



# Entrepreneurship and technological innovation: The micro-entrepreneur in Mexico

## *Emprendimiento e innovación tecnológica: el microempresario en México*

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### Abstract

Entrepreneurship has gained importance in the field of research due to its ability to dynamize the economy. Knowing how technological expertise and access to financing influence business performance will enable micro-entrepreneurs to make decisions about technological training strategies within their company. Therefore, the aim of this investigation is to analyse and identify the influence between the Technological Training of Human Resources and awareness on the use of ICTs in business management on an ICT development level and access to finance, by micro-entrepreneurs of Celaya, Guanajuato, Mexico. The methodology is quantitative and transversal, with data collection taking place between 2016-2017 and the informants being the owners or partners of micro businesses located in the municipality of Celaya, Guanajuato, Mexico. Obtaining from a population of 24100 economic units according to the National Statistical Directory of Economic Units of INEGI, establishing a sample of 379 companies with a confidence level of 95% and 5% sample error, via simple random sampling. The share corresponds to 21.11% of the total sample, and it is a representative sample as entrepreneurs have low participation due to the insecurity in the region. A model based on quantitative indicators which have an influence on

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business performance of Mexican micro-entrepreneurs is proposed. Nine indicators are taken into consideration; three from the Business Performance variable: 1) Customer Retention, 2) Asset yield, 3) Return on equity, and five from the Technological Expertise of Micro-Enterprises: 4) Technological Preparation of Human Resources, 5) ICT access, 6) awareness of the use of ICTs, 7) Use of ICT in the administration of the company, 8) Level of ICT development, and one from access to financing 9) Financing for technological preparation of the company. Concluding that while micro-entrepreneurs are aware of the importance of ICTs in their businesses, Celaya's micro-enterprises have a low level of technological expertise.

*JEL Code:* D83, O14, O31, 041

*Keywords:* entrepreneurship; México; innovation; micro-enterprises; business performance; technological

## **Resumen**

El emprendimiento ha cobrado importancia en el campo de la investigación debido a su capacidad para dinamizar la economía. Conocer cómo la experiencia tecnológica y el acceso a financiamiento influyen en el desempeño empresarial permitirá a los microempresarios tomar decisiones sobre estrategias de capacitación tecnológica dentro de su empresa. Por tanto, el objetivo de esta investigación es analizar e identificar la influencia entre la Formación Tecnológica del Recurso Humano y la sensibilización sobre el uso de las TIC en la gestión empresarial a nivel de desarrollo de las TIC y acceso a financiamiento, por parte de los microempresarios de Celaya, Guanajuato, México. La metodología es cuantitativa y transversal, teniendo lugar la recolección de datos entre 2016-2017 y siendo los informantes propietarios o socios de microempresas ubicadas en el municipio de Celaya, Guanajuato, México. Obteniendo de una población de 24100 unidades económicas según el Directorio Estadístico Nacional de Unidades Económicas del INEGI, estableciendo una muestra de 379 empresas con un nivel de confianza del 95% y 5% de error muestral, mediante muestreo aleatorio simple. La participación corresponde al 21,11% del total de la muestra, y es una muestra representativa ya que los empresarios tienen una baja participación debido a la inseguridad en la región. Se propone un modelo basado en indicadores cuantitativos que inciden en el desempeño empresarial de los microempresarios mexicanos. Se toman en consideración nueve indicadores; tres de la variable Desempeño Empresarial: 1) Retención de Clientes, 2) Rentabilidad de Activos, 3) Rentabilidad sobre el Patrimonio y cinco de la Experiencia Tecnológica de las Microempresas: 4) Preparación Tecnológica del Recurso Humano, 5) Acceso a las TIC, 6) conocimiento del uso de las TIC, 7) Uso de las TIC en la administración de la empresa, 8) Nivel de desarrollo de las TIC, y uno desde el acceso al financiamiento 9) Financiamiento para la preparación tecnológica de la empresa. Concluyendo que mientras los microempresarios son conscientes de la importancia de las TIC en sus negocios, las microempresas de Celaya tienen un bajo nivel de conocimiento tecnológico.

*Código JEL:* D83, O14, O31, 041

*Palabras clave:* emprendimiento; México; innovación; microempresas; desempeño empresarial; tecnológico

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## **Introduction**

Entrepreneurship has become very important in the field of research due to its capacity of being a great economical driver (Halberstadt, et al, 2021), which is further accentuated by globalization and the

challenges it represents (Aceituno et al., 2018; Godínez & Canales, 2018; Rocha, Arévalo, & Cocunubo, 2018). There are more and more commercial agreements which represent conditions that demand greater competitiveness (Barragán & Ayaviri, 2017). The environment is changing at an alarming rate and it is difficult to maintain long-term competitive advantages (Casanova-Villalba et al., 2022; González, Mandirola, & Miles, 2016). The population is also growing at a faster rate than the economy (Ovalles-Toledo et al., 2018). Entrepreneurship has become a success factor for a countries' economy (Khan, Salamzadeh, Shah, & Hussain, 2021; Garcidueñas et al., 2017) as it promotes the creation of companies which in turn increases the number of job offers therefore expands the size of the labour market and at the same time increases stability (Godínez & Canales, 2018) and becomes the strategic driver for economic development (Marulanda & Morales, 2016; Blázquez, Zaldívar, & Leite, 2018; Álvarez & Grazi, 2018).

