

The use of new technologies to improve Value Added Tax (VAT) compliance.

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Introduction

Due to the relevance of VAT in tax revenue -everywhere, but specially in developing countries¹- and the huge amount of microdata involved for its fair and efficient administration, new technologies offer a promising field to improve VAT compliance.

Departing from the work already done to collect and review these new technologies (1), this chapter summarizes the options opened to enhance the tracking of VAT data (2), improve tax services and tax fulfillment favoring voluntary compliance (3) and exploit tax data analysis to enforce compliance (4), in an environment of high-quality data governance (5).

This paper aims to give an overview of all these topics, presenting the different options and encouraging deeper analysis by individual countries to design and adapt new technologies to improve VAT compliance, according to their particular needs, restrictions and possibilities.

1. Background: sources of information on current developments on Tax Administration, VAT, and technology

The use of new technologies to improve Tax Administration (TA) performance and VAT compliance is now clearly the mainstream, and fortunately we can count on several different sources to track the new developments around the world. This section reviews some of them that can be used as a source of information on how technologies are changing the way Tax Administrations (TAs) operate and where are they being implemented².

To begin with, the International Survey of Revenue Administrations (ISORA)³ offers free-access information⁴ on all basic features of TAs⁵ in 174 countries updated annually. Regarding digitalization, innovation, and new technologies, ISORA provides evidence on:

- Operational Digitalization: electronic payment ratios, electronic filing ratios for the main taxes (Income Taxes and Value Added Tax), the effective use of digital contact channels for taxpayer services, and the availability of digital tax registration channels.
- Technological Innovation: the effective use of innovative techniques and tools oriented to tax management such as data analytical science, cloud computing, artificial intelligence, distributed ledger technology (Blockchain), application

¹ According to OECD statistics, VAT accounts for around 20% of total tax revenue (including taxes and social security contributions) on average in OECD countries, while the percentage is higher in other regions as Latin America and the Caribbean (27%), Asia-Pacific (23%) and Africa (28%).

² Previous overviews of this topic are available in CIAT (2020) or OECD (2021), for example.

³ Developed by CIAT (Inter-American Center of Tax Administrations), IMF (International Monetary Fund), IOTA (Intra-European Organization of Tax Administrations), OECD (Organization for Economic Cooperation and Development), and with the collaboration of the ADB (Asian Development Bank).

⁴ Access is available at this [link](#).

⁵ Revenue collection, resources and ICT infrastructure, staff, operating metrics (registration, filling, payment, arrears, audit, dispute resolution, etc.), stakeholders' interactions, etc.

programming interfaces (APIs), digital identification technologies, virtual assistants, whole-of-government identification systems, and robotic automation of processes.

- Other innovations for compliance Improvement: cooperative approaches, behavioral insight, electronic invoicing or pre-filled tax returns, among others.
- Resources and Budget: availability and effective use of human and economic resources available to each TA.

Based on this database, the Innovation, Digitalization and Technology Index (INDITEC)⁶ provide a detailed and systemic picture of the status of tax collection agencies around the world in terms of the incorporation of technological innovations to improve tax compliance and statistical information management, the digital transformation of operational processes and the strategic orientation of available financial and human resources.

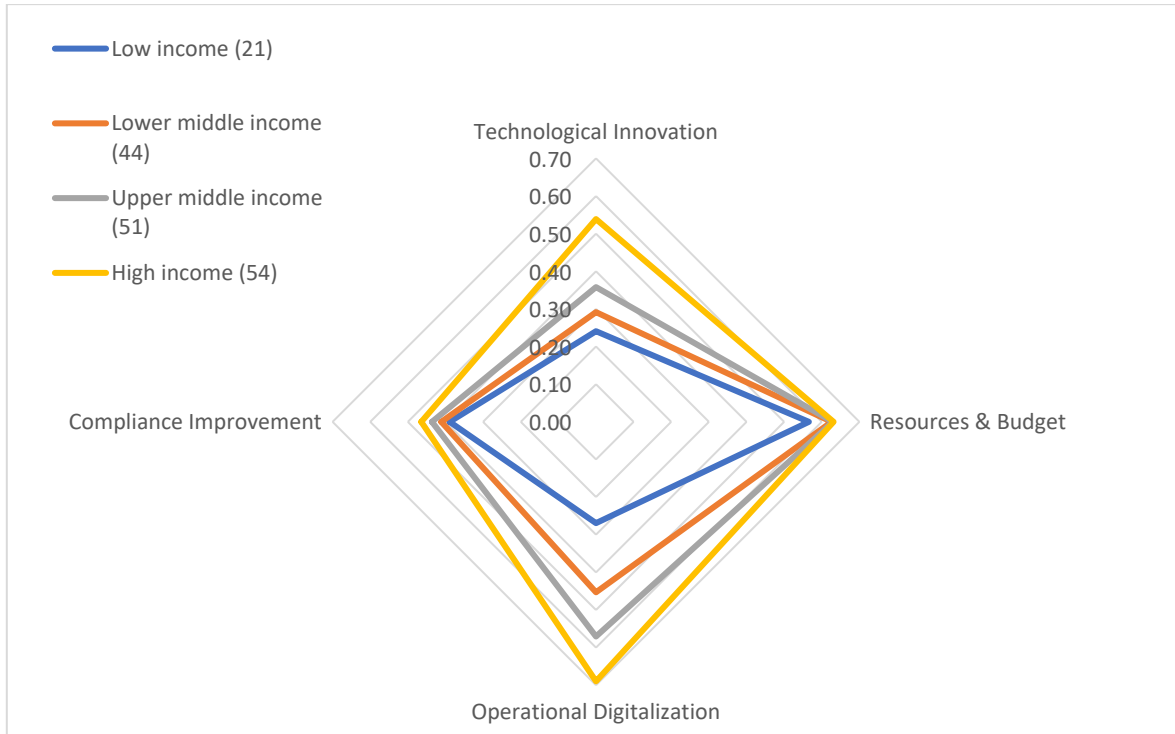
Table 1. Innovation, Digitalization & Technology Index (INDITEC) for Tax Administrations around the world (2021 data; based on ISORA Survey 2022)

Index	Jurisdiction			
	Low income (21)	Lower middle income (44)	Upper middle income (51)	High income (54)
Technological Innovation	0.24	0.29	0.36	0.54
Resources & Budget	0.57	0.63	0.63	0.63
Operational Digitalization	0.27	0.45	0.57	0.69
Compliance Improvement	0.39	0.41	0.44	0.46

Source: Morán, D. and Díaz de Sarralde, S. (2024) based on ISORA

⁶ <https://www.ciat.org/tax-performance/?lang=en>

Figure 1. Innovation, Digitalization & Technology Index (INDITEC) for Tax Administrations around the world (2021; based on ISORA Survey 2022)



Source: Morán, D. and Díaz de Sarralde, S. (2024) based on ISORA

Table 1 and Figure 1 synthesize the overview of the use of new technologies in TAs. If the individual results are summarized according to the income level (World Bank classification criteria), a clear positive association can be detected, where the average values grow with income and reach their maximum in the group of High-Income countries, being the gaps most noticeable with regard to the dimensions of technological innovation and operational digitalization.

OECD's Inventory of Tax Technology Initiatives (ITTI), is another essential source of information, containing evidence on technology tools and digitalization solutions implemented by tax administrations⁷. Specifically in relation to VAT, the ITTI⁸ database can

⁷ Currently 80 countries have filled the survey. ITTI has been put together by the OECD with the assistance of the ISORA Partners (the Inter-American Center of Tax Administrations, the International Monetary Fund, the Intra-European Organisation of Tax Administrations and the OECD), the Asian Development Bank, the African Tax Administration Forum, the Cercle de Réflexion et d'Échange des Dirigeants des Administrations fiscales, the Commonwealth Association of Tax Administrators and the Study Group on Asia-Pacific Tax Administration and Research. Available at <https://www.oecd.org/tax/forum-on-tax-administration/tax-technology-tools-and-digital-solutions/>

⁸ <https://www.oecd.org/tax/forum-on-tax-administration/tax-technology-tools-and-digital-solutions/value-added-tax.htm>

assist with better understanding on how Administrations and policy makers are increasingly looking at the opportunities offered by digitalization to help reduce their VAT gap, including by:

- Increasing electronic recording and/or reporting requirements on transactions for example through requirements to use e-invoices, to store transaction information on approved devices, or to provide tax administrations access to invoice information electronically.
- Developing new approaches to VAT collection on online sales, in particular by imposing collection obligations on digital platform operators for the VAT on e-commerce sales that are carried out on their platforms.
- Enhancing risk assessment through the incorporation of a greater range of data sources and the use of new analytics tools including, in some cases, the use of artificial intelligence (AI).
- Improving online services to make it easier for taxpayers to understand their tax obligations, to interact with the tax administration and to report their activities that are subject to VAT. This can include providing third parties with software that allows them to embed tax services and processes in the natural systems used by businesses.

Additionally, to these benchmarking tools, TAs digital maturity models have been developed to assist TAs in self-assessment or experts assisted assessment of their organizations. For example, OECD's Digital Transformation Maturity Model⁹, developed in 2021 and updated in 2022, explore six key building blocks of future tax administration (Digital Identity; Taxpayer Touchpoints; Data Management and Standards; Tax Rule Management and Application; New Skill Sets; and Governance Frameworks), establishing for each of the themes, descriptor of maturity classified into emerging, progressing, established, leading and aspirational¹⁰.

