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Social approaches to the 2030 business challenge in Ecuador: migration to free software and statistical projection

Enfoques sociales del desafío empresarial 2030 en Ecuador: migración al software libre y proyección estadística

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Original article

Abstract

Introduction: the social approaches to the 2030 business challenge in Ecuador gave an introduction to the technological paradigm of the migration to Free Software. **Objective**: to institute actions in favor of corporate advancement through Exploratory Research. **Method**: based on experimental procedures, Inferential Statistics enabled the GNU/Linux competencies as a sample. **Results**: the projection of Software, as an exchange, was discovered as freedom of expression, with 2030 as the deadline. This is to the extent that Ecuadorian companies migrate computationally and delve into the operational evolution of user computing as a literal proposition of 'Good Living'; forging innovation. **Conclusion**: appealing to interoperability, as a connection in technological development, the boom in research was framed within a pioneering Operating System. So, in terms of flexibility, it was transformed into an appendix intended for identifying patterns in a globalized world and thus, commercial organizations could emerge in the business field.

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Keywords: business; Ecuador; free software; Linux; statistics

Resumen

Introducción: los enfoques sociales del desafío empresarial 2030 en Ecuador dieron preludio al paradigma tecnológico de la Migración al Software Libre. **Objetivo**: i nstituir acciones en pro del avance corporativo mediante la Investigación Exploratoria. **Método**: con base a procedimientos experimentales, la Estadística Inferencial viabilizó las competencias GNU/Linux como prototipo. **Resultados**: la proyección del Software, como intercambio, fue descubierta como libertad de expresión; con 2030 como fecha límite. Tanto cuanto, la empresa ecuatoriana migre computacionalmente y se adentre en la evolución operativa de la Informática de usuario como literal pro del 'Buen Vivir'; forjando innovación. **Conclusión**: apelando a la interoperabilidad, como un nexo del desarrollo tecnológico, se encuadró en la bonanza de la investigación dentro de un Sistema Operativo pionero. Entonces, en términos de flexibilidad, se transformó en un apéndice destinado a la identificación de patrones en un mundo globalizado y así, las organizaciones puedan surgir en el campo de los negocios.

Palabras clave: Ecuador; empresa; estadística; Linux; software libre

Introduction

This research explores the challenge Ecuadorian companies face by 2030: migrating to Free Software (FS). Then, consulting online resources was vital to the development of this article; citing sources from portals such as Scopus, Paperpile and RefWorks. So, these platforms, along with the Digital Object Identifier (DOI), facilitated the cross-referencing, confirmed the main objective and provided perspectives for the study of the proposed business paradigm; considering, the principles of Exploratory Research (ER) to formulate its hypothesis.

It is then, as background to study, that in this country, the business world has undergone a great transformation since the technological boom; especially in the area of Information and Communication Technologies (ICT). However, as a consequence, modernization has brought revolutionary paradigms within the universe of Research and Development (R+D) and has driven digitalization by promoting FS; their migration may be an inconvenience for users (Wang *et al.* 2024; Zhang *et al.* 2024). But, as a consequence, modernization has brought revolutionary paradigms within the world of

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R+D and has driven digitalization by promoting FS; migration can be an inconvenience for users. This is accentuated, for example, if we consider the manipulation of logic automation as a technical complement to robotics. In fact, there is sign that underlies its importance within any discipline and even more so when seeking open access; mainly, when operational productivity has been achieved. To the extent that migration to the FS, mainly Linux, represents a dynamic exchange within the mission of ICT for commercial companies and its typology fits the technological scarcity; provided that it is recognized as missing digital infrastructure.

Development

Given the evolution of Ecuador's institutional environment, it is necessary to consider the context in which it operates. Likewise, the 'Good Living' paradigm refers to technology as an engine of development and to the quality of national production as the foundation for investment; this strengthens the R+D process within the technology. Therefore, as a finding, this principle encourages migration to FS and as a limitation, it considers the process as a challenge; moreover, when interoperability exists.