Entrepreneurs and MSMEs are a crucial factor in a country's economy for this reason, understanding the role of a micro-entrepreneur and SMEs is critical for understanding a country's social and economic development (INADEM, 2016). The entrepreneur is determinant when considering development, innovation and social promotion since the creation of MSMEs depends on them. It is important to pay special attention to this type of company due to the fact that most economic theories have focused on large companies (Chirinos et al., 2018; Valdés & Sánchez, 2012), undermining the importance they have in Mexico and the world.

Globally, MSMEs have great relevance in the economy of nations as they promote job creation as well as development and economic growth (World Bank, 2016). Half of the Gross Domestic Product (GDP) in the United States is generated by these types of companies which are the source of 50% of private sector jobs (OECD, 2017). In Eastern Europe and Central Asia, they account for 64% of jobs, however in America and the Caribbean they are responsible for 67% of jobs (OIT, 2015).

In Mexico, MSMEs account for 99.8% of the total economic units. Their contribution to the Gross Domestic Product is of 52%. They are responsible for the creation of formal sources of employment, as they create 72% of these jobs (National Commission for the Efficient Use of Energy, 2017). The commercial sector is responsible for 56.5% jobs whereas the services sector is only responsible for 11%; 97.6% are micro-enterprises.

Despite the importance of micro-enterprises on the Mexican economy, they are faced with unfavourable conditions (Bakhtiari et al., 2020; Promexico, 2014). Their life expectancy has an average of 7.8 years and the probability that they will survive the first year of activity is of 64% (INEGI, 2020).

Information and Communication Technologies (ICTs) have had a positive impact on people's lives (Mazon-Olivo et al., 2018; Văidean & Achim, 2022) as well as on companies and countries as they allow better access to sources of knowledge (Qureshi et al., 2022; Qureshi, et al. 2014). They trigger changes in the context in which they are implemented (García-Tudela, Montiel, & Prendes-Espinosa,

2022; Garcia et al., 2017). The existence of ITC in a company does not imply that it is being taken for granted (Buenrostro & Hernández, 2019). It is at this point that technological preparation (Mkansi, 2021), understood as the ability to benefit from the use of ICT, becomes vital (Qureshi et al., 2022; Qureshi et al., 2014). The use of ICTs in micro-enterprises is extremely beneficial for them as it allows for cost reduction and greater production flexibility (Piget & Kossai, 2013; Busto, Pando, & Álvarez, 2021).

On the other hand, business performance is a multi-dimensional construct whose definition and measurement has yet not been defined (Agrawal et al., 2022). However, the measurement of financial indicators provides a good reflection on the achievement of the objectives. Other indicators such as customer retention show a broader picture of business performance (Eyng et al., 2021); although the relationship between business performance and ICT has not been definitively established (Jameel, Abdul-Karem, & Mahmood, 2017). There is evidence that they are connected (Piget & Kossai 2013; Ab Wahab et al., 2020), therefore further investigation is needed. Knowing how technological readiness and access to financing influence business performance, will enable micro-entrepreneurs to make decisions on technological readiness strategies within their company. For this reason, the objective of this chapter is to identify the influence which exists between the Technological Preparation of Human Resources, Awareness of the use of ICT, ICT Access, the Use of ICT in Business Management, the Level of ICT Development in ICT and Access to Financing in the Business Performance of the Micro Entrepreneur in Celaya, Guanajuato, Mexico.

## **Literature review**

### *Micro entrepreneurs in emerging economies*

Latin America is the region with the greatest conditions of inequality in the world (Moreno-Brid, Garry, & Krozer, 2016). Countries in this region depend mostly on the economy of other countries. These countries are characterized by a lack of industrialization along with the lack of digital readiness due to poverty and general dependence on external funding (Chen, kumara, & Sivakumar, 2021). ICTs are in the same situation; the disparity in their adoption is enormous (Margalina & Robalino, 2018) whereas in other regions of the world, countries with emerging economies have developed to the point of matching those of developed countries. In Latin America this has not occurred, mainly due to the lack of innovation and entrepreneurship (Alvarez & Grazi, 2018). Mexico is included in these conditions and situation. Conditions of regional heterogeneity can be found in Mexico (Moreno-Brid, Garry, & Krozer, 2016). There is very low social mobility and low employment income (COLMEX, 2018). Only regions that were

eligible to take advantage of foreign investment have benefited from trade openness which has accentuated the disparity (Germán-Soto & Escobedo, 2011).

Despite the above, emerging economies are regarded as angular axes of the world economy by the Economic Commission for Latin America and the Caribbean (ECLAC). This entity has pointed out that there is an increasing influence of the dynamics that occur in emerging countries (Máttar & Cuervo, 2017). Mexico has been recognized as attractive for foreign investment, ranking in tenth position for direct foreign investment (World Investment Report, 2014). This reference makes it attractive for research also. The state of Guanajuato is one of the federal entities that has made the best use of trade opening (Gobierno del Estado de Guanajuato, 2018) due to foreign investment from 30 different countries (Marvella, 2015). In this Federal Entity, specifically the municipality of Celaya, there has been an increase in foreign investment in recent years, especially in the mechanical metal industry (Gobierno Municipal de Celaya, 2019).