In its turn, IDB's Digital Maturity Index (DMI)¹¹ aims at evaluating, in a standardized form, the efforts carried out by TAs to transform themselves into digital institutions and providing a roadmap for those responsible for tax collection to advance the digital transformation process. DMI identified that the best practices are based on the following principles: Data enters the system only once (data-only-once); Data is managed and processed centrally for various products and services (single source of truth); Data travels and is stored on digital media (paperless); and Information is received and processed in real time (real time). Under

⁹ <https://www.oecd.org/ctp/administration/digital-transformation-maturity-model.htm>

¹⁰ This model could be complemented by the Analytics Maturity Model, developed by the Analytics Community of Interest in the Forum on Tax Administration (FTA) -together with the FTA Secretariat-, to facilitate self-assessments by tax administrations globally of their maturity in the area of analytics. This set of products developed by the OECD could be grouped in its Tax Administration 3.0 Action Plan. OECD (2020, 2022a). Additionally, different Data Governance maturity models have been developed and could be applied to Tax Administrations, see, for example, CIAT (2022) Data Governance for Tax Administrations: A Practical Guide.

¹¹ <https://blogs.iadb.org/gestion-fiscal/en/digital-maturity-index-how-to-measure-digital-transformation-progress-in-tax-administrations/>

these principles and best practice experiences, the index builds a scale with four levels of maturity: beginner, intermediate, advanced, and best practices. The DMI dimensions are grouped, on the one hand, in the enablers of the digital transformation process, such as the country's digital environment and the resources available to the TA. On the other hand, the model group the digital transformation under the information process approach, the collection of data, and the generation of digital products and services.

Finally, other well-known more general tax administration's assessments tools, as TADAT (Tax Administration Diagnostic Assessment Tool)¹² and Tax DIAMOND (Development of Implementation and Monitoring Directives for tax reform)¹³, include valuable information about tax administration's digitalization and ICT developments in some of their sections.

All these developments offer TAs some tools for benchmarking, self-assessment and good practices in the field of new technologies and digitalization, the next sections will deepen in the key stages of an efficient strategy to take advantage of that innovations to improve VAT compliance.

2. New technologies to track commercial transactions and VAT data.

The cornerstone of VAT's administration and control, is the reliable, timely and complete knowledge of commercial transactions, minimizing, at the same time, compliance costs for taxpayers.

Traditionally, the control of these market operations rested on paper-based invoices, bookkeeping requisites, information obligations by taxpayers about their transactions, analogic auditing of this information and control of point-of sales. Innovations that digitalized the registration of transactions and its transmission to TAs have the potential to transform radically VAT's administration, improving both taxpayers experience and TAs capabilities. In this section we will review the different options available, including e-invoicing, e-reporting, digital cash registers, products and services classification, e-solutions for e-commerce and low value imported goods taxation, etc.

2.1. Goals, technologies, and options.

The first thing to take into account is that there is a nominative or terminological debate around the different innovative technologies that have been introduced to facilitate digital record of transactions, to allow the transition from paper-based invoicing systems to electronic invoicing and how to use it all for a better tax administration¹⁴. This debate has run parallel to the diverse trajectories and country experiences during this journey, adapting each of them to their own restrictions, business environment and legal framework. The approach in this guidance is not going to focus on solving this debate, nor to advocate for a

¹² <https://www.tadat.org/home>

¹³ <https://www.taxdiamond.org/Authentication/Login.aspx>

¹⁴ See, for example, pages 13-14 of OECD (2022b). The results of the survey quoted in this paper show that even if the majority of TAs identify the e-invoice with a structured data set allowing for automated digital data processing, still many of them indicated that images of paper documents, like PDFs, could be considered to be an e-invoice.

one-size-fits-all solution, but to highlight desirable goals and, according to them, raise the options available to help each country to design its own national strategy.

The starting point of the use of new technologies to improve VAT's administration is to get access to the information on sellers and buyers' transactions in a reliable and timely way, minimizing compliance costs, promoting voluntary compliance and making easier control and enforced compliance when needed. To reach these goals it is recommended to implement a technological system that provides a digital identification and electronic validation/signature of the subjects involved, tamper-proof digital register of transactions and secure digital communication of the information. And currently, three options, not necessarily mutually exclusive, are being implemented. Departing from the point of view of the tax administration, these options may be labelled -for the sake of explanation- as: e-invoicing, e-reporting and digital cash registers.

In an e-invoicing system taxpayers are required to issue a structured -according to a machine-readable standard- electronic invoice with a specific format established by the authorities and the e-invoice (or a set of data from it) must be transmitted to the tax administration¹⁵.

These would be its basic characteristics, even if the system could vary in many different aspects:

- a) the set of taxpayers involved, on voluntary or mandatory basis.
- b) the format of the e-invoice¹⁶.
- c) the way in which it is issued (web services provided by the tax administration and or private authorized services) and "travels" from the seller to the buyer, and to the tax administration (with or without previous authorization or clearance); and
- d) the moment in which the tax administration receives the information (prior to its issuance, as it takes place, or shortly thereafter).

E-reporting could be described as any digital reporting system that does not require the existence of a predefined e-invoice (even if this e-invoice could exist in some systems, especially if it is used a broad definition of it, including unstructured ones like PDFs, digital images, scanned paper invoices, etc.) but focus on establishing the obligation to transmit digitally a set of data of the transactions that is relevant to the tax administration, periodically or in real time.

Digital (or electronic) cash registers are the evolution of traditional cash registers that began to be used for tax control purposes of the points of sale (under different names as fiscal registers or fiscal printers), evolving to include a device where each and every sale is

¹⁵ This terminology can be found in CIAT and IDB (2018) and European Commission (2022), for example.

¹⁶ UN/CEFACT cross-industry invoice (CII), the OASIS UBL (ISO/IEC 19845) International Standard, and the European standard on e-invoicing (EN 16931) which was developed and published by the European Committee for Standardisation (CEN), are among the standard formats used -OECD (2022b)- but many countries have adapted and developed their own formats to domestic requirements and legislation -CIAT and IDB (2018)-.

registered in a way that identify digitally the seller and the details of the transaction, that cannot be erased, and that is accessible to the tax administration, even, in the most advanced systems, on-line in real-time basis.

All the options offer tax administrations the possibility to access to better and faster information for VAT management and control but differ in the degree of information collected and the implementation process, as well as in the complementary advantages that could associated with them.

E-invoicing system would provide the maximum amount of information while minimizing the possibility of errors¹⁷, as the information contained in the invoice will be transmitted automatically to the tax administration: the document is the same for seller, buyer, and tax administration. At the same time the process of implementation of the system may foster digitalization and innovation of the economy and businesses in general -encouraging the adoption of better business management processes, increasing IT capacity, promoting digital innovations as electronic signature, facilitating the standardization of electronic relationships among businesses and customers and the e-commerce in general, and minimizing the use of paper-. Once implemented, the system would reduce compliance costs (decreasing invoice processing costs and processing errors, allowing the removal of other burdensome tax reporting and compliance regimes, etc.) and foster formalization. The information collected could be used to provide further services, as we will survey in the next sections.

E-reporting systems do not require to transform the legislation and business practices on invoicing and could provide timely the basic information needed for tax administration and compliance purposes. On the other hand, this option does not offer (at least not at the same degree) the other advantages enumerated for e-invoicing¹⁸.

Finally, digital cash registers focus only on the retail stage and require an additional investment in hardware. Consequently, their potential to improve VAT administration and to provide additional advantages and services have a more limited range. In general, this was the first system introduced in most countries and its use can be simultaneous to the others, even if the maturity of e-invoicing systems, reaching the retail sector and business to consumer (B2C) operations, could leave to its substitution.

The choice among the above-mentioned options to improve control and information on commercial transactions and VAT administration is affected by each country particular circumstances -including the degree of technological maturity, business environment and legal framework- and temporal goals -short-term solutions or medium and long-term

¹⁷ Always depending, of course, on the validation rules applied to the process of e-invoice issuing.

¹⁸ In case the authorities plan to move to a e-invoicing system in the future, the potential duplication of efforts should be also taken into account.

strategies¹⁹. The next section provides more information on implementation and country experiences to help to evaluate the best scenario for each country²⁰.

Another specific area where technological innovations are fundamental to improve VAT compliance and administration is e-commerce of digital goods and services and low-value imports of goods. The global policy dialogue organized by the OECD identified internationally agreed rules and mechanisms that allow governments to secure important VAT revenues on e-commerce and to ensure a level playing field between e-commerce and traditional businesses, without stifling innovation and economic growth²¹. Of particular relevance in the context of this technology-oriented report is that the recommended rules and mechanisms promote the design and implementation of a simplified registration and collection regime via a secure, user-friendly online portal through which non-resident suppliers and digital platforms can register for VAT and manage their VAT obligations. The development of an IT infrastructure for a simplified VAT compliance regime could be done by the tax administrations themselves or could resort to digital solutions developed by other entities²². Over 90 jurisdictions around the globe have implemented VAT reforms directed at digital trade based on these recommended approaches.