Challenges and Perspectives of the New Ecuadorian Business Structure

Ecuadorian businesses have undergone a significant transformation in recent decades; adapting to constantly changing social, economic and political contexts. In other words, Ecuador possesses a diversity of natural resources; however, it also faces challenges in providing quality production. Then, "…despite progress, shortcomings persist in some areas; especially in the manufacture of finished products. But the need to modernize the production system is becoming increasingly urgent; mainly in a world where technological advancement demands skills" (Lyudmyla *et al.,* 2024, p. 198). Whereby, since the government of Rafael Correa Delgado [2007; 2017], the country is in a privileged position and thus benefits from international experiences; learning from successful models that involve innovation.

Thus, from this perspective, the stance of business leaders is to seek objectivity in the face of the technological challenge. Likewise, production system is characterized by institutional multiplicity. This means that, "…over the years, it has evolved to adapt to the needs of the population and the market. It is composed of business organizations of different kinds; each with its own vision and objectives" (Rahmawati *et al.,* 2023, p.

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172). So, every company, public or private, offers products according to social needs. But it responds to demand in specific areas and for the benefit of its implementation, the Código Orgánico de la Producción, Comercio e Inversiones (COPCI) establishes regulatory frameworks that promote quality; in addition, to guaranteeing access to products regulated by the Cámara de Industrias y Producción (CIP). Also, the Código de Comercio (CC) supports its structure at different levels; both, administrative and judicial. This paves the way for economic progress as the foundation of the Ecuadorian State and, being a pillar, has parameters that define the institutional framework; being, a compilation of rules that endorse the operation and organizational functioning. Then, based on this, the Ministerio de Producción, Comercio Exterior, Inversiones y Pesca (MPCEIP) it complements its structure with the accreditation of the venture; ensuring that the work adheres to international standards. Likewise, the Ministerio de Trabajo (MDT) supports tactical planning within the informal sector and addressing challenges through the regulations established by the modernization of the State; while adapting to sociodemographic demands.

In the case of workplace equity inequalities arise that affect the stability. These differences are reflected not only in the infrastructure and available resources; but also, in job opportunities (Russen and Dawson, 2024; Kamal and Chandrakala, 2024; Qin, 2025). Therefore, this indicates that the coastal region, especially the city of Guayaquil, has a productive society dedicated to commerce; which increases the national wealth. The opposite occurs in the mountainous regions, especially in urban areas like the Distrito Metropolitano de Quito, where state institutions abound and promote the life cycle of every employee until retirement; therefore, programs to attract young people are not well received. Though, in the Amazon region, the situation is worse; given the scarcity of businesses. But the situation is worse in that region, given the scarcity of businesses.

As consequence, some indigenous communities rely solely on agriculture and raising livestock; which severely limits their economic activity. In the field of R+D, it is vital to highlight that it should become a fundamental pillar for the development of the State. Therefore, despite progress, some institutions; especially those at the state level that face difficulties in changing; since they only partially implement the guidelines that

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address technological training. It is worth noting that this initiative should foster knowledge generation and involve staff in creating solutions (Gauttier *et al*., 2024). So, conducting research addresses technological issues and in Ecuador, of all the existing university centers, few dedicate time to this; Pontificia Universidad Católica de Ecuador (PUCE) as case. Subsequently, since 2007, the National Government has attempted to raise awareness among the Ecuadorian population about the importance of R+D for community and to promote policies that incentivize investment in science; however, with limited success. In other words, years ago, some private corporations established online training partnerships; case of IBM International with Red Hat Enterprise Linux (RHEL). This fostered the exchange of knowledge and participation in technological research structures. So, these agreements not only enrich the commercial experience but also position the country within the global stage; particularly, within the framework of business dynamics.

Consequently, through on-the-job training programs, employee participation is considered a guarantee of a new corporate culture. It should be noted that institutional strengthening incorporates human resources and their skills to support digitalization. In other words, corporate techniques, at least in Ecuador, have evolved favorably since the COVID-19 era and, at the same time, have promoted technological environments related to FS. In this context, learning platforms, such as evolCampus, include digital repositories to support administrative management; fostering human interaction. So, these portals have become allies of senior management; especially by enabling the creation of virtual environments that overcome geographical distances.