Entrepreneurship occurs for reasons such as opportunity or necessity. Entrepreneurship in emerging economies is particularly arduous due to the economic instability characteristic of developing countries. In addition, there are high taxes, unforeseen and inconsistent legislation with little access to market information (García-Cabrera, Gracia, & Días-Furtado, 2015).

### *Factors influencing the adoption and use of ICT by micro entrepreneurs*

Micro-enterprises have characteristics which distinguish them from other companies, whether by size or sector. Several studies show that there are differences in ICT adoption related to the size and sector of enterprises (Andaregie & Astatkie, 2021; Mushtaq, Gull, & Usman, 2022; Pérez, Ramírez, & Topete, 2017).

Micro entrepreneurs face greater barriers to ICT adoption compared to their larger-enterprise counterparts. ICTs are expensive, high risk and complex. It should also be noted that micro-enterprises often have under-trained staff and are unaware of the benefits ICTs can provide (Barrera, 2017).

### *Human resources technological preparation (HRTP)*

Technological preparation of human resources can be defined as the skill in which individuals (although it can also be seen from a company's or a country's perspective) acquire knowledge of ICTs and understand the benefits of using them (AlSheibani, Cheung, & Messom, 2018; Okundaye, Fan, & Dwyer, 2019). This arises from the need to assess the digital division between countries (Tavengerwei, 2018).

Decision makers in companies in particular, need to enable their workers to create a synergistic environment for the organization, taking into consideration that human resources are a source of intellectual resources and skills which influence the development of the daily work in companies (Srivastava & Madan, 2018).

Human resources are the means of establishing competitive advantages. Therefore, it is vitally important for organizations that individuals have the knowledge and skills which allow them to develop their capabilities and enhance them through technology (Assensoh-Kodua, 2019; Molla & Liker, 2005; Reyes, 2020; Ríos, 2016).

Based on the above, the first hypothesis H1 is established: Technological Preparation of Human Resources has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.

### *Awareness of the use of ICT (AuTIC)*

Poor investment in ICT negatively impacts innovation (Margalina & Robalino, 2018). In turn, innovation-based entrepreneurship impacts economic development (Barragán & Ayaviri, 2017) which positions entrepreneurship as a driving force for the economy (Álvarez & Grazzi, 2018; Blázquez, Zaldívar, & Leite, 2018; Ovalles-Toledo et al., 2018).

However, the benefits associated with ICT acquisition are only generated when technology becomes a successful and sustainable factor and when adequate assimilation of technology exists (Prada, 2016). Based on these arguments, the second hypothesis H2 arises: Awareness of the use of ICTs has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.

### *ICT access (AccTIC)*

To be able to take advantage of ICT effectively, it is necessary to put the technology in the hands of all the members in the company as no technology is capable of generating long-term competitive advantages by itself. This makes and assures ICT is accessible to all the workers (Love & Matthews, 2019; Qosasi, 2019; Soledispa-Rodríguez et al., 2021). The benefits associated to ICT does not appear to have been reflected in micro-enterprises. One of the greatest advantages of information technologies associated with the Internet is the value that information can give to individuals. To be able to have access, appropriation of technology is required (Becerril-Velasco, 2018). Therefore, the third hypothesis H3 is established: ICT Access has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.

### *The use of ICT in business management (UTICGE)*

If ICT is adopted effectively and accompanied by employee planning and training, efficiency would be improved therefore making the company more competitive (Oliveros & Martínez, 2017). The ability of micro-enterprises to cope with ICT adoption inhibitors enables them to participate in the digital economy (Okundaye, Fan, & Dwyer, 2019; Rahmana & Senusia, 2019) ICTs are a key element for the competitiveness of companies. However, micro-enterprises are scarcely investing in management systems (Castellanos, Loaiza, & Cuesta, 2016). Based on the above the fourth hypothesis H4 is put forward: The use of ICT in business administration has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.

### *Level of development in information and communications technologies in the company (NDTIC)*

Although the absorption of ICTs is quite heterogeneous according to the size of the company, micro-enterprises have gradually adopted them since costs have been reduced and tools have been simplified. Although the profit of the investment in ICTs has not been definitively related, the impact they have had on the different areas of the company can clearly be seen (Kwilinski et al., 2019; Slusarczyk, Pozo, & Perurena, 2015). Based on this, the fifth hypothesis H5 is established: The level of ICT Development has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.

### *Financing for the technological preparation of the company (FINZPT)*

Management of innovation requires adequate financing, since without finance, economic performance is affected. However, without any intervention, the debt and equity markets usually give entrepreneurship an optimal sub-level of financing which in turn, has an impact on the growth of the economy (Rojas, 2017). The lack of funding that micro-entrepreneurs have to access ICTs makes it difficult to acquire and consequently influences their adoption and use of related advantages (Carvajal-Álvarez & Valencia-Pérez, 2019; Bvuma & Marnewick, 2020). Based on this, the sixth hypothesis H6 is put forward: Financing for the technological preparation of the company has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.

## *Company performance*

Despite being widely addressed in literature, financial performance has not been commented on as a concept (Ahinful, Boakye, & Bempah, 2019). Much of the research has focused on how external factors influence performance based on availability of credit sources, complexity of administrative procedures and internal and external customer relationships (Romero, Melgarejo, & Vera-Colina, 2015; Baah et al., 2021). Other research has focused on its measurement and interpretation (Rojas-Lema et al., 2021).