2.2. Available approaches to implement a national strategy.

Given the already cited ambiguous use around the world of some terms that define the strategies previously exposed, it is not easy to synthesize the overview of its implementation. Fortunately, we can resort to ISORA for an approximation good enough. Following the Overview published by CIAT²³ and based on ISORA, the implementation of electronic invoicing and its requirement as a mandatory tool for recording sales and other transactions

¹⁹ Along the technical considerations, attention should be given to the collaboration with private sector, considering, for example, ICC (International Chamber of Commerce) set of Practice Principles for the Implementation of Continuous Transaction Controls (<https://iccwbo.org/news-publications/policies-reports/icc-continuous-transaction-control-ctcs-practice-principles/#single-hero-document>). These principles aim at: consider the need for balance between the legitimate interests of tax collection and economic growth; ensure efficiency and maximum benefits for both the private and public sectors ('Provide data only once' principle; Consistency; Interoperability; Harmonization; Robustness and continuity); communicate a holistic and long-term strategy embedded into a broader strategy of the digitalization of the public administration; stimulate cooperation; facilitate possible changes; provide data protection and privacy; and ensure non-discrimination, considering and minimizing trade impacts.

²⁰ From the international perspective, some degree of harmonization should be encouraged and promoted in order to reduce compliance costs.

²¹ Further guidance on the design and implementation of these rules and mechanisms can be found in the VAT Digital Toolkits for Latin America and the Caribbean, Africa and Asia-Pacific developed by the OECD and other regional partners. For example: <https://www.oecd.org/tax/consumption/vat-digital-toolkit-for-latin-america-and-the-caribbean.htm>

²² As the Digital Economy Compliance (DEC) software, developed by CIAT with the support of NORAD (Norwegian Agency for Development Cooperation). This open source and free software offers a simplified voluntary mechanism for registration, declaration, payment and communication of companies operating without a physical presence in a country (<https://www.ciat.org/the-dec-tool-digital-economy-compliance-tool-adds-new-functionalities/?lang=en>). Aligned with the OECD VAT toolkit, DEC completed its implementation in Bolivia, Guatemala and Nigeria, and it is planned to be implemented soon in Dominican Republic, Honduras, Panama and five Pacific Islands

²³ Garcimartín and Díaz de Sarralde (2024).

is one of the most important innovations in the fight against tax fraud. Of all the countries in ISORA, 36.8% of them have a mandatory electronic invoicing system for some or all taxpayers registered by their respective TAs. CIAT countries lead, by groups of countries, in the degree of adoption of this tool with 50% of the total, while in LAC this percentage reaches 39.4% (Figure 2). Unlike most technological innovations for tax management, the implementation of electronic invoicing is not led by high-income countries (25.9%), since its dissemination and incorporation are currently more intensive among middle-income countries (40.9% Lower-Middle Income; 47.1% Upper-Middle Income). Looking ahead, electronic invoicing seems to continue to be a higher priority for lower-income countries, given its potential as an instrument for reducing tax evasion.

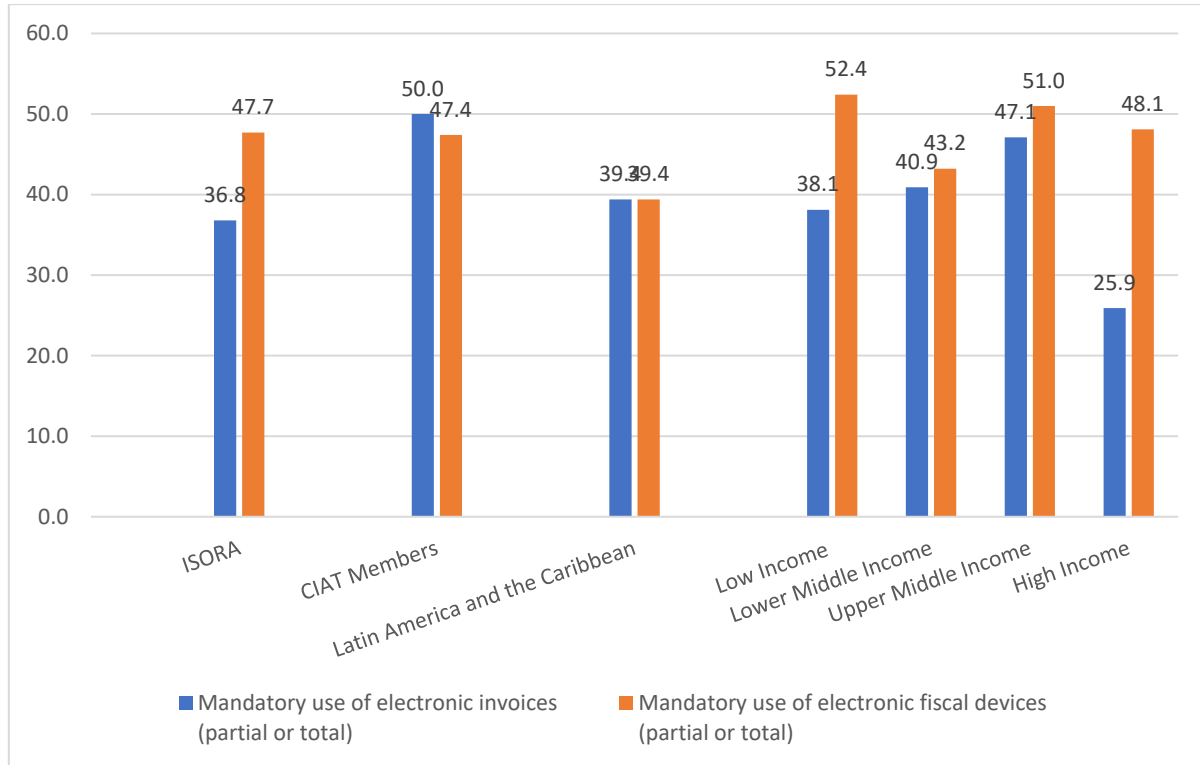
Other techniques, aimed at the same objective of improving levels of voluntary compliance, are represented by the requirement by TAs for taxpayers (sellers of goods and services) to record their transactions through the use of electronic fiscal devices or duly certified cash registers. In ISORA this practice is observed in almost half of the cases, while in CIAT in 47.7%, with relatively similar values for other groups of countries according to income level (Table 2).

Table 2. Mandatory use of electronic invoices and fiscal devices. (2021 data; based on ISORA Survey 2022)

Country Groups	Mandatory use of electronic invoices (partial or total)	Mandatory use of electronic fiscal devices (partial or total)
ISORA	36.8	47.7
CIAT Members	50.0	47.4
Latin America and the Caribbean	39.4	39.4
Low Income	38.1	52.4
Lower Middle Income	40.9	43.2
Upper Middle Income	47.1	51.0
High Income	25.9	48.1

Source: Garcimartín and Díaz de Sarralde (2024).

Figure 2. Mandatory use of electronic invoices and fiscal devices. (2021 data; based on ISORA Survey 2022)



Source: Garcimartín and Díaz de Sarralde (2024).

The implementation of national systems of electronic invoicing in Latin-America²⁴ is a well-known trend, with early adopter and leader countries in the use of the technology to reduce compliance costs and tax fraud, like Chile (2003), Brazil (2006), Mexico (2005, 2011)²⁵ and Argentina (2006), with adoption levels close to a hundred per cent of all registered invoice issuers, are being followed closely by Ecuador (2016), Uruguay (2012) and Peru (2016) that have significantly expanded the number of issuers and documents, with only small taxpayers still using paper-based invoices.

In the last years other countries have joined the club: Colombia (2018) put in place a new operational model implementing an pre-clearance model supported by a cloud based application hosted by the tax administration that reached mandatory level for all large taxpayers by the end of 2019; Costa Rica (2017) went into full production establishing a mandate for all taxpayers to use the system currently handling over a hundred million documents per month; Guatemala (2018) implemented a new operational model that replace

²⁴ CIAT and IDB (2018); and Raúl Zambrano (update version, mimeo).

²⁵ Some countries, like Bolivia, Colombia, México and Ecuador, changed their models along these years giving solution to different problems (low scale of adoption, low quality of information, technological problems).

the old GFASE based with one that would match the tendency elsewhere in Latin-America where all documents are transmitted to the tax administration; the Dominican Republic (2019), Panama (2018) and Paraguay (2018) started their own systems with all three countries conducting and successfully concluding their pilot projects and got ready for general production in a voluntary phase; Bolivia, El Salvador, Cuba and Honduras have ongoing projects for the development and adoption of their own national systems.

We could say that e-invoicing in Latin America have created a snowball effect and nowadays is a symbol of modernity. Even with different clearance models and role of private solutions, e-invoicing in this area is, without exceptions, a national project, written, directed and co-starred by the tax administration. The tax administrations receive all invoices issued by taxpayers, e-invoices comprise all information of the registered operations and can be used by taxpayers only after cleared by the tax administration. In most of European and Asian countries, e-invoice involves basically only companies and their mutual relationship, and the tax administrations only receive an extract of the information registered on the invoices.

The Latin American experience allow to draw some valuable lesson on how to structure the process taking into account different elements: technology; stages of implementation; taxpayers involved; and communications strategy.

A prerequisite is to assess the adequacy of the infrastructure of the tax administration, the capacity of service by solution providers and the adequacy of communication infrastructure. After that, tax administrations need a well-defined pilot phase (including big companies and problematic sectors, and ideally a whole supply chain, but keeping small the number of taxpayers involved). Usually, the main difficulties are not strictly technological, but affecting the adaptation of company's invoicing processes. If the pilot phase has been successful, the voluntary adoption phase can be launched, always giving enough time in advance to adapt to the new regulation. During this phase is essential to be prepared for bottlenecks (and if needed, to limit the access to the system in order to avoid overloads). There is no rule for the duration of this phase, in Brazil, it took less than two years, while in Chile more than ten years. One conclusion is unanimous though: without mandating, there are a number of companies that will not become users of the system, for many different reasons (blurred benefits and management of change difficulties, unclear or very complex laws, unfavorable cost/investment ratios and lack of knowledge).