It is worth highlighting the availability of Open Technological Resources (OTR) as they provide a methodology that democratizes access to free applications; for PCs and Internet. This macrosystem is considered an integral part of the virtual universe and its purpose is to facilitate collaborative work in the user's computing environment.

Furthermore, this methodology is innovative and removes barriers to enhance its development, as is currently the case with the Artificial Intelligence (AI) paradigm. Therefore, this branch is not only useful for corporate data analysis, but also fosters cooperative work. It adapts to the company's needs and leverages digitalization to address technological challenges. But, "…the lack of training in cooperative work does

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not guarantee human connectivity and therefore, it is essential to have a standard that integrates digital resources with the participatory timeline; promoting ICT in a positive way" (Yen, 2024, p. 177). Obviously, becomes relevant when digitization is introduced into the world of FS; being an analog-to-digital conversion process.

The Free Software Migration Paradigm and its Technological Procedure

"The migration to FS represents a momentous change in the way all institutions manage ICT and because of this, its features must be aligned with needs; above all, with its flexibility" (Lanko and Sarapulova, 2024, p. 178). Therefore, in a context where Proprietary Software imposes restrictions on its use, FS promotes models where the user has the right to share. This fosters a philosophy of cooperation and the continuous improvement of collaborative work; for this reason, has gained relevance worldwide. Perceptibly, in search of control over operations and the execution of a new paradigm. Also, acquisitions benefit and security are improved; even more, so when considering the privacy of information and its protection when sharing.

However, Software Migration entails challenges that must be managed through student adaptation and dual interoperability of present Operating Systems (OS). Thus, strategies must be addressed to achieve efficient processes and create an optimal infrastructure; providing decisions for the transition. Unfortunately, to obtain proprietary Software you must pay at least a license fee; this is very expensive for the average citizen. But, for small and medium-sized institutions, opting for open-source solutions is the best choice; as flexibility is their hallmark. At the same time, having access to the source code makes it possible to modify and adapt applications to specific needs; for ex., using Akaunting instead of Freshbooks.

In other words, migration to FS presents challenges that can hinder the process and the obstacle is resistance to change; starting with the top management of national and international corporations. "It should be noted that this paradigm stems from staff accustomed to working with proprietary Software; showing disinterest and opposition to changing their routines" (Miss, 2024, p. 428). Though, this stubbornness can be exacerbated by fear of the unknown; leading authorities to implement strategies for its elimination. At the same time, it is primordial to ensure compatibility indicators with existing OS; case of Windows, GNU/Linux and macOS. Furthermore, it is essential to

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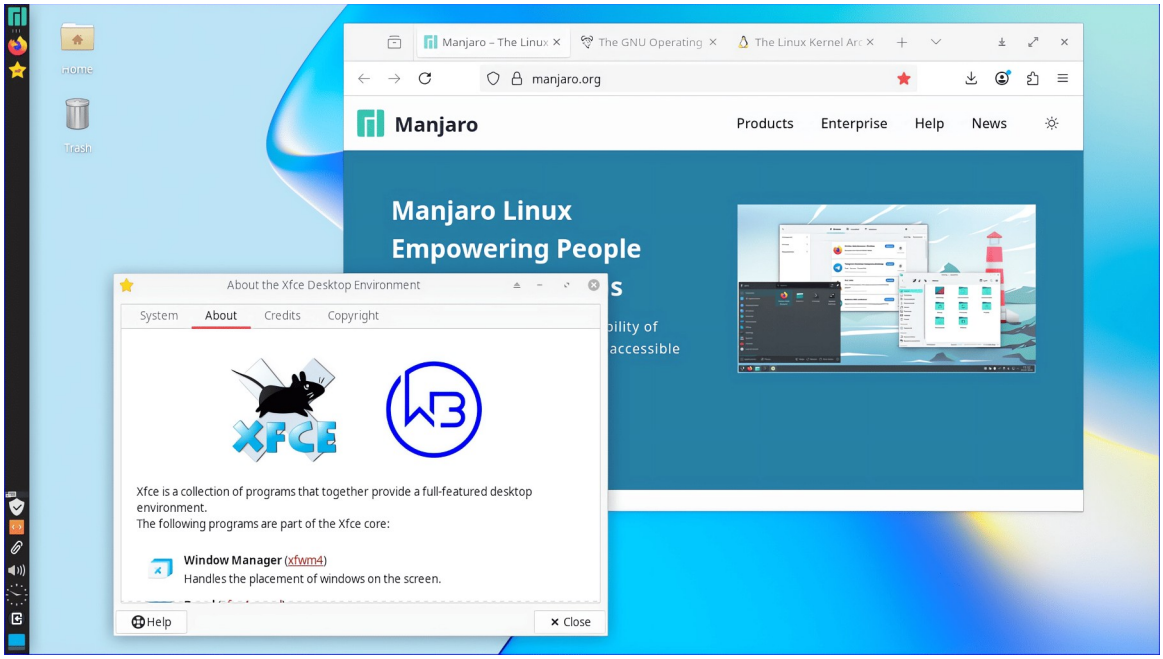
guarantee that Hardware incompatible with FS will not be used; mainly, dot matrix printers. Previously, an investment was required; this caused problems, slowed down the process and made staff training vital. But the success of the migration will depend on the team's ability to adapt, effectively use the new Software and know how to operate it for the benefit of the business world; this is exemplified in Figure 1.