Financial reasons have often been used as a means of economic financial analysis (Leyva, 2018). In fact, the way in which financial indicators reflect the company's objectives is a strict way of measuring this concept (Osadchy et al., 2018). The most commonly used financial reasons are asset performance (ROA), sales performance (ROS) and return on equity (ROE) (Huergo & Moreno, 2004; Melgarejo, Vera, & Mora, 2014; Panigrahi, 2021; Rawat, 2020; Strouhalet al., 2018). Other studies have focused on a broader perspective, arguing that accounting does not necessarily reflect the entire organization (Correa, Reyes, & Montoya, 2018).

Literature demonstrates that ICTs can contribute to the creation of competitive advantages, however it also demonstrates the limitations of micro-enterprises to access them. This is due to the costs, quantity and quality of online infrastructure and services as well as the lack of knowledge surrounding the benefits of ICTs, low-skilled and under-trained human resources and the lack of incentives and funding to acquire them (Bvuma & Marnewick, 2020). Based on all this, the seventh hypothesis H7 is raised: The Technological Preparation of Human Resources, Awareness of the Use of ICTs, ICT Access, Use of ICT in Business Management, the level of Development in ICT and Financing for the Technological Preparation of the company has a positive and significant influence on the business performance of the micro entrepreneur in Celaya, Guanajuato, Mexico.

## *Importance of entrepreneurship in technological innovation in Celaya, Guanajuato, Mexico*

Guanajuato is located in the north center of Mexico and with 31 more states make up the country. Guanajuato ranks sixth in its share of GDP (4.3%) (Guanajuato, 2020), whose population is mostly concentrated in the Celaya-León industrial corridor (53.1%), where Celaya is the most productive municipality in this corridor. industrial. It contributes 14.2% of the state GDP, with 48.6% of economic units per thousand inhabitants according to INEGI data (Aguilar et al., 2020, Mancera, 2021), where more than 50% of the companies are concentrated in Celaya (10%), Irapuato (10%) and León (30%) (DENUE,

2019). In addition, the logistics future of Mexico is considered, as it has roads and highways from north to south and from east to west in the country, highly dynamic due to its diversification of the industry, contributing to the promotion of Guanajuato and Mexico in the world (Ruiz, 2021).

Entrepreneurship and technological innovation are essential elements in the development of companies in Celaya. The government is aware of the lack of support from entrepreneurs, which is why it establishes as one of its objectives of the 2021-2024 government program, to promote conditions that benefit the entrepreneur and innovation in their companies (Ayuntamiento de Celaya, 2021). One of the positive aspects is that entrepreneurs find it easy to start their business in Celaya, such as the operating license that is issued immediately and online, ranking second in Mexico (World Bank, 2016). However, they show a low level of innovation, facing problems for a successful venture (Ayuntamiento de Celaya, 2021).

Micro companies in Guanajuato face various problems, among which are financial needs (due to lack of capital and lack of access to credit); restricted access to ICTs (due to limited infrastructure, lack of ICT management); lack of innovation (due to lack of access to training, acquisition and use of knowledge, staff training and continuous training), results obtained in the research of Aguilar et al. (2020). In relation to entrepreneurship, the director of Economic Development, indicates that a program has been carried out for the digitization of micro, small and medium-sized companies, to improve the sales of entrepreneurs, giving them support, especially for those who are starting in the trade. electronic (Medina, 2021). The exposed situations, glimpse clarity in delving into these issues, which are the subject of this research: entrepreneurship, technological innovation, technological preparation and financing.

## **Methodology**

This research is cross-sectional and has a descriptive, correlational and regression approach, describing the factors which influence the Company Performance of micro-enterprises located in Celaya, Guanajuato, Mexico.

### *ICT indicators and access to finance which influence entrepreneurial performance of the micro entrepreneur*

Description of the indicators of the variables in this investigation: Company Performance and Technological Preparation are shown in Table 1.

Table 1

ITC indicators and access to financing which influence entrepreneurial performance of the micro entrepreneur, located in Celaya, Guanajuato, México

Variable	Code	Indicators	Code
Business Performance	DE	Customer Retention	RC
		Asset yield	RSA
		Return on equity	RSP
Technological Preparation of Micro-Enterprises	PT	Technological Preparation of Human Resources	PTRH
		ICT access	AccTIC
		Awareness of the use of ICTs	AuTIC
		Level of ICT development	NDTIC
Financing for technological preparation of the company	FinzPT	Use of ICT in the administration of the company	TICAE
		Level of ICT development, and one from access to financing	FinzPT

Source: Own elaboration

### *The hypotheses set out in the work*

Based on the literature, in the Table 2, The Hypotheses raised on quantitative indicators that influence the business performance of Mexican micro entrepreneurs.

