated nature. Its elaboration will respond to the scientific conventions of the respective field, being able to use the discipline's own methods or multi, inter or transdisciplinary methods, as an additional qualification requirement, the student will deliver the certification of presentation of a scientific article related to his research, in an indexed magazine

In research master's programs, because of their full-time dedication, the teaching component may not exceed 6 hours per day. Only exceptionally and justifiably, in the case of foreign guest teachers, some days of the teaching component may be executed on the weekend. (art. 47)

These types of programs should deepen the knowledge of the epistemology of science and develop research projects of an explanatory or comprehensive nature with a clear contribution to the area of knowledge; they can be approached from discipline methods or multi, inter or transdisciplinary methods. As a student of the Master in Audit of Technologies and Information Systems, you have the opportunity to carry out professional practice and fully implement the knowledge acquired these two years of sharing and acquiring knowledge from a series of professors and colleagues with a lot of experience in the area of information technologies (Guzmán, 2007)

## 4. Materials and methods

The present investigation is carried out in two moments, a moment of bibliographical revision of the legal basis and the conditions of training in research, specifically in computer audit, and the second moment of social study to determine the relevance and need of a formal study program. For the systematic review of the literature, the following methodology is applied.

- **Research question:** Is the creation of a Research Master in Computer Audit relevant?
- **Area**: Computer science - Postgraduate training
- **Source**: Books, Technical reports, projects, and legal basis.
- **Search engine:** google academic
- **Search Criteria:** postgraduate law, research masters programs,
- **Inclusion criteria:** validity of the law, location of master's programs
- **Exclusion Criteria:** laws and regulations that are not from Ecuador, that the law is not in force, that the master's programs are not research or are not in force, or are not in the area of application.
- **Content evaluation:** It must contain the implementation characteristics of a master's program and the relevant legal basis.

Applying the Methodology Research you get to the following table of values:

**Table 1**
Methodology Research Result

| Search Criteria (in Spanish) | GOOGLE ACADEMIC |
|---|---|
| **Postgraduate Regulation (since 2017)** | 59 |
| **research master's degree (since 2019)** | 115 |

Prepared by: The authors

## 4.1. Information Analysis

From the application of Methodology Research, applying the inclusion and exclusion criteria, the present study has at least 15 publications analyzed.

Due to the nature of the research, it was necessary to put into practice the fusion of the approaches: qualitative and quantitative to achieve the objectives set. This is justified because the combination of the two techniques allows to carry out relevant educational research and evaluations, according to Goetz and Le Compte (1988); Thus, based on the regulations, the research process was: 1) Identification of the relevant variables, 2) Analysis of the National Plan of Development A lifetime, focused on actions for the change of the productive matrix for the Development zone 3. 3) Analysis of the expectations of the graduates in the area of research in computer auditing. With this information a survey is designed and a descriptive conclusive type of design of individual cross-sectional sample design is applied and with applied in the focus group of zone 3.

The demand and employability study was based on the descriptive research method, being of a quantitative type and its cross-sectional study since the data was analyzed at a certain time.

The characteristics of the study population, work, measure of contribution to the performance and development of organizations in the area of ICT are determined.

For the analysis, the higher education institutions of development zone 3, made up of the provinces of: Cotopaxi, Tungurahua, Chimborazo and Pastaza, are considered. The population is 448 professionals located through the Fraternal HEI Graduate Tracking database, corresponding to the last 5 and 3 years, with a cut-off in 2019. The sample size with a 95% confidence level and a margin of error of 5% is set at 207 participants.

The instrument used for data collection is a survey consisting of 11 questions and was generated online, which allowed obtaining information on (a) the need and interest to study a master's degree, (b) competitiveness and job growth advantages. In general, allowing to know the evaluation criteria between the professional profile versus the academic offer of the master's program.

The survey was sent to the emails of the graduates of the systems and computer and related careers of the National University of Chimborazo, the Higher Polytechnic School of Chimborazo, the State University of Bolívar, the Technical University of Ambato, as well as the college of Engineers in Computer and Computing Systems of Chimborazo, in order to know the perception of the subject matter treated and the demand and employability of the proposal.

Making an analysis between the last three years, that is, 2016, 2107 and 2018, a decrease of 6 133 and 5872 records of titles for each year respectively is evident, and therefore a decrease in professionals between 2017 and 2018, meanwhile there is a increase of 2643 and 669 degrees and professionals respectively per year who decided to study for some reason in another country(Senescyt, 2018)(Sniese, 2018).

In an analysis of the total of companies with investment in ICT, information with a cut to 2015 (INEC, 2015), the changes produced in the productive and service organizations are recognized. Small, medium and large companies make investments of 66%, 73%, up to 85% in Information and Communication Technologies. Therefore, it is necessary to have educational programs focused on the improvement and specialization of workers in the area, guaranteeing their job permanence and, in the same way, it is the opportunity to hire new qualified personnel in the management of computer technologies and information processing.

## 5. Results and discussion

According to (Shadish W., 2002), to reduce the threat to the validity of the statistical conclusion, aspects explained below are taken into account.

The questionnaires were answered with the same scale, in the same period of time and by all the actors involved, without there being a change of environment in that period of time. It was done anonymously, however, there is an additional document that the actor has signed as proof of its application.