In advance of the mandatory phase is important to promote extensive publicity with enough time of antecedence, opening the production environment for all taxpayers reached by some legal obligation on the same date that this obligation begins, and the test environment long enough before this date. Extra care must be taken with the starting dates of obligations, avoiding critical commercial and accounting periods.

Throughout all these phases, the times need to be long enough to do a quality work both for taxpayers and for tax administration, taking always into account its impacts on businesses' invoicing systems, which are at the core of their commercial relationships with customers and suppliers.

Regarding the taxpayers involved, different considerations should be made for business to business (B2B) and B2C companies. In the B2B sector, when a company is obligated, its entire sector should ideally be reached at the same time. If we cannot avoid defining a threshold²⁶ in terms of the size of the company (expressed by turnover) that separates those who need to adopt the system, it could be reduced every year to make the extension automatic. All establishments of a company should be included simultaneously, and companies involved should completely stop using paper invoices²⁷. Of course, the beginning of the obligation must be published sufficiently in advance and some sectors could be left out, for pragmatic reasons, as semi-industrial activities executed by artisans or individual farmers and fishers.

Normally taxpayers who operate only on B2C operations are around 80% of the total number of VAT taxpayers, and the total number of invoices issued on B2C operations are 8 to 10 times greater than the number of invoices issued on B2B operations, making the mandatory phase for B2C taxpayers an important and difficult step where simple and free technological solutions are essential. Most taxpayers are small and medium businesses, consequently, it is very likely -depending on national VAT legislation- that below a threshold of economic size there will not be mandatory use and other solutions have to be considered (special tax regimes, cash registers, point of sale -POS- controls, etc.).

In general, it should be taken into account that, even if sometimes unavoidable, segmentation of e-invoicing implementation by economic sectors or business size could increase complexity, aiming to minimize the coexistence of different invoicing regimens.

Finally, the communication strategy is a corner stone of the process, combining a clear roadmap of the authority's plans, an extended generic message²⁸, the creation of an "e-Invoice Brand" and a visual identity, the establishment of channels for consultation between the government, professionals, and taxpayers, and the dissemination of specific messages for tax professionals and for information and communication technology (ICT) professionals, going much deeper than the generic information campaign.

Another geographical area where technological innovations are recently transforming the way tax administrations are tracking commercial transactions to improve VAT compliance is the European Union (EU)²⁹. On 8 December 2022, the European Commission proposed a series of measures to modernize and make the EU's Value-Added Tax (VAT) system work

²⁶ Thresholds are always problematic in terms of design and implementation.

²⁷ The acceptance of e-invoices must be universal.

²⁸ This message must be adapted to the country's idiosyncrasy and the characteristic of the system implemented. For example, if the adoption of e-invoicing is a free choice for taxpayers, as is the case in the United States of America or in most European countries, the main reason for adopting the electronic invoice is economic, focusing on the savings by the issuer.

²⁹ See VAT in the Digital Age (https://taxation-customs.ec.europa.eu/taxation-1/value-added-tax-vat/vat-digital-age_en#:~:text=On%208%20December%202022%2C%20the,by%20embracing%20and%20promoting%20digitalisation.)

better for businesses and more resilient to fraud by embracing and promoting digitalization³⁰. Among other reforms, the EU is promoting a move to real-time digital reporting based on e-invoicing for businesses that operate cross-border in the EU. The new system introduces real-time digital reporting for VAT purposes based on e-invoicing that will give Member States valuable information they need to step up the fight against VAT fraud, especially carousel fraud. The move to e-invoicing is intended to help to reduce VAT fraud and bring down administrative and compliance costs for EU traders. It also facilitates that existing national systems converge across the EU, mitigating possible distortions of the competition, and paves the way for Member States that wish to set up national digital reporting systems for domestic trade in the coming years.

The country level developments in the EU are subject to a specific legislation. As it is highlighted in OECD (2022b), there is no explicit option available for EU Member States to introduce mandatory e-invoicing requirements as a means to ensure the correct collection of VAT and to prevent VAT fraud. As a consequence, if a Member State wishes to introduce mandatory e-invoicing requirements, it must do so by requesting a derogation from article 395 of the VAT Directive, which is subject to the unanimous agreement of the Council based on a proposal from the European Commission. The framework is different for B2G transactions. According to Directive 2014/55/EU, Member States must require public administrations to accept structured e-invoices compliant with the European standard. Though not explicitly provided by the VAT Directive, the Member States may voluntarily impose a domestic obligation to use structured e-invoices for B2G transactions - European Commission (2022) -. In this context different country strategies have been developed, most of them focusing on e-reporting schemes that does not require the generalization of e-invoicing for B2B or B2C operations³¹.

Beyond Latin America and the European Union there are also other significant experiences in the implementation of e-invoicing. For example, the Zakat, Tax and Customs Authority of the Kingdom of Saudi Arabia has very recently introduced Fatoora, its e-invoicing system, in one of the fastest implementation experiences³². China's State Taxation Administration (STA) is also vigorously stimulating the use of electronic invoices. On December 1, 2015, China started to promote electronic VAT general invoices nationwide, and introduced electronic VAT special invoices for new taxpayers on a pilot scale on September 1, 2020³³. In general, e-invoicing is steadily spreading across Eastern Europe and Asia³⁴.

³⁰ It has to be taken into account that this is an area of continuous evolution, and the EU is looking to harmonize some requirements across the region.

³¹ See, for example, the developments in Spain (Immediate Supply of Information, 2017) or Hungary (Online Invoicing System, 2018), while Italy and Greece are closer to an e-invoicing system (OECD (2022b)). Middle East/North Africa (MENA) countries are also undertaking initiatives in these areas.

³² Details of the system and its implementation can be found in <https://zatca.gov.sa/en/E-Invoicing/Pages/default.aspx> and in its presentation at the 4th BRITACOF

(https://www.britacom.org/ebook/4rd_britacof/mobile/index.html), Presentations, Session 5.4).

³³ "A Study of China's Tax Environment (2016-2020)" in Best Practice of Selected Jurisdictions on Improving Tax Environment BRITACOM Secretariat (2023).

³⁴ See, for example, information on recent advances in: <https://blog.groupseres.com/en/whats-new-in-e-invoicing-in-eastern-europe> and <https://blog.groupseres.com/en/recent-advances-in-e-invoicing-across-asia>

Finally, the approach based on electronic on-line cash registers has been summarized in OECD (2019). This report provides insights and lessons learned on: the broader picture as regards electronic cash registers, and the factors that tax administrations may wish to take into account when considering options; core elements of successful introduction of online cash registers, including the business case, the legal framework, stakeholder management and data protection; case studies of the implementation of online cash register systems in Hungary, Korea, Russian Federation and Slovakia; and a detailed set of recommendations and guidance for tax administrations that may wish to consider adopting and implementing online cash registers³⁵.

3. Making VAT compliance easier through technology

Thanks to new technologies VAT voluntary compliance can be encouraged and facilitated, providing better information both to taxpayers and tax administration. In this process, the innovations in the tracking of commercial transactions have a protagonist role, but there are also others that help to improve all stages of the tax cycle. Next subsection will summarize the potential areas to improve VAT compliance through technology, while the second one will focus on same relevant country experiences.

3.1. VAT voluntary compliance and technology

The tax administration functions are related to the taxpayers' main obligations or duties, namely: registering as a taxpayer; the submission of returns within the required terms; timely payment of tax obligations; and accuracy and completeness of the returns submitted. Based on these obligations we may identify the areas where technology can help tax administrations to promote voluntary compliance making easier taxpayer registration and identification, offering taxpayer services, facilitating returns, payment and refunds processes, and providing dispute prevention tools³⁶.

A good international practice is the automation of the registration process (and its modification) in the taxpayer registry file. This can be done by means of a flexible procedure in the "virtual office" of the tax administration where the taxpayer's identity is proven through the use of an advanced electronic signature, without the need for physical presence in the offices. Alternatively, it may be done through common interfaces with other

. Specially relevant are some experiences to expand the use of electronic documents to international transactions, as the Belarus-Russia electronic shipping documents exchange project (<https://eng.belta.by/economics/view/second-stage-of-belarus-russia-electronic-shipping-documents-exchange-project-launched-141019-2021/>).

³⁵ It is also worth looking at the experience of the European countries that are implementing these systems, like Poland (<https://www.gov.pl/web/finance/fiscal-cash-registers>), Croatia (https://www.porezna-uprava.hr/HR_publicacije/Prirucnici_brosure/FiskalizacijaWEB.pdf) or Belarus.

³⁶ CIAT (2020), section 2. Concerning dispute resolution, the EU experience should be also considered. EU businesses that encountered VAT issues in the EU Member States, can use SOLVIT, an online tool coordinated by the European Commission to helping solve without legal proceedings problems associated with misapplication of the EU legislation by public authorities. SOLVIT centers, which have to provide real solutions to problems within 10 weeks, are located in every EU member state, and using their services are free of charge (Source: SOLVIT. European Commission. Accessed at: https://ec.europa.eu/solvit/index_en.htm)

government agencies involved in this process. In some cases, the physical presence is limited to the capturing of biometric data at the headquarters of the tax administration.