Table 2

#### The hypotheses set out in this investigation

Quantitative indicators	The hypotheses set out in this investigation	
Technological Preparation of Human Resources	H1	The Technological Preparation of Human Resources has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.
Awareness of the use of ICTs	H2	The Awareness of the use of ICTs has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.
ICT access	H3	The ICT Access has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.
Use of ICT in the administration of the company	H4	The use of ICT in business administration has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.
Level of ICT development, and one from access to financing	H5	The level of ICT Development has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.
Financing for technological preparation of the company	H6	The Financing for the technological preparation of the company has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.
Business Performance variable	H7	The Technological Preparation of Human Resources, Awareness of the Use of ICTs, ICT Access, Use of ICT in Business Management, the level of Development in ICT and Financing for the Technological Preparation of the company has a positive and significant influence on the business performance of the micro entrepreneur in Celaya, Guanajuato, Mexico.

Source: Own elaboration

## Model proposed in this research

A model based on quantitative indicators which have an influence on business performance of Mexican micro-entrepreneurs is proposed. Nine indicators are taken into consideration; three from the Business Performance variable: 1) Customer Retention, 2) Asset yield, 3) Return on equity. And five from the Technological Expertise of Micro-Enterprises: 4) Technological Preparation of Human Resources, 5) ICT access, 6) Awareness of the use of ICTs, 7) Use of ICT in the administration of the company, 8) Level of ICT development, and one from access to financing 9) Financing for technological preparation of the company.

Considering the following equation:

$$\text{DEMicro} = \beta_0 + B_1\text{PTRH}_i + B_2\text{AccTIC}_i + B_3\text{AuTIC}_i + B_4\text{TICAE}_i + B_5\text{NDTIC}_i + B_6\text{FinzPT}_i + \varepsilon_i \quad (1)$$

Where the acronym corresponds to:

DEMicro<sub>i</sub>= Technological Preparation of Micro-Enterprises

PTRH<sub>i</sub>= Technological Preparation of Human Resources

AccTIC<sub>i</sub>= access to information and communication technologies

AuTIC<sub>i</sub>= Awareness of the use of Information and Communication Technologies

TICAE<sub>i</sub>= Use of ICT in the administration of the company

NDTIC<sub>i</sub>= Level of development in Information and Communication Technologies

FinzPT<sub>i</sub>= Financing for technological preparation of the company

## Sample

This study was aimed at micro-enterprise entrepreneurs located in the municipality of Celaya, Guanajuato, Mexico. With a population of 24100 economic units according to the National Statistical Directory of Economic Units of INEGI (DENUE, 2019). A sample of 379 companies with a confidence level of 95% and 5% sample error has been established. Through simple random sampling, fieldwork was carried out by visiting companies, 80 of which participated, corresponding to 21.11% of the total sample. The causes of low participation were due to the insecurity of the region. Table 3 demonstrates the characterization of the sample. It is made up of 61.3% male entrepreneurs and 38.8% female entrepreneurs. The most represented profile in this investigation are adults aged between 45 and 54 (50%), the majority of whom have a technical career (40%). Four economic sectors have participated in the study: agricultural (6.3%) industry (2.5%), trade (66.3%), and services (25%).

Table 3

Sample characteristics

Sample characteristics		%
Geographical scope		Celaya, Guanajuato
Population		24100
Sample		379
Actual Sample Size		80
% Sample		21.11%
Sample design		Personal interview
Gender	Man	61.3%
	Woman	38.8%
Entrepreneur Profile (years)	18 - 24	7.5%
	25 - 34	16.3%
	45 - 54	50.0%
	55 - 64	26.3%
Education	Primary	2.5%
	High school	10.0%
	High school or technical career	40.0%
	Bachelor's degree	22.5%
	Master's degree	23.8%
	Doctorate	1.3%
Sector	Farming	6.3%
	Industry	2.5%
	Commerce	66.3%
	Service	25.0%

Source: Own elaboration.

In order to determine the internal consistency of the DEMicro institution, an analysis was performed using the Cronbach Alpha test (Cronbach, 1951), establishing an acceptable reliability of  $\alpha=0.739$  (George & Mallery, 1995; Hogan, 2004; Landero & González, 2006; Nunnally & Bernstein, 1994; Oviedo & Campos-Arias, 2005).

## Analysis and results

### *Situation of micro-enterprises in an emerging economy such as Mexico in relation to information and communication technologies*

Firstly, the technological expertise of the human resources working in micro-enterprises is analysed. The entrepreneur is asked whether, from their perspective, their human resources are considered to have an adequate level of ICT training. The results show that, young entrepreneurs (18 to 24 years of age) from the commerce sector (2.5%) perceive that they slightly disagree that their human resources (HR) have adequate training in ICT. For the young adult (between 25 and 34 years of age) 2.5% of the commerce

sector strongly disagrees that their HR are trained in the use of ICT. In relation to the adult Entrepreneur, 45 to 54 years of age, they slightly agree on their human resources' training (16.3%). The older adult entrepreneur (from 55 to 64 years of age), from the commerce sector 2.5% strongly agrees that their human resources are technologically prepared, from the agricultural sector 1.3% moderately agrees and in the same proportion the industry sector slightly agrees. Overall, 36.3% of the entrepreneurs who participated in this study slightly agree that their HR are trained in the use of ICT.