Figure 1

The GNU/Linux operating system as a replacement for Ms. Windows



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Apart from all this, this is possible by implementing customized solutions that optimize process efficiency; such as Computer Audit and the Kali Linux as its engine. Thus, security and privacy are crucial aspects within an increasingly threatening digital environment. Therefore, when using open-source software, enterprises must work with BSD (Berkeley Software Distribution) distributions; OpenBSD is recommended due to its high level of development in computer security. Apparent, this UNIX-like distribution enables processes to audit the source code and uncover hidden processes of unethical hacking; such that adware includes phishing. Subsequently, this is the most ideal way to identify and correct vulnerabilities. Also, FS promotes free access and guarantees the evolution of its technological tools; case of the Business Administration (Jain *et al.,* 2023; Khazaei, 2021; Ali and Muhammad, 2021). At this argument, the FS Migration

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strategy requires meticulous planning that considers organizational factors. So, first and foremost, it is essential to establish leadership; by designating a team to manage it. Therefore, this team must analyze the status of the technological infrastructure and conduct an inventory of applications and computer systems. Then, "…this planning should include timelines that consider migration phases, necessary resources and risks. At that moment, it is vital to involve stakeholders, communicate the benefits and build trust so that staff feel confident" (Khurma *et al.,* 2021, p. 15). Furthermore, there is massive participation from companies and for this, it was important to develop a strategic plan to integrate operational planning; in this way, loyal employees emerge and those who grow alongside the goals. Visibly, pilot testing must be established as a key strategy within the migration process; implementing prototypes to evaluate functionality and identify problems. So, an optimal working group must be chosen and feedback provided on their actions; ensuring that performance is optimal within the usability of the new system. Thus, during this phase, it is valuable to make adjustments based on user observations and requirements. This approach not only helps mitigate any problems that arise, but also generates a sense of ownership; which is crucial for a successful transition. In this sense, the gradual implementation of FS does not imply interruptions in institutional operational management, this strategy allows for changes to be made in stages and guarantees their consolidation; subsequently, technical support can be established to manage the new tools.

Big Data Inferential Projection, Five Years, of the Migration to Free Software

The use of Big Data is crucial for solving problems in Inferential Statistics. Thus, within the framework of FS Migration, this section presents challenges; especially, in the future estimation of certain technological procedures. Obviously, the high priority of this social approach, particularly in Ecuador's Business Challenge 2030, fosters a retrospective perspective. This is because the massive volume of data links the census sample to the evaluation of results and becomes causal objectivity; which in turn provides predictive models. Whereby, "…the volume of projective information becomes scalable and its relevance lies in delving deeper into the definition of adaptive concepts; by applying apposite computer tools. In other words, this analysis focused on statistical sampling" (Prateek and Maity, 2023, p. 294). Subsequently, this trend

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provided parameters under the presence of massive volumes of data; this transforms the online survey into an active process that validates the participation of engaged staff. Furthermore, at this point, the variable reduces variance and parallelization of Big Data process methods by aggregating complex datasets; containing information about the structure, content and quality of the data collected.