Additionally, the registration file may include a module referred to as “taxpayer obligations management” section containing information on each taxpayer entity’s tax obligations (e.g., filing requirements), which are based on the taxpayer’s economic, entrepreneurial or professional activities, the taxpayer’s profile or rules associated to specific regimes. Also known as the “fiscal vector,” this module may inform and make available on-line the frequency and filing dates according to each taxpayer’s different obligations (deadlines for submitting the returns, dates for making payment, dates for filing information returns, etc.). At the same time, registration should activate a secure digital channel to deal with correspondence between taxpayers and tax administration, in substitution of physical mail addresses and incorporating the possibility of uploading the data files required for tax management.

Assistance to the taxpayer is essential for increasing the levels of voluntary compliance. The base of the tax compliance pyramid consists of a large number of taxpayers, who require maximum assistance from the administration, with all types of services and assistance channels. The complexity of the tax rules, the need to approach the taxpayer when he needs it most, the obligation to provide truthful, reliable, and complete information to the citizen, different for each taxpayer segment and adapted to their needs, constitutes a real challenge for the tax administrations. This challenge has been favored by the upsurge of information and communication technologies, which offer taxpayers a wide range of possibilities for interaction.

Today, tax administrations count on a number of channels in order to provide service to the taxpayer. Among these are the traditional telephone assistance centers and face-to-face channels that now can be complemented with the tax administrations’ Web page, 24/7 virtual office services, mobile telephone applications, electronic mailboxes, virtual assistants and chatbots guided by AI, and “Frequent Questions” systems. Add to this the frequent use of social networks by the tax administrations to disseminate messages, interact with taxpayers, receive recommendations and feedback.

Specifically for the tax returns filling stage, in addition to the information and service innovations, technology can help to reduce compliance burden offering prefilled tax returns and digital channels -in particular for small taxpayers³⁷-. All tax administrations are on the path to become paper-free organizations offering (or even making compulsory) multiple options for on-line, digital, or electronic tax return filling, saving time and reducing errors in the transcription. At the same time, improvements in the availability of commercial transactions data, thanks to e-invoicing and e-reporting systems, is making possible for tax administration to offer taxpayers VAT prefilled returns and to reduce some redundant

³⁷ Big companies, especially those quoted on stock markets, face strict accounting and internal control rules to allow periodic closing of books and proper information of shareholders, and prefilled tax returns is- at least partially - an exogenous data set which creates a new need for reconciliation vs the accounting books.

information obligations, especially for small and medium enterprises (SME)³⁸. Complementing digital tax return channels, tax administrations are able to offer now a wide range of digital payment options, on-line, embedded in the tax returns software or through mobile devices. Ideally, these digital interfaces should offer the possibility to ask for the extension of payment deadlines or modify payment arrangements, always according to national legislation.

A key element to improving VAT management is to increase refunds speed and certainty. The business sector makes a fundamental effort collaborating in the collection of value added taxes and for them is fundamental to receive refunds, when qualified for them, the sooner the better. The improvements in information available to tax administration thanks to the innovations explained in the previous section (e-invoicing, e-reporting) should be used to speed up refunds without risking an increase in tax fraud³⁹.

Additionally, digital innovations are key to prevent disputes. Tax administrations with access to real time information on commercial transactions and the capability to analyze it can detect in advance possible errors or discrepancies in relation to tax returns. After validating them - avoiding rising and unnecessary information requests that could increase compliance costs- TAs may contact taxpayers in the context of a cooperative compliance framework to review voluntarily their returns and correct them -or clarify the misunderstanding in a cooperative way-, before triggering enforce collection procedures and judicial dispute resolution procedures. At the same time, the use of digital communication channels could be used to substitute, with all the legal safeguards, physical meetings, saving time and money to both sides.

As has been highlighted previously, e-commerce of digital goods and services and low-value imports of goods is a specific area where technological innovations are fundamental to improve VAT compliance and administration. Even if this is not a topic that is going to be dealt with in depth here, it is worth it to point out again that, according to international standards and best practices, implementing the channels to make non-resident enterprises or the platforms/marketplaces used by the buyers responsible for VAT collection, declaration and payment have a significative potential to foster voluntary compliance. In the case of the sometimes-called collaborative economy, where non-resident platforms work as middle agents between supply and demand for goods and services in the national jurisdiction (secondhand markets, tourist apartments renting, transportation, etc.), receiving information on transactions from these platforms could be key to reduce informality and tax fraud in these sectors.

Finally, the quantity and quality of information available to tax administrations on commercial transactions may be used to offer a whole new set of services to taxpayers and

³⁸ For bigger companies accurate pre-filled VAT returns could be more difficult to generate, due, among other reasons, to the complexity of their operations.

³⁹ In Belarus, for example, the mandatory e-invoicing system is crucial to ensure obtaining VAT refunds in a timely manner. The supplier submits an e-invoice through an online portal, and the buyer has to verify and accept it (which creates two levels of controls over invoices, by the businesses involved in a supply chain and tax administration). When the buyer submits a VAT refund claim, tax officers compare the information in the VAT return with the "balance" on the online portal and allow the refund only if the match.

the citizenship in general (e-invoices factoring, statistics, studies, goods and services final consumer price comparatives, etc.), new services that will be summarized in the next section.

3.2. Overview of country experiences and case studies

Tables 3 to 5 offer an overview of the degree of implementation of new technologies to improve tax compliance, in the world and across the countries, grouped by their income level.

Regarding one of the traditional processes of tax administration operations, ISORA provides detailed information about the different registration channels available to taxpayers. The results highlight that face-to-face (in-person) registration is still the channel with the highest presence (87.9%) among the countries participating in the survey, even though the availability of digital channels (online or through applications) has grown significantly compared to paper registration by postal mail (65.5% of the countries offer the computerized alternative; compared to 43.1% for paper). By income level, there are large differences in the adoption of these new online technologies, with 88.9% of high-income countries adopting them, far beyond the 38.1% of low-income countries.

Table 3. Taxpayers' Registration Channels. (2021 data; based on ISORA Survey 2022)

Country Groups	Taxpayers' Registration Channels (% of countries where available)					
	Online	Telephone	Email	Mail / post	In-person	Other
ISORA	65.5	37.4	48.9	43.1	87.9	30.5
Low Income	38.1	19.0	23.8	28.6	81.0	33.3
Lower Middle Income	50.0	34.1	54.5	34.1	90.9	29.5
Upper Middle Income	70.6	37.3	51.0	37.3	94.1	31.4
High Income	88.9	50.0	55.6	64.8	88.9	31.5

Source: ISORA

In terms of the availability of different communication channels (Table 4), in recent years digital channels (online, e-mail and digital assistance) have been increasing their presence in a large number of countries, even before the outbreak of the COVID-19 pandemic which has accelerated this movement towards non-face-to-face digital based communication and interaction solutions with the taxpayer. The digital options' set is now the main channel of communication for taxpayer services, followed by "phone/postal mail" and the in-person channel. By income level, it is confirmed that digital and traditional nonface- to-face channels (telephone/postal mail) are more intensively used by higher income countries, while the face-to-face channel ("in person") reduces its degree of use as the income of the countries analyzed increases.

Table 4. Services and new technologies. (2021 data; based on ISORA Survey 2022)

Country Groups	Service channels (in % of incoming contacts)			Application programming interfaces (APIs) (%)	Digital identification technology (%)	Virtual assistants (e.g. chatbots) (%)
	Online/Digital Assist./E-mail	Phone/Mail	In-person			
ISORA	41.9	39.9	18.1	72.4	29.3	43.7
Low Income	33.8	23.9	42.3	71.4	19.0	28.6
Lower Middle Income	35.3	40.3	24.4	72.7	25.0	36.4
Upper Middle Income	42.8	37.4	19.8	58.8	31.4	41.2
High Income	46.6	43.8	9.5	87.0	37.0	61.1

Source: ISORA

In this field, the introduction of Application Programming Interfaces (APIs) stands out for its importance and diffusion. APIs allow secure digital interaction between revenue systems and external applications in banks, accounting software providers and other government agencies, and can be used to send and receive information, validate activities and facilitate operations. In this area, 72.4% of ISORA countries have this technology (in use or in the implementation phase). Digital identification technologies (e.g., biometrics, voice identification) have also had an acceptable diffusion among the different countries, reaching an outstanding relevance within the advanced technological solutions (29.3%), growing their implementation with the level of income. Finally, Virtual Assistants (e.g., chatbots), are already in use or are in the implementation phase in 43.7% of the total number of countries included in the survey (174), outstanding their implementation in High Income countries (61.1%).

Regarding returns filled through electronic channels -aggregating their different possible modalities - the overall averages for ISORA are 72.8% for Corporate Income Tax (CIT), 79.2% for Personal Income Tax (PIT) and 68.5% for VAT (Table 5). The differences by income level are clear: electronic filing is below 50% for all taxes in the group of Low Income countries while for High Income countries are 87.2% (CIT), 90.9% (PIT) and 80.3% (VAT). In average, 49.4% of the countries reported offering pre-filled tax returns at least for one of the main taxes (PIT, CIT, VAT). The use of this technique to improve and facilitate voluntary compliance shows a clear increasing pattern according to income level of analyzed countries⁴⁰. The relative proportion of tax payments through electronic channels reaches a global average in ISORA of 68.8%, if the number of payments is taken into account, and 75.5%, if their economic value within the total collection is considered. By income level, the

⁴⁰ In most cases prefilling is used for PIT purposes, while experiences in the field of CIT and VAT are scarce are more recent, later some significant ones will be quoted, like the implementation of VAT pre-filled tax returns in Chile.

gap between the different groups of countries is still evident, with average e-payment values growing with income level, from 51.3% of the amount and 69.3% of the value of payments received (Low Income) to 79.1% and 79.4% of the total (High Income), respectively -even if the gap has been closing quickly after the pandemics-.