An important aspect in the technological preparation of a company is the awareness at all levels of the importance of the use of ICT, starting with its adoption and use of the technological tools that the technology industry currently offers. Young entrepreneurs from the commerce sector slightly disagree that awareness in the use of ICT (3.8%) is raised. However young adults from the service sector (2.5%) perceive that in their companies they do make their workers aware of the use of ICT. Regarding adult entrepreneurs, 6.4% of the commerce sector strongly agree and 5% of the service sector moderately agree that they make their HR aware of the use of ICTs. Meanwhile older adult entrepreneurs in the commerce sector moderately agree (5%). In general, 23.8% of the entrepreneurs strongly agree that they make all their staff aware of the use of ICTs in their companies. Another aspect of great importance in the technological preparation of companies is the access they have to ICTs, such as mobile phones, Internet, computers, broadband connections and software. Regardless of the profile of the entrepreneur, 30% strongly agrees that they should have access to ICT.

Another interesting fact is that it is adult entrepreneurs who are most convinced of having access to ICT in their companies, 5% from the service sector, 3.8% from agriculture, 1.3% from the industry sector, although adult entrepreneurs from the commerce sector slightly agree on access to ICT (13.8%).

Undoubtedly, administration leadership is fundamental in the technological preparation of companies, since they are the ones who drive the adoption of ICT and establish strategies for its development. Hence the reason why respondents were asked about whether entrepreneurs used ICT for management of their businesses. The results show that 20% of the respondents strongly agreed to using ICT to manage their business and only 30% slightly agreed to using ICT for administrative management.

### *Level of development in ICT*

In a highly competitive business environment, companies would be expected to be technologically prepared with mobile telephony, basic infrastructure, internet, website, interactive web, social networks, information storage, software management, online shopping, product offers on internet, corporate intranet, e-banking, e-invoicing, online tax payments and procedures, specialized ERP, CRM systems, etc., in all areas of the company, and to carry out e-commerce. Therefore, micro-enterprises were asked about their

level of development in ICT. Based on the results, 21.3% of the micro-enterprises have no technology (they only have a landline telephone), 23.8% are in the initial stage of technological preparation (they only have a mobile telephone), 11.3% are considered to be in an ICT development stage (mobile phone, e-mail, web page and also make on-line purchases, advertise their products and services on the Internet, carry out electronic banking, on-line tax payments and use social networks), and only 1.3% also have the aforementioned specialized ERP, CRM systems, etc, corporate intranet and carry out electronic commerce. These are companies that have already reached the maturity stage. In general, it is considered that the entrepreneurs of these micro-enterprises are at a competitive disadvantage with other companies in the same sector.

### *Funding for technological preparation*

Lack of resources is a problem often faced by micro-enterprises, so funding is essential in the adoption of ICT. In this study, micro-enterprises are asked which the sources of funding for Information and Communication Technology adoption are. These organizations mainly turn to personal sources (37.5%), 36.3% prefer to turn to a formal loan from a formal institution, and 25% indicated other sources of financing, without specifying which. Commercial companies of adult entrepreneurs prefer to go to formal institutions to apply for a loan (13.8%) as do entrepreneurs from the service sector (7.5%). However older adults and adult entrepreneurs in the industrial sector prefer to finance themselves from personal contributions for the acquisition of ICT for their company (1.3%, respectively).

### *Business performance of micro-enterprises*

Companies now use both financial and non-financial indicators to determine their business performance. Two financial indicators were considered in this study: 1) Asset returns of at least 6% and 2) Equity returns of at least 10%. A non-financial indicator was also considered: Customer retention rate of at least 90%. Based on the results, most companies are in a successful situation in all three indicators, exceeding 50%. From the profile of the entrepreneur we observe that, there is a stable situation in adult entrepreneurs, obtaining 26.3% in the rate of client retention. There is the same percentage in the rate of asset returns and 27.5% is the rate of equity returns on their own capital of at least 10%.

### *Association between technological preparation and financing indicators with business performance*

Considering the indicators that can be related to business performance of the Micro-enterprises in this study, a correlation analysis was carried out in order to analyse the positive or negative, significant or non-significant relationship. In Table 4, it can be seen that there is a positive and significant relationship  $p < 0.01$  between the Technological Preparation indicators in this study "Technological Preparation of Human Resources, Access to Information and Communication Technologies, Awareness of the use of Information and Communication Technologies, Use of ICT in the Administration of the company and Level of development in Information and Communication Technologies". Amongst these indicators, the most associated are "Use of ICT in the Administration of the company" and "Access to ICT" ( $r = 0.885$ ), and the least associated is Level of development in ICT and Awareness of the use of ICT ( $r = 0.516$ ). Meanwhile, there is a negative and significant relationship ( $p < 0.01$ ) between "Financing for the technological preparation of the company" and "Level of development in ICT" ( $r = -0.295$ ). However, there is no relationship between the Business Performance variables and the variables proposed in this study.

Table 4  
Correlations

	PTRH	AuTIC	AccTIC	TICAE	NDTIC	FinzPT	DEMicro
PTRH	1						
AuTIC	,821**	1					
AccTIC	,814**	,869**	1				
TICAE	,784**	,813**	,885**	1			
NDTIC	,548**	,516**	,553**	,617**	1		
FinzPT	-,172	-,195	-,119	-,065	-,295**	1	
DEMicro	-,142	-,007	-,017	-,220	-,177	,179	1

\*\* The correlation is significant at the level 0.01 (bilateral)

Source: Own elaboration

#### *DEMicro model*

In order to meet the objective of this research, a multiple regression analysis was carried out to answer the H7 hypothesis. The Technological Preparation of Human Resources, Awareness of the use of ICT, Access to ICT, Use of ICT in Business Management, Level of development in ICT and Financing for the technological preparation of the company, positively and significantly influence Business Performance of

the micro-entrepreneur in Celaya, Guanajuato, Mexico. In Table 5, it is noted that the independent variables explain 22.4% ( $R^2$  in 0.224) of the Micro-Enterprise Performance variance (DEMico).