Then, as shown in Figure 2, the surveyed personnel were identified and a portal dedicated to handling large amounts of data was used; specially, the Apache Hadoop[1] portal. This online portal provided coding environments and allowed statistical analysis in 15 Ecuadorian companies; at 10 public (2318 persons) and 5 private (895). But the period considered for this purpose was [Jun 2025;Nov 2025]; as determined by the Senior Management of each corporation. Hence, the Sample size (n) was calculated based on Universe (N) of 3213, Confidence level (Z) of 95 %≡1.96 and margin of Error (e) of 5 %=0.05. Likewise, Probability of Occurrence (p) in 85 %=0.85 and Probability of Non-Occurrence (q=100–p) in 15 %=0.15

Figure 2

Sample calculation parameters applying representative population data

$$n = \frac{NZ^2pq}{e^2(N-1) + Z^2pq}$$

Therefore, the Sample (n) was reduced to a finite number of 185 employees. Using this information, it was possible to create a trend line, predict its behavior and estimate it within intervals. Thus, having Xi (with i=1,2,…,n) as input values, shown in Figure 3, a Parametric Function was constructed. So, this function contained decimal values and was represented by a waterfall-type curve. Also, it was demonstrated that the Statistical Sampling Interval reached 6.9 % and Probability associated with higher values reached 0.6 %. Then, since this value was close to 0, the validity of the trust in the pilot surveys was verified and this is the result of a Complex Combination (CC); above all, legitimizing cases. In this way, employees understood their commitment to the migration to FS and responded with high participation.

Figure 3

[1] It's an Apache platform that, being online, provides an open-source environment. This open-source code supports the statistical manipulation of massive datasets and, consequently, is a collaborative project that maintains local copies of the information; Yahoo! is a prime example.

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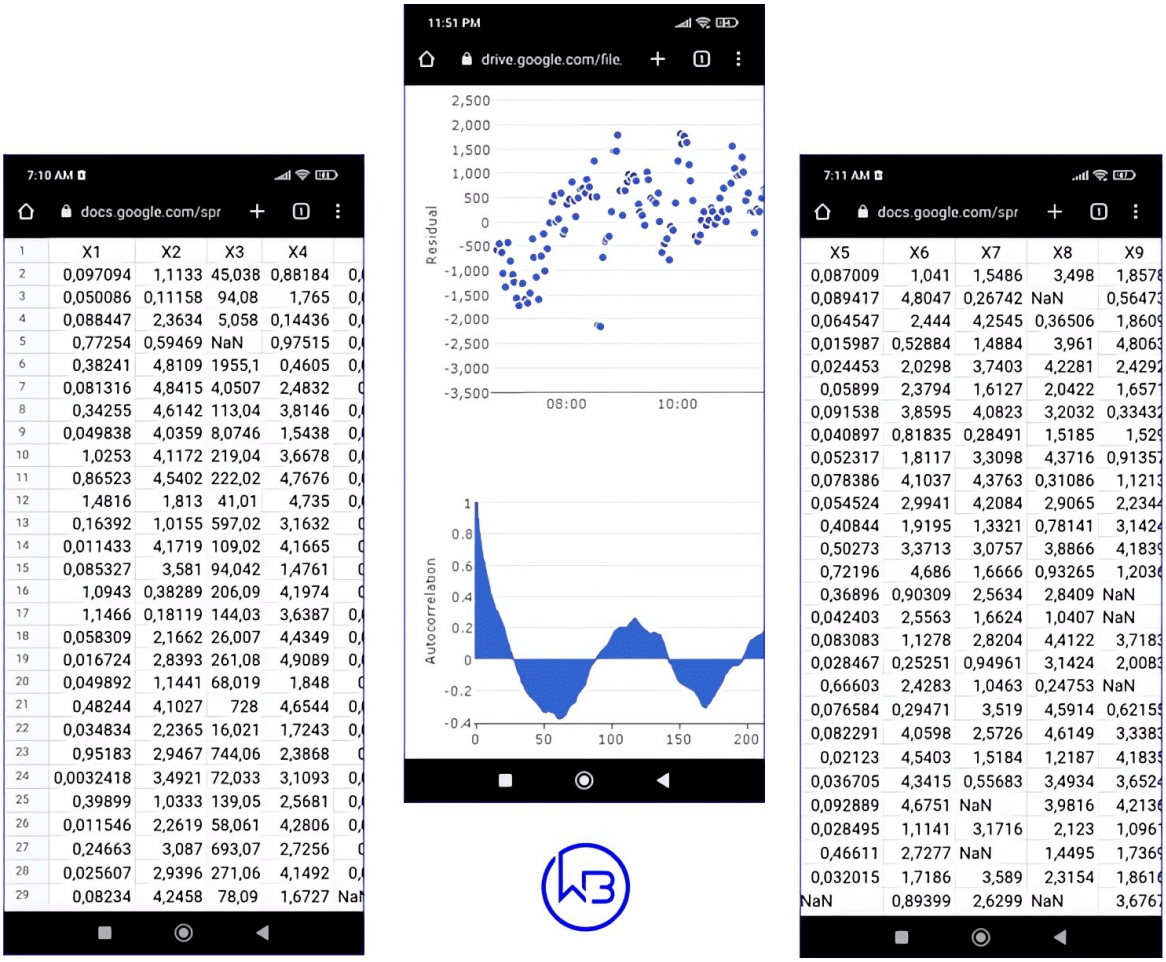
Analysis process between the Big Data technique and its data matrix