In the internal threat to validity, the effect of history has not been considered, since there is no master's program in implemented auditing, there are no threats of selection bias, because, in the institution where the survey is applied, they have not been selected groups, and all actors have the same level of knowledge.

In the external threat of validity, there is no risk of interaction, since the sample is the total population of the applied institution.

This result can be extrapolated to all cities that have similar environments, in Ecuador, this result is useful anywhere.

The following results are obtained from the survey applied for the relevance analysis of the research master's degree in Computer Audit.

For the most part, 72.15% of respondents belong to a public institution, as well as the main reason for a master's degree to improve job performance with 49,15%, knowledge update with 21.19%, demands of the environment with 19.89%, and finally for a particular interest 9.77%, an inclination to the improvement of work performance is determined.

Additionally, it is obtained that there is a priority to the fact that the title is offered with 45.11%, follows the priority of the trained teaching staff with 26,87%, compared to the infrastructure of the institution of higher education with 23.76 % and the cost of the program 4,26%, which evidently translates into interest in the degree issued and the quality of training.

The 89.68% of respondents consider it appropriate to carry out master's studies, and 76.43% would be interested in a master's degree in research in computer auditing

Regarding the modality of studies, 82,43% prefer presidential modality, as well as semi-potential, 15,04% prefer the online modality and 2,53% the distance modality.

The form of payment of the program costs is distributed with 38.65% semiannually, 26,81% prefer to do it with a single payment with a discount, 21,62% prefer payment by modules, and 13,92% in monthly payments.

The survey also evaluates the theoretical, professional, investigative and axiological competences to build a suitable curriculum, and the following results are obtained.

When consulting about the advantages in the theoretical field and which would generate greater competitiveness and labor growth, considering these advantages the following: a) Technical Methods and tools for evaluation, audit, internal control and risk management of Information Technology, b) Regulations and Good practices focused on the audit of Information Technology, c) General knowledge of security and audit of Information Technology and d) Development of skills for document management, on a Likert scale from 1 to 5, 31% inclined towards the maximum valuation, 44% for a 4-peso valuation, 13% for an intermediate valuation, 7% for a valuation of 2, and 5% with the lowest valuation of 1. This evidently indicates that 75% consider that the theoretical competences mentioned would generate greater competitiveness in job performance.

When consulting about the advantages in the professional field and which would generate greater competitiveness and labor growth considering those advantages the following: a) Plan, design and execute projects of Information Technology audits. B) Align the audit projects with accepted regulations and good practices, and with IT governance, on a Likert scale from 1 to 5, 67% chose the maximum valuation, 18% for a valuation of Weight 4, 8% for an intermediate valuation of 3, 4% for a valuation of 2, and 3% with the lowest valuation of 1. This evidently indicates that 85% consider that the professional competencies would generate greater competitiveness in work performance.

When inquiring about the advantages in the research field and which would generate greater competitiveness and job growth, considering these advantages the following: a) Research in Government of information security, Audit and business continuity management, b) Research in Business Management organizational change, C) Investigation in IT Services Management, d) Fraud and Legislation Investigation of electronic crimes, on a Likert scale from 1 to 5, 83% were inclined to the maximum valuation, and 17% by a valuation of weight 4. This evidently indicates that 100% consider that the aforementioned research skills would generate greater competitiveness in job performance.

Finally, when consulting about the advantages in the axiological field and which would generate them greater competitiveness and labor growth, considering these advantages the following: a) Research in good practices of ethical leadership in all the actions carried out by the professional of audit of Technologies of the Information., B) Research in self-regulation skills in terms of self-control, reliability, integrity and adaptability, on a Likert scale from 1 to 5, 46% were inclined to the maximum assessment, and 54% by a weight assessment 4 This indicates that 100% consider that the theoretical competences mentioned would generate greater competitiveness in job performance.

## 6. Conclusion

According to the data obtained in this study, the research question posed is positively answered, since by obtaining that the majority of respondents indicate that the master's program will allow them to improve work performance, update knowledge, meet the requirements of the environment and improvement of work performance.

In the same way, most respondents determine that the study of a research master's degree in computer auditing contributes highly to the theoretical, professional, investigative and axiological competences.

The realization of postgraduate programs through interdisciplinary and transdisciplinary studies allows establishing adequate and specific mechanisms to promote research, education and training. The master's degree program in information technology auditing contributes to the development of the territory not only in zone 3 but also at the National level, since many medium and large companies are modernizing their computer and information systems.

In this sense, the study program that is presented, in addition to defining professional profiles, demand and employability, has the independent function of training professionals in Information Technology capable of conducting audits in organizations or companies, establishing an efficient and effective control and evaluation of computing environments, at the same time they become consultants and specialists in aspects of security and risks, veracity, integrity, analysis and availability of information.

This master's degree contributes to the general mission of the National University of Chimborazo, to the National Development Plan in its short and long-term vision, in addition to training professionals in accordance with scientific-technological trends and development, through processes that involve teaching with research, management and connection with society, capable of proposing comprehensive solutions based on local, national and international problems. In addition, it is justified by the projection made with respect to the demand of the graduated professionals of the careers of the computer science area of the institutions of higher education of zone 3 and the need to have a fourth level program that helped to acquire knowledge scientific and technological, with social responsibility, as a result of the dynamic articulation of the academic and the demand of Ecuadorian society.

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