With regard to autocorrelation, the Durbin-Watson test (1.840) was applied, which ruled out correlation between errors with a 1% significance level, when working with cross-sectional data.

Table 5

Linear regression depending on the aspects that influence the current situation of micro-enterprises as a whole

Model	R	R square	R corrected square	Typical error of the estimate	Exchange Statistics					Durbin-Watson
					Change in square R	F change	gl1	gl2	Sig. F change	
1	.532a	.283	.224	9.61461	.283	4.811	6	73	.000	1.840

a Predictor Variables: (Constant) Customer Retention, Asset yield, Return on equity, and five from the Technological Expertise of Micro-Enterprises: Technological Preparation of Human Resources, ICT access, Awareness of the use of ICTs, Use of ICT in the administration of the company, Level of ICT development, and one from access to financing Financing for technological preparation of the company.

b Dependent variable: DEMicro

Source: Own elaboration

In Table 6 it is possible to see the degree of significance among the independent variables Technological Preparation of Human Resources, Access to Information and Communication Technologies, Awareness of the use of Information and Communication Technologies, Use of ICTs in the Administration of the company and Level of development in Information and Communication Technologies, Financing for the technological preparation of the company, and DEMicro, in which test F determines that, together, the predictive variables are relevant when explaining the business performance of the micro-enterprises of Celaya, Guanajuato, Mexico with a significance level of  $p < 0.01$ .

Table 6

ANOVA of the predictor variables which have an influence on the business performance of Celaya's micro-enterprises, Guanajuato, Mexico

Model	Sum of squares	gl	Quadratic mean	F	Sig.
Regression	2668.404	6	444.734	4.811	.000b
Residual	6748.174	73	92.441		
Total	9416.578	79			

a Dependent variable: DEMicro

b Predictor Variables: Customer Retention, Asset yield, Return on equity, and five from the Technological Expertise of Micro-Enterprises: Technological Preparation of Human Resources, ICT access, Awareness of the use of ICTs, Use of ICT in the administration of the company, Level of ICT development, and one from access to financing Financing for technological preparation of the company.

Source: Own elaboration

In order to demonstrate that in the model there are no multicollinearity problems between the variables in the model, the Variance Inflation Factor (FIV) and Tolerance (TOL) tests were used. Table 7 shows that all the regressor variables have an FIV of less than 10 as well as a TOL close to 0.1, results which indicate that there are no multicollinearity problems (Gujarati and Porter, 2010). The variable DEMicro coefficients regarding the independent variables have the following results: Access to Information and Communication Technologies (AccTIC) has a degree of sig=0.00; Use of ICT in the Administration of the company (TICAE) sig=0.000; Awareness of the use of Information and Communication Technologies (AuTIC) sig=0.054, and Financing for the technological preparation of the company (FinzPT) sig=0.025. As a whole, all of these variables influence the business performance of microenterprises located in Celaya, Guanajuato, Mexico.

Table 7  
 Coefficients of the DEMicro dependent variable with regard to the predictor variables

Model	Non-standardized coefficients		Typified coefficients	t	Sig.	Collinearity Statistics	
	B	Typ. Error	Beta			Tolerance	FIV
(Constant)	.720	4.487		.160	.873		
PTRH	-2.203	1.432	-.293	-1.539	.128	.270	3.702
AuTIC	2.888	1.477	.437	1.956	.054	.196	5.096
AccTIC	4.856	1.703	.740	2.851	.006	.146	6.866
TICAE	-7.156	1.677	-1.012	-4.268	.000	.175	5.722
NDTIC	.497	1.474	.045	.337	.737	.546	1.832
FinzPT	2.298	1.006	.248	2.285	.025	.835	1.198

Source: Own elaboration

The DEMicro model is set out below with the non-standardized coefficients ( $\beta_k$ ) which are part of the equation on the indicators which influence Business Performance of Microenterprises:

$$\text{DEMico} = 0.720 - 2.203\text{PTRH} + 4.856\text{AccTIC} + 2.888\text{AuTIC} - 7.156\text{TICAE} + 0.497\text{NDTIC} + 2.298\text{FinzPT} + \varepsilon_i$$

(2)

## Discussion

Micro-entrepreneurs in emerging economies face great challenges starting up business due to social inequality (Moreno-Brid, Garry, & Krozer, 2016), the lack of entrepreneurship and innovation that has occurred throughout history in Latin America (Álvarez & Grazi, 2018; Moreno-Brid, Garry, & Krozer, 2016). The opening up of trade has brought in foreign capital, however it has not implied a homogeneous

benefit for all organizations (Germán-Soto & Escobedo, 2011) and these conditions have been reflected at the expense of entrepreneurship and access to information and communication technologies (Barrera, 2017).