	X1	X2	X3	X4
2	0,097094	1,1133	45,038	0,88184
3	0,050086	0,11158	94,08	1,765
4	0,088447	2,3634	5,058	0,14436
5	0,77254	0,59469	NaN	0,97515
6	0,38241	4,8109	1955,1	0,4605
7	0,081316	4,8415	4,0507	2,4832
8	0,34255	4,6142	113,04	3,8146
9	0,049838	4,0359	8,0746	1,5438
10	1,0253	4,1172	219,04	3,6678
11	0,86523	4,5402	222,02	4,7676
12	1,4816	1,813	41,01	4,735
13	0,16392	1,0155	597,02	3,1632
14	0,011433	4,1719	109,02	4,1665
15	0,085327	3,581	94,042	1,4761
16	1,0943	0,38289	206,09	4,1974
17	1,1466	0,18119	144,03	3,6387
18	0,058309	2,1662	26,007	4,4349
19	0,016724	2,8393	261,08	4,9089
20	0,049892	1,1441	68,019	1,848
21	0,48244	4,1027	728	4,6544
22	0,034834	2,2365	16,021	1,7243
23	0,95183	2,9467	744,06	2,3868
24	0,0032418	3,4921	72,033	3,1093
25	0,39899	1,0333	139,05	2,5681
26	0,011546	2,2619	58,061	4,2806
27	0,24663	3,087	693,07	2,7256
28	0,025607	2,9396	271,06	4,1492
29	0,08234	4,2458	78,09	1,6727

X5	X6	X7	X8	X9
0,087009	1,041	1,5486	3,498	1,8578
0,089417	4,8047	0,26742	NaN	0,56473
0,064547	2,444	4,2545	0,36506	1,8609
0,015987	0,52884	1,4884	3,961	4,8063
0,024453	2,0298	3,7403	4,2281	2,4292
0,05899	2,3794	1,6127	2,0422	1,6571
0,091538	3,8595	4,0823	3,2032	0,33432
0,040897	0,81835	0,28491	1,5185	1,529
0,052317	1,8117	3,3098	4,3716	0,91357
0,078386	4,1037	4,3763	0,31086	1,1213
0,054524	2,9941	4,2084	2,9065	2,2344
0,40844	1,9195	1,3321	0,78141	3,1424
0,50273	3,3713	3,0757	3,8866	4,1839
0,72196	4,686	1,6666	0,93265	1,2036
0,36896	0,90309	2,5634	2,8409	NaN
0,042403	2,5563	1,6624	1,0407	NaN
0,083083	1,1278	2,8204	4,4122	3,7183
0,028467	0,25251	0,94961	3,1424	2,0083
0,66603	2,4283	1,0463	0,24753	NaN
0,076584	0,29471	3,519	4,5914	0,62155
0,082291	4,0598	2,5726	4,6149	3,3383
0,02123	4,5403	1,5184	1,2187	4,1835
0,036705	4,3415	0,55683	3,4934	3,6524
0,092889	4,6751	NaN	3,9816	4,2136
0,028495	1,1141	3,1716	2,123	1,0961
0,46611	2,7277	NaN	1,4495	1,7369
0,032015	1,7186	3,589	2,3154	1,8616
NaN	0,89399	2,6299	NaN	3,6767