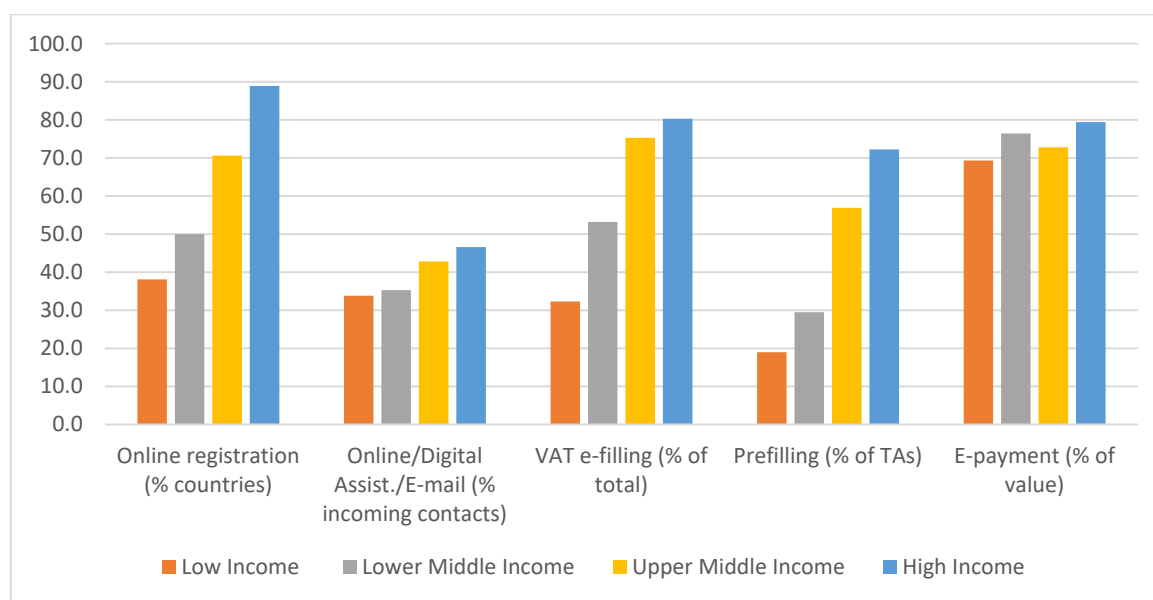
Table 5. E-filing, Pre-filing and E-payment. (2021 data; based on ISORA Survey 2022)

Country Groups	Electronic filling rate (in % of total)			TA pre-fills returns or assessments	Electronic payment proportion (in %)	
	CIT	PIT	VAT	% of TAs	Amount	Value
ISORA	72.8	79.2	68.5	49,4	68.8	75.5
Low Income	36.0	48.4	32.3	19.0	51.3	69.3
Lower Middle Income	64.9	64.8	53.2	29.5	67.0	76.4
Upper Middle Income	72.2	80.2	75.3	56.9	63.1	72.8
High Income	87.2	90.9	80.3	72.2	79.1	79.4

Source: ISORA

Figure 3 summarizes the differences in the implementation of new technologies depending on the level of income.

Figure 3. Technology innovations by level of income. (2021 data; based on ISORA Survey 2022)



Source: ISORA

It is worth highlighting that tax administrations, particularly those with solid and stable e-invoicing systems, are using the new data in different and innovative ways to provide new services. A few examples of its usage would be⁴¹:

- Brazil, besides using its e-invoicing data to track the economy real-time on a sectoral basis, has developed the Public System of Digital Accounting (SPED⁴²), which has become the only channel between businesses and the TAs. This system includes modules for electronic invoicing, digital bookkeeping, and digital tax records, among other projects.
- Also, in Brazil there are new Internet applications that use e-invoice's databank as an input to foster competition, completing the information in the market. Specifically, there are two uses that improve the information, enhance transparency, and therefore boost market efficiency on the demand side: (i) price consultation applications that businesses have for the final consumer; and (ii) the setting of maximum prices to be accepted in public procurement. As regards the first of these, the data on the electronic consumer invoice (corresponding to purchases of final goods) is used as an input. Consumers thus have information on the prices of goods and can identify the most suitable. This use has been developed in the states of Piauí, Amazonas, Espírito Santo, Rio Grande do Sul⁴³, and Paraná⁴⁴, the latter being the state deemed to have the best

⁴¹ CIAT and IDB (2018) and Zambrano (2023)

⁴² <http://sped.rfb.gov.br/>

⁴³ <https://www.rs.gov.br/carta-de-servicos/servicos?servico=1052>

⁴⁴ <https://www.fazenda.pr.gov.br/servicos/Cidadao/Nota-Parana-e-Menor-Preco/Pesquisar-precos-Menor-Preco-do-Nota-Parana-dYo9jKNL>

model. More specifically, e-invoices have become a pillar of clarity for important goods in free markets, such as the price of fuels or intermediate products (construction inputs, for example) which are important because they are of mass consumption. Concerning maximum prices in public procurement, note that the e-invoice databank makes it possible to determine product details and the quantities sold, and it is a matter of comparing the price of similar products so as to secure the best deal for the state. The states of Amazonas, Bahía and Río Grande do Sul⁴⁵ use this application.

- In Ecuador, the traceability of e-invoice has allowed identification and analysis of value added and market composition, the percentage of Ecuadoran goods and services in production chains for a series of economic sectors, complementing other sources of information. This type of study has two important applications as regards knowledge of the value chain. The first is to support public policy design, identifying national production nodes and the industries with the densest chains; the second is to improve the impact of public investment and tax incentives, gearing them to those activities with a greater national component and multiplier effect. Overall, this application gives the TA a role in the process of regulation and competition, and in improving traditional fiscal policies on the design of public investment and tax incentives.
- A large-scale implementation by the Chilean tax administration for factoring, on a voluntary basis, of electronic invoices⁴⁶ has opened access to fresh resources to a lot of taxpayers. Although the number of exchanged documents is not very high, the traded values are impressive reaching a couple of percentage points of GDP.⁴⁷
- In Chile too, the tax administration has prepared input and output registries for all VAT taxpayers, lifting their requirement for them to keep the corresponding books. Additionally, the SII (Servicio de Impuestos Internos) is pre-filling VAT returns since 2017, with an acceptance rate above 90 percent of all VAT registered taxpayers. Following the trend, Ecuador started to pre-fill some fields of the VAT returns in early 2019 and various countries are currently working in joining these two countries in this trend. Spain is also using its e-reporting system (SII, Servicio de Información Inmediata) to offer prefilled vat returns to most small and medium taxpayers⁴⁸.

⁴⁵ [https://tesouro.fazenda.rs.gov.br/conteudo/14183/precos-de-referencias-de-mercado-\(prm\)](https://tesouro.fazenda.rs.gov.br/conteudo/14183/precos-de-referencias-de-mercado-(prm))

⁴⁶ https://www.sii.cl/destacados/factura_electronica/cesion_facturas.html

⁴⁷ Peru's tax administration (SUNAT) is also promoting e-invoice factoring through their Confirmation Platform (<https://cpe.sunat.gob.pe/plataforma-de-confirmacion-del-rhe-y-de-la-fe>). See <https://www.ciat.org/ciatblog-factoring-and-digital-transformation-the-role-of-the-sunat-in-the-promotion-and-massification-of-this-important-financing-mechanism/?lang=en> for more info.

⁴⁸ <https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/hacienda/Paginas/2021/120221-iva.aspx>

4. Enforcing VAT compliance via tax data analysis and digital innovations

Beyond fostering voluntary compliance, new technologies may help to improve tax control and enforced compliance⁴⁹ in many areas. In a strict sense, tax control involves the examination and auditing activities (both massive -using the information already available at the TA to determine compliance with formal obligations and the accuracy of the returns filed- and intensive -resorting to the powers granted by the legislation to the tax administration to audit specific cases in detail-), but in a broad sense it could also include tracking and checking registry errors, non-filers, payment delays and debt collection efficiency.

4.1. 360 degree and real time analysis of VAT data

Technologic innovations may help to build a comprehensive VAT enforcement strategy, connecting all the possible steps and giving a 360 degrees panorama of the risks map, and approaching interaction with the taxpayers to a real time framework. Having access to high quality data timely and being able to process it, make all the difference.

Beginning with registry, TAs need to check it continuously, being sure that contact information is accurate, something that the existence of digital mailboxes/addresses make possible. At the same time information on economic sector activity classification is key, and it should be contrasted with the data collected on sales and purchases -what kind of goods and services are being trade-, checking that this activity correspond with the standard patrons to every different sector. The information from e-invoicing and e-reporting systems -containing qualitative data, not only quantitative- is essential to this process, and the use of advance big data analytics and, in some cases, artificial intelligence to detect anomalies in this area allow TAs to pre-detect nearly in real time possible risks.