All this shows that the objective under study is relevant and also highlights the need to go deeper into the subject. Reviewing the literature made it possible to establish the seven hypotheses that were tested in this study with empirical evidence. Once the proposed methodology was systematically applied and having the empirical evidence, it was found that although micro-entrepreneurs are aware of the importance of ICT in their businesses (Andaregie & Astatkie, 2021; Demuner, Nava & Gómez, 2014; Mushtaq, Gull, & Usman, 2022; Palacios, Flores-Roux & García 2013; Pérez, Ramírez, & Topete, 2017), the micro-enterprises of Celaya have little technological preparation. Authors in previous studies showed the trend of low ICT adoption in micro-enterprises, which is confirmed in this study. However, other authors had stated that the lack of ICT adoption in micro-enterprises was largely due to a lack of knowledge about its benefits (Bvuma & Marnewick, 2020), which differs from what is found in this research.

With the regression analysis, the DEMicro model was established with the non-standardized coefficients ( $\beta_k$ ) which are part of the equation on the indicators that have an influence on Business Performance of Micro-enterprises. This analysis made it possible to accept the following hypotheses raised in this study. In Table 8 presents the final conclusion for each of them with respect to the results found in the study.

Table 8  
 Research hypothesis

Hipótesis de investigación	Result
H1: The Technological Preparation of Human Resources has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.	Only partially accepted because even though is proved to have influence and help explain business performance, their relationship is not direct.
H2: The Awareness of the use of ICTs has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.	Accepted
H3: The ICT Access has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.	Accepted
H4: The use of ICT in business administration has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.	Only partially accepted because even though is proved to have influence and help explain business performance, their relationship is not direct.
H5: The level of ICT Development has a positive and significant influence on entrepreneurial performance of the micro entrepreneur.	Accepted

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H<sub>6</sub>: The Financing for the technological preparation of the company has a positive and significant influence on entrepreneurial performance of the micro entrepreneur. Accepted

H<sub>7</sub>: The Technological Preparation of Human Resources, Awareness of the Use of ICTs, ICT Access, Use of ICT in Business Management, the level of Development in ICT and Financing for the Technological Preparation of the company has a positive and significant influence on the business performance of the micro entrepreneur in Celaya, Guanajuato, Mexico. Accepted

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Source: Own elaboration

## Conclusions

In a highly competitive business environment, companies would be expected to be technologically prepared in all their areas and to conduct e-commerce. However, this research determines that microentrepreneurs in Celaya, Guanajuato, Mexico, are at a competitive disadvantage with other companies in the same sector and size, since few companies make use of e-commerce (1.3%). Other conclusions are:

- The practical implications of this study lie in providing a real picture of The Technological Preparation of Micro-Enterprises; Technological Preparation of Human Resources; access to information and communication technologies; Awareness of the use of Information and Communication Technologies; Use of ICT in the administration of the company, Level of development in Information and Communication Technologies; and Financing for technological preparation of the company.
- Although microentrepreneurs are aware of the importance of the adoption and use of ICTs, their adoption and use is deficient, with adult companies being the most convinced of the use of ICTs. In general, they consider that their HR are not prepared to handle ICTs; in the managerial area, only a third use ICTs for their administrative management; and there are few microenterprises that use electronic commerce. Indicating a poor level of technological preparation, since most are moving from the initial phase (mobile phone only) to the ICT development phase (mobile phone, email, web page and also make online purchases, advertise their products and services on the Internet, carry out electronic banking, online tax payments and use social networks).
- Another aspect is that they face financing problems to adopt ICTs, resorting mainly to personal sources or loans with formal institutions, being the adult companies of commerce and services the ones that mostly resort to this type of loans, while the adult industrial companies they prefer

to finance themselves with personal contributions and/or from their partners. In relation to their business performance, more than half consider that their situation is successful in the return on their assets, return on equity and customer retention and they do not see the impact of the use of ICT, especially in e-commerce that makes the difference in times of crisis to stay in the market.

- Fulfilling the objective of this research and determining that together the variables of this study influence the business performance of the microenterprises located in Celaya, Guanajuato, Mexico. Based on the "Technological Preparation of Micro-Enterprises" model satisfactorily passing all the tests, determining that there is sufficient statistical evidence to accept this explanatory model. Where the variables that most influence are: the Awareness of the use of Information and Communication Technologies, access to information and communication technologies, and use of ICT in the administration of the company.
- The results obtained have direct implications for companies, considering that the main contribution of this research is to generate knowledge for Mipyme entrepreneurs about their situation and the importance of ICT use, access and training, in order to be competitive in current scenarios with the new way to position its products and services through electronic commerce and its responsibility, trust and empathy with human resources, by training and empowering them in the management of ICT.
- Finally, the theoretical implications of this research focus on the proposal of the DEMicro model for companies. As well as contributing to the literature on the real situation of Mipymes, specifically in Celaya. The results obtained from this study are of great value to decision makers, hoping that the information provided will support them to observe the importance of ICT use, access and training. In the academic field, it contributes by addressing the importance of studies and awareness of the various DEMicro applications, the use of new analysis tools and their renewal for the support of Micro-enterprises in the market.

One of the main limitations of this study is the sample, therefore as a future line of research the sample could be expanded to local and state level in order to obtain more solid results and deepen the analysis of structural equations to establish a more reliable model. In order to check the results and be able to compare them, a study to replicate it in other Latin American countries is also proposed.

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