Note. Own authorship

Accordingly, the timeline was set at m=60 months (5 years) and the following variables were used in the calculation for tabulation of Google Forms: Chi-Square (x^2), Observed Frequency (o_i) and Expected Frequency (e_i); see Figure 4.

Figure 4

The Chi-Square distribution applied to the topic of migration to Free Software

$$x^2 = \sum_{i=1}^{m} \frac{(o_i - e_i)^2}{e_i}$$

Based on this data and using quantitative indicators, a Systemic Projection (PS) was carried out. This projection analyzed the phenomenon and supported the forecast of the resulting curve in time series; maintaining regular and irregular intervals. Also,

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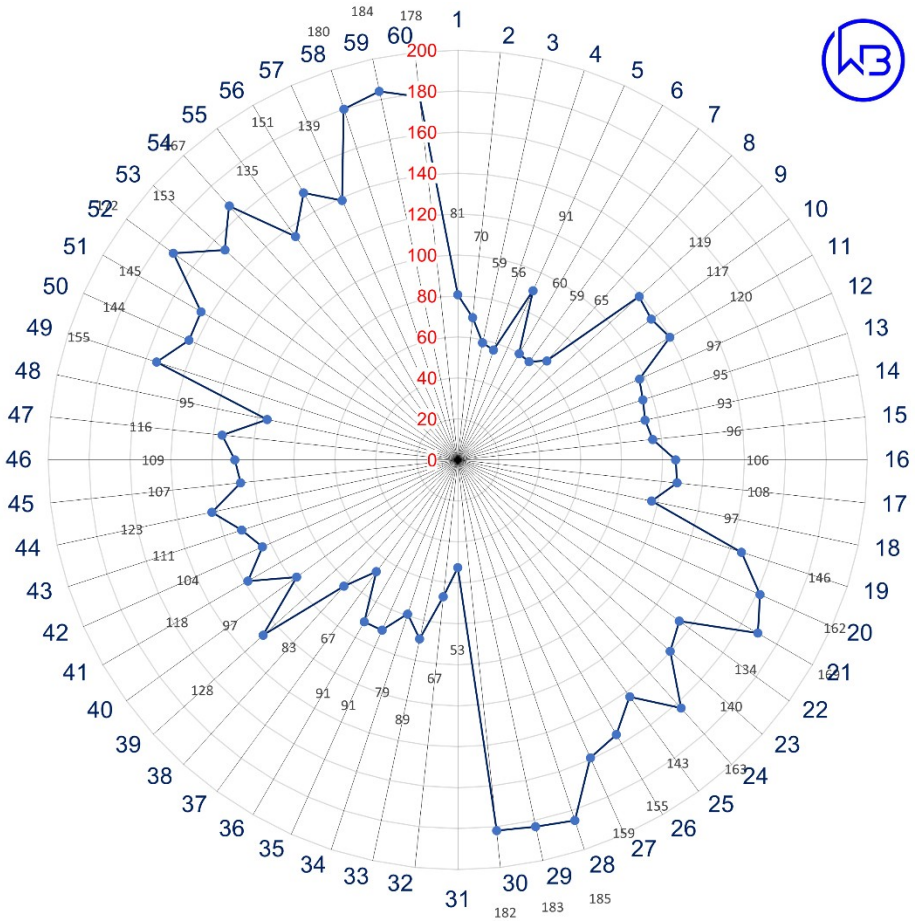
the trend extrapolation method showed linearity within the analytical calibration range and predicted future values based on historical data; as shown in Figure 5.