Processing tax returns stage involves the risks of not receiving them on time, with a low quality of data reported and, even, the reputational risk in case the tax administration does receive tax returns on time but is unable to process them in a timely manner due to inefficient processes. Technology may help to mitigate these risks, first of all migrating to e-filing to reduce paper-based systems' flaws due to errors, illegible data and slowness in processing. Of course, e-filing is not free of risks and validation rules must be implemented to prevent errors, and both software and hardware have to be tested under stress to assure their adequacy (in any case, business continuity plans should be designed even for worst case scenarios where e-filing results blocked for different causes). Pre-filing of tax returns using the information from e-invoicing or e-reporting will help too to reduce the risks.

Tax payment risks may also be mitigated adopting technological innovations, especially online payment channels through the tax administration's information systems, minimizing other traditional options slower and more susceptible to errors. Again, this option involves their own risks (insufficient funds in the account provided by the taxpayer or network

⁴⁹ Of course, the distinction between voluntary and enforced compliance is somewhat blurry in practice (given that tax control generates the perception of risk in the taxpayers -an important factor for promoting voluntary compliance-), but useful for exposition purposes.

failures) that should be anticipated offering alternative ways of payment and with the implementation of ex post controls, what leads us to the next step: tax debt collection risks.

At this stage, information technology systems should allow the implementation of preventive measures, sending automatic reminder messages before the upcoming maturities of payment and/or immediately following a delayed or missing payment⁵⁰. Information systems must also be able to control debtor's assets, establishing electronic communication channels with the relevant databases and preventing asset stripping. Furthermore, the new data analytic techniques and artificial intelligence are being used to improve the selection of debts in the enforce collection phase and maximize recovery.

Strict sense tax control via auditing is incorporating new technologies to improve its efficiency too. Massive and automatic audits⁵¹ are now possible using tax administration's IT systems to check tax returns for their accuracy, minimizing the use of resources and providing the taxpayers a digital channel to add new information on their tax return data. In this procedure, AI can help traditional econometric and statistical techniques to identify anomalies in the tax returns compared to similar taxpayers (clusters) and identify potential risks, triggering the request for clarification automatically.

Given the scarce resources available in any tax administration to perform in-person audits, the use of new technologies to prioritize, select and analyze the cases is essential. Traditional risk assessment and case selection based on the use of statistics, series analysis and multivariate techniques (analysis of conglomerates, discriminant analysis, regressions and logistic regressions) have proven its efficiency, being used to identify outliers and create red flags and score systems to measure taxpayers' relative risks and help to focus auditing efforts. Artificial Intelligence should be used to help in this task and different models are being tested on their efficiency to detect and avoid potential tax fraud, using expert systems (that combine the knowledge of experts and their decision-making rules with machine learning and data mining) and autonomous machine learning (supervised -using labeled datasets to train algorithms that classify data or predict outcomes- or unsupervised -using not-labeled datasets-), and based on neural networks to process the data (with different structures of layers and feedback alignment functions, being deep learning the most human-independent system). Additionally, Social Network Analysis is being used to analyze complex relationships among multiple agents, identifying the main actors (nodes), the links among them (edges) and providing algorithms to measure their characteristics and help to isolate groups of agents (clusters) relevant to prevent tax fraud and visualize their activity (graphs), something essential when dealing with VAT fraud schemes.

⁵⁰ These messages should be designed using the behavioral economics insights and nudges.

⁵¹ There are different auditing procedures with diverse names depending on the country. For example, the IRS (<https://www.irs.gov/businesses/small-businesses-self-employed/irs-audits#conduct>) distinguish among correspondence or mail audits (the bulk of all audits, usually a letter requesting more information or proposing an adjustment based on mismatching between tax return data and tax administration info), and in-person audits, at IRS offices ("office audit", when questions about your return are too complex or large for a correspondence audit) or at taxpayers' office (also called "field audit", the most comprehensive and detailed, involving visiting the taxpayer at their home or place of business to examine records). When we talk about massive and automatic audits, we are focusing on the first class, correspondence or mail audits.

In parallel to risk management, data management innovations are essential to perform audits, improving data bases interoperability, data import and analysis, search, and visualization tools. They allow for receiving massive data -in different formats- from the taxpayer and integrate them to the information available at the tax administration, provide Optical Character Recognition (OCR), web-scraping, and data-mining tools -to analyze written documents, internet disperse information and big data bases-, and help to understand better the results building customized graphs.

Finally, other well-known disruptive new technologies are going to play a role in specific areas of tax administration⁵². For example, the potential use of blockchain technology in tax administration is mainly concentrated in processes with the participation of more than two players. These private blockchains would have different players, with different purposes in which the tax administration would be only one more of the players. The use of intelligent contracts, with operations and access restricted to specific players, and with the capability of limiting access of data through cryptographic techniques, open great opportunities to operate cooperation ecosystems among the different players. In the same vein, Internet-of-things (IoT) will play a role in the tax area. Devices that use IoT-based technology can automatize the handling and tracking of merchandise, the management of taxes related to transit, such as the VAT, and customs management.

Nowadays, all the technologies above mentioned -even with some confusion and overlapping over terminology- are still competing among each other (with different relative advantages concerning the information given to tax auditors on the explanation of the results and new challenges on the possible biases implied in the process⁵³) but there is no doubt that they will be the future of tax compliance risks management giving a 360 degree and real-time analysis of VAT data.

4.2. Examples of innovations on enforced tax compliance

Innovations in the use of new technologies to tax administration is an ongoing process, extremely dynamic and continuously updating. In this section we will provide some examples of these innovations, among many other relevant experiences. The purpose of this review is not to cover all areas, but to encourage further research in specific areas of interest to individual tax administrations..

Blockchain in Tax Administration. The Brazilian Federal Tax Administration (RFB) currently implements a system based on blockchain to share data from the Registry of Individual Taxpayers (CPF)⁵⁴ among institutions in the three levels of government (federal, states, and municipalities), called “bCPF”. It uses a permissioned blockchain based on auditable open-source software in which only authorized institutions can participate. There are three kinds of participation: (i) participation only for consuming data, (ii) participation for the contribution of a data field, and (iii) participation for the modification of data; the latter one is carried out by institutions with legal prerogatives for this activity, which will be

⁵² CIAT (2020), p. 507-512.

⁵³ We will be back on this issue in the last section when dealing with AI ethical use.

⁵⁴ CIAT (2020), p.509.

implemented by means of “intelligent contracts.” Not all nodes will be active, that is, not all nodes will have copies of the database. The exchange of data of the CPF with other institutions is determined by the Constitution and the RFB currently has more than 800 valid agreements for this purpose. Thus, this application will render greater automation, security, transparency, and traceability of the process, besides promoting greater quality of data from the CPF.

Use of AI to identify real state. France⁵⁵ (DGFIP) implemented an AI image recognition system to optimize the process of detecting undeclared constructions or developments, in order to fight more effectively against fraud and declarative anomalies in the field of real estate and update the cadastral map along the way.

Integration of big data analysis and data analytics. Bolivia’s tax administration (SIN) has digitalized⁵⁶ all processes, from registry to taxpayers’ services and risk management, combining efforts to improve infrastructure, data bases and analytical tools.

Establishing a system to measure, monitor and report on taxpayer compliance in a uniform, standardized, and scientific manner. The South African Revenue Service (SARS) identified the need of such a system back in 2006 and since then has developed the CEMIS (Compliance Evaluation and Monitoring Information System), successfully deployed in 2011 and currently houses over 10-years of compliance data. The lesson learned in the development and implementation of CEMIS served and assisted other African countries with establishing their own compliance initiatives, including, amongst others, Uganda, Kenya, Lesotho, Zambia, and Mauritius⁵⁷.

Identifying anomalous transactions that do not correspond to a specific economic activity in the Tax Administration of Chile (Sii)⁵⁸. One of the major problems detected in the management of VAT is the improper use of tax credit by taxpayers. To improve the detection of such irregularities, the SII set up a system, in the proof of concept (PoC) mode, which uses AI tools - especially machine learning - whose main source of information is the electronic invoices presented by taxpayers. The main stages of the system are: Cataloging products based on glosses; Determination of the relationship between products and economic activities; Identification of transactions that do not correspond to the specific economic activity of the buyer; Generating signaling and visualizations.

On-line monitoring of transit of goods. Brazil’s TAs developed a freight-vehicle tracking project using radio frequency, integrated into the electronic tax documents related to transported goods. While the vehicles are on the move, antennas scan them each time they

⁵⁵<https://ciat.org.sharepoint.com/:b:/s/cds/EVO7Ztw7hPtDmrk0euWgbhgBhh0K0eaXCVVVoP11TK-JdA?e=slcfEN>

⁵⁶<https://ciat.org.sharepoint.com/:b:/s/cds/EaJbsYMdTy5Mjq7ILzWo0x0Bw2LGD8g3J8UAcJBZ-qfxag?e=QdlMLY>

https://ciat.org.sharepoint.com/:b:/s/cds/EZEbNmIEVvBKmZD6xrZbPIsBkwwgJxP9qzEH55ouV_rWZxQ?e=MbQ7MH

⁵⁷ Taxpayer Compliance Evaluation and Monitoring, South African Revenue Service (2023), page 131 of BRITACOM Secretariat (2023).

⁵⁸ CIAT (2020), p.502.

pass by goods-transport control units located along the highways. This allows the TAs to monitor goods traffic in real time, and the goods are matched to their respective tax documents. In addition to the tax control, it is expected that the exchange of information will also help reduce the theft of vehicles and cargos. Apart from this real-time control of freight, the use of information technologies in Brazilian states has allowed for the simplification of companies' obligations to the TAs

Machine learning induced nudges when filing tax returns. In the process of reviewing, by the taxpayer, the prefilled tax return before the acceptance, the Spanish tax agency (AEAT) implemented a system of nudge messages that appear to taxpayers that are “similar” to those that in the past have changed manually that kind of data, introducing mistaken data and resulting in an adjustment by tax administration. The nudge-message informs of that possibility and the selection of the taxpayers is managed through a machine learning process.⁵⁹

Identification of false e-invoices issuers. Chilean tax administration (SII)⁶⁰ developed a data analytics model for early identification of false e-invoices issuers, combining data mining, big data analysis, machine learning and dynamic dashboards to identify different risk models depending on the period of activity of the taxpayers.

Implementation of electronic audits in Mexico (SAT)⁶¹: beginning in 2018 and using all the information available at the tax administration, a total of 74 processes were built, going from computation revisions to cross matching. Over two million companies went through control procedures or what we can call electronic audits. The processes include the generation of audit working papers for the audit until the preparation of reassessment notices when needed. Latest SAT's master plan for 2024⁶² keeps on adding new technologies to control activities (as a code scanner app for the verification of the legality of a product and the implementation of graph analytics models and machine learning in audit activities).

Electronic virtual audits. India tax authorities⁶³ have moved to a completely electronic, AI driven, anonymized and team-based assessment system known as Faceless Assessment. Spain (AEAT) has also introduced a system of virtual tools for auditing, named VIVI (Virtual Visits)⁶⁴.

⁵⁹https://ciat.org.sharepoint.com/:b:/s/cds/EST4M-OnoKtGlarBXv_GK1UBEbnp5V-rRWDnLxdJ_dFqkQ?e=0090Zr

⁶⁰https://ciat.org.sharepoint.com/:b:/s/cds/ERvV4Kf7LhZGrSZD0Utq4tUB3GOg_R2b-85Rh-0c8tdKXQ?e=4Evv0u
<https://ciat.org.sharepoint.com/:b:/s/cds/ESF13j-oTItBqsWPnLAmKi4Bq5t7QbnP9uwkBrmjZgDI1w?e=H1tcwX>

⁶¹ CIAT (2020), p.505.

⁶² <https://www.gob.mx/sat/documentos/plan-maestro-2024-sat>

⁶³ Beginning with direct taxes (CBDT, Central Board of Direct Taxes). <https://incometaxindia.gov.in/booklets%20%20pamphlets/faceless-assessment-under-income-tax-act-1961.pdf>

⁶⁴https://sede.agenciatributaria.gob.es/Sede/en_gb/normativa-criterios-interpretativos/analisis/2022/El_sistema_de_Visita_Virtual_una_revolucion_practica_de_los_procedimientos.html

Indonesia is investigating the potential revenue impact of new digital activities such as the Social Media Influencers using new research tools (data crawlers, computer vision, social network analysis, etc.)⁶⁵.

Machine learning and big data analytics. CIAT has developed⁶⁶ a software named e-IAD (e-Invoice Anomalies' Detector) in collaboration with Microsoft. This software allows to identify, select, and prioritize cases of taxpayers with unusual behavior⁶⁷, by applying unsupervised machine learning models to the data of the electronic invoice, the taxpayer's registry, and the tax returns⁶⁸. The system prioritizes cases through an anomaly index, similar to a risk ranking, providing also descriptive statistics and graph theory visualization. The deployment in the Costa Rica Finance Ministry⁶⁹ was completed in March 2023 and the results are currently being analyzed. Guatemala (SAT) and Colombia (DIAN) plan to complete its deployment before the end of 2023.

5. Other issues in implementing new technologies for VAT compliance: data and its use.

At the base of the use of new technologies and digitalization to improve VAT compliance is the data, its governance to make it useful and safe, and the legal and ethical consequences of the techniques used in the process. Of course, this is not something exclusive of VAT or taxes in general, and covering this topic thoroughly is far beyond the scope of this section. But its importance requires, at least, to enumerate the challenges and risks associated to the use and transformation of data. Even if interrelated, it is relevant to highlight security of information, data governance and ethical use of the information, among those challenges.

Security of information⁷⁰. The data that tax administrations and all citizens share to make it possible collective action must be protected to fulfill the social contract. And to make it possible coding -cryptography-, secure client-server interaction and robust digital identity certificates are key, necessary but not sufficient. Besides the technological requisites, we need to keep in mind that security is a transversal process for the organizations, and tax administrations need to pay attention to the definition of clear policies, consistent practices, effective procedures, and staff's active participation⁷¹. The establishment of an Information Security Program (ISP) will have to deal with: the coordination of roles and responsibilities of information security; the alignment with the legal and regulatory requisites, including

⁶⁵ Discovering Tax Potency in Social Media Analytics, presentation available at https://www.britacom.org/ebook/4rd_britacof/mobile/index.html, session 5.1.

⁶⁶ CIAT's Center for Advanced Analytics and Artificial Intelligence, with the financial support of NORAD, Norway's development agency and the collaboration of CIAT's member countries' experts.

⁶⁷ For example, taxpayers with non-existent or simulated operations (suspicious invoicing), receiving income for unusual behavior or with an atypical supply network -where the volume of customers and /or suppliers is out of proportion-, among many other potential anomalies.

⁶⁸ 1.12 billion records were processed in less than seven hours (thirty-three months of data).

⁶⁹ Costa Rica provided the anonymized data from e-invoices, essential to develop the software in its early stages.

⁷⁰ CIAT (2020), p.316.

⁷¹ Through the establishment of an Information Security Program (ISP), whose main objectives are: coordination of roles and responsibilities of information security; guarantee alignment with the legal and regulatory requisites, including privacy and civil freedom related to information security; and governance of the information security system.

privacy and civil freedom related to information security; and the governance of the information security system.

Data governance⁷². Data governance is an organization's ability to manage the knowledge it has about its own information so that it can respond to questions such as: What do we know about our information? Where does that data come from? Are these data aligned with our institutional policy? According to the Data Governance Institute, data governance is defined as the specification of a framework of responsibility to encourage appropriate behavior in the valuation, creation, storage, use and disposal of information. This includes the processes, roles, standards, and metrics that ensure the effective and efficient use of information so as to enable an organization to achieve its goals. For tax administrations in particular, there are different proposals available to implement and evaluate a data governance model⁷³, adjusted to their particular need in terms of privacy and data protection, transparency in management, control and auditability, responsibility and data stewardship.

Ethical use of the data and the new technologies. Beyond the legislations to protect citizens privacy, civil rights, and a fair treatment by tax administrations, recently a new awareness became, far beyond the tax arena, the hot topic: the ethical use of Artificial Intelligence. The exponential growth of the capacities of AI and the black-box nature of some of its mechanisms have led to global initiatives to identify the risks and control the possible damages involved in its use. What data are we using to train the machine learning algorithms? Are the results biased by the data? Are there specific characteristics of the taxpayers that should not be used as discriminatory when designing, for example, audit programs? Do we give the taxpayer enough information on the process as will allow their fair defense in case of dispute? In this field is impossible right now to offer clear guidelines, but tax administrations must follow closely the developments that are taking place concerning the ethical use of tax control technologies and AI in general⁷⁴, in order to be prepared to adjust their procedures.

In this sense is most relevant the recent European Parliament initiative to implement a set of rules to curb the risks of artificial intelligence (AI) and promote its ethical use⁷⁵.

⁷² CIAT (2020), p.408.

⁷³ CIAT (2022)

⁷⁴ Recent research has alerted on the risks associated with the use of algorithms in this field. See, for example, the Stanford collaboration with the Department of the Treasury of the USA, yielding the first direct evidence of differences in audit rates by race (Elzayn, H, Smith, E. et al (2023)) or the Dutch case on biased control of childcare benefits (<https://www.politico.eu/article/dutch-scandal-serves-as-a-warning-for-europe-over-risks-of-using-algorithms>)

⁷⁵ <https://www.europarl.europa.eu/news/en/agenda/briefing/2023-06-12/1/debate-and-vote-on-landmark-rules-to-manage-artificial-intelligence>

See also Bias in Algorithms. Artificial Intelligence and Discrimination Vienna, by the European Union Agency for Fundamental Rights, 2022 (https://fra.europa.eu/sites/default/files/fra_uploads/fra-2022-bias-in-algorithms_en.pdf)

Many other centers and institutions are researching on this topic, providing useful insights, as, for example, the Digital Regulation Cooperation Forum (DRCF) in the UK (See: Auditing algorithms: the existing landscape, role of regulators and future outlook, available in <https://www.gov.uk/government/publications/findings-from-the-drcf-algorithmic-processing-workstream-spring-2022/auditing-algorithms-the-existing-landscape-role-of->

6. Final remarks

Technology can help to improve VAT compliance in many ways. But, as always when addressing so heterogeneous needs and restrictions, no solution fits all and no solution solves everything.

This chapter offer an overview of the (quickly evolving) possibilities, presenting different options and encouraging deeper analysis by individual countries to design and adapt new technologies to improve VAT compliance, according to their particular needs, legal framework, restrictions and possibilities.

[regulators-and-future-outlook](#)). About the use of large language models (LLM) in the public sector it is worthwhile to consult the EU Council Analysis and Research Team 2023 paper on “ChatGPT in the Public Sector –overhyped or overlooked?”

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