Figure 5

Systemic Projection and Time Series in Trend Extrapolation for 60 months [Dec 2025;Dec 2030]



Note. Own authorship

This illustrates the exponential growth of the Software Migration curve over the initial 30 months. According to the butterfly chart, month 31 projects an almost vertical increase in the number of employees migrating, almost entirely, to FS. A questionnaire about Linux distributions, managed through Microsoft Forms, shows 81 increases in participation since month 1. Following the peak of the sample curve and the low point in month 31, a sharp decline begins, reaching 53.

Then, the curve resumes its upward trend reaching 178 by month 60. Similarly, an average per participant is available for the five-year period. This is how the projected annual growth of 36.2 % and the critical point of the deflection are evaluated; settling in

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month 37. At that moment, the concavity of the curve is estimated with a maximum number of users and the parameterization is restructured with a single independent variable. So, as a complement to the migration to FS and through Cloud technologies, employees were surveyed about their preferences for the three Linux distros proposed by Ministerio de Telecomunicaciones y Sociedad de la Información (MINTEL). Exactly, information about its stability, update and software package use was collected through a Google Form. Therefore, based on these 3 literals and the Sample *n*=185, high levels of acceptance were obtained. Then, Mint ranked first with 38.1 %=70, Ubuntu second with 36.2 %= 67 and Manjaro third with 25.7 %=48. Also, depending on the difficulty, the rejection rate varied for each distro: Manjaro ranked first with 39.5 %=73, Ubuntu second with 30.8 %=57 and Mint third with 29.7 %=55. Likewise, in the cybersecurity[2] an almost uniform evaluation was achieved: Manjaro ranked first place with 33.8 %=63, Ubuntu second with 33.1 %=61 and Mint third place with 33.1 %=61. Regarding the Linux desktop, strong trends are observed in the use of CINNAMON (Mint) with 36.5 %=68 for its simplicity, GNOME (Ubuntu) with 34.8 %=64 because it is intuitive and XFCE (Manjaro) with 28.7 %=53 for its speed.

As an observation, there are countless Linux distributions; including, Solus and PorteuX. In addition, there are also several desktop environments; such as COSMIC and NIRI. But none of these were considered, as they are unknown to the Ecuadorian business community.

Conclusions

The business environment in Ecuador has improved significantly in the last 25 years and despite this progress, the challenges continue to grow. So, 'Good Living' is insufficient and as technology advances; it demands more skills. Therefore, Senior Management must take the initiative, adapt to the needs of its employees and provide suitable administrative Software to ensure the modernization of the country. But, to complete, it is important to eliminate inequalities, support R+D and develop solutions that stimulate investment; in addition, promote computer-generated training, foster a 2030 management culture and support digitization.

[2] It prevents malicious attacks on all types of PCs and servers.

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Thus, a migrating to FS is a laudable technological process given its flexibility and cost. Therefore, Pro Software imposes restrictions and Free makes sharing easier. Unfortunately, paid programs require a license and do not allow access to the source code to identify vulnerabilities. Equally, the investment creates inconveniences, slows down the process and training are decisive. Then, to a large extent, the success of the migration depends on the team and to achieve this it is vital to involve stakeholders; communicating benefits and building trust.

To finish, the Big Data process, as the basis of Inferential Projection, indicated that the migration to FS is feasible. Since the challenges presented can be resolved within the stipulated time frame; in this case, 2030. So, the technological issues must be overcome and Ecuador, being a developing country, should be the prototype for business advancement. Similarly, as demonstrated by the Statistical Calculation, the Sample Analysis establishes that GNU/Linux is the paradigm envisioned for the end of this decade. Confirming, for simplicity, the Mint distro (38.1 %) as the ideal computing environment; also, CINNAMON desktop (36.5 %) for comfort. So, the combination of this pair should be leveraged to optimize business resources through AI applications offered by a pioneering system; Grisbi as a personal financial manager and GnuCash as an accounting administrator.

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Interest conflict

The authors declare no conflicts of interest.

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