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Enhancing E-Government Proactive Services Through Advanced Data Processing Technologies

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Abstract

The approach of citizen to digital world allows to public sector provide services crossing frontiers of traditional relationships citizen-administration. Anticipate to consumer needs, approach to a more satisfaction relationship and reduce resolution time, are some of the goals for a new era of electronic public sector services. We compile a reduced set of proactive systems to illustrate and analyse options. The main goal of this paper is analysing the key role of Big Data and Digital Twin in public administrations as tools for provide ProActive Services (PAS). It Is common in government administration consider the use of disruptive technologies to increase services created to improve relationships with citizens. This document explores the use of innovative technologies to raise the number of proactive services running on public administration (Proactive Public Services - PPS), challenges it faces and technical limits that appear. A change in mindset must be done. Paraphrasing an illustrious United States president in inaugural address "*Ask not what citizens do for administration – ask what administration can do for its citizens*."

Keywords: Big Data, Government services, proactive, decision-making

Introduction

Life is plenty of events that need some administration service like bird, going to school, graduate, getting drive license, starting a job, getting married, having a child or start an original activity or company. Sometimes, public administration creates services to serve citizens in needs for his life events.

A first goal is provided as overview of data-driven public services could become a source of knowledge for policymaking. Next goal justifies use of proactive service as best way to communicate with the citizens based on big data use. Digital Governance has improved public service provision for several years. First era was based on transferring paper-based system into digital domain using holistic solutions. A second digital governance era is running today enabling more effective policies. Data-driven policies of the new implement better individualized, tailor-made service with better process efficiency and higher citizen satisfaction.

At first era, it is common for public administrations offer their services as reactive tasks improving public services by removing paper-based systems. As a copy of a paper fill-form action, manager create digital forms that they replaced physical ones. This digitalization creates sometimes help to fill but increased the number of information to provide. The new era of digital governance enable individualization, tailor-made service that yield better process efficiency and higher citizen satisfaction. Some author, as Tan & Crompvoets (2022), exposes a transition from e-government to a new era of digital governance. But interactive services have not word. In some cases, suggest about “Digital Neo-Weberianism" proposing a new way “to shape how the citizen and government interactions take place.” This looks like first era but using better forms.

Data-driven government that will be able to proactively use and deliver information to their clients would be the next generation of government. On Lemke et al. (2020), authors even argue that “designing proactive services of e-governance should be seen as the next stage in service design for e-governance".

Organizational and cultural condition move forward from a “electronic government” paradigm to a “digital governance” paradigm (Omar et al., 2020). Some strategies to carry out this digital governance strategies include a reactive to proactive government concerning public policy and service provision (Dias & Gomes, 2021) without ignoring a transformative information-centric government to data-driven public sector or move towards a user-driven administration.

There are regulations limitation too. It is necessary to consider certain guaranteeing legislations that limit the possibilities of data processing, such as those of the European Union. There may be legal problems with the use of

proactive services based on automated decision making. Europe has a more advance data legislation. Also, some laws recognize the right not to present the same documentation twice, but it no true, data is requested several times. According to Velasco (2020) based in article 22 of Regulation (EU) 2016/679 of the European Parliament and of the Council, "The data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her." may require human intervention for decision making, can make allegations or are authorized to challenge said decision. To this we must take into account the different efforts for openness and collaboration with other Trans-Atlantic countries, such as the data processing agreement between the US and Europe. Although there are many attempts that have not produce satisfactory results (Safe Harbour – 2000, Privacy Shield 2016). Negotiations continue with the EU-US Data Privacy Framework (EU-US DPF) to achieve this data processing framework.

Some authors spoke about the needs of design public service using citizens as centre does not design around providers. Tailoring services to the needs of citizens', business and all actors that interact with e-government. Henriques et al. (2019) expose a clarifying twelve events list in the context of public service that can be monitorized (Birth / Marriage / Divorce - Issuance / renewal of citizen's card or passport - Enrollment in a public school - Parental benefit / family allowance / school proof -Associate household with family doctor - Illness / Family Assistance - Vaccination / family planning / pediatrics - Issuance / renewal of driving license - Registration of vehicles / building / commercial – Tax – Unemployment – Retirement).

Public services must be ready to adapt to changes brought on by new generations and mobility. In the European Union, just 6% of PPS are supplied proactively compared to 81% of government services that can be accessed online (Barasa & Iosad, 2002). A proactive governance model of governance has the potential to transform the relationship between citizens, and governments. Speed and Simplicity, both among benefits of proactivity, improve perceptions of government services (Baig et al., 2014). Proactive services are used for long time in selling systems. Strategies as Cross-sell and up-sell proactively based on product data/history aim to enhance sales and improve buyer experience. Based on this new understanding of government, a new stage for describing this transition of government will follow. In this case, it can be said that due to the rapid growth in demand of government e-services for mobile devices and the occurrence of data-driven government that will be able to proactively serve their citizens and enterprises requires a new stage to define the maturity of governments in the

transition process from eGov to sGov (Lemke et al.,2020) . They present the foundational framework for analysing stage models in the current study, as it has been the most referenced model in recent years. Several others, such as Hiller & Bélanger (2001), Andersen & Henriksen (2006), and Klievink & Janssen (2008), have been used to shape the right understanding for developing a stage model extension for a novel and innovative way of government that is primarily data-driven and proactive. Proactive services are not only beneficial for citizens; businesses, companies, organizations, and societies can also derive advantages from services aimed at reducing administrative burdens.

The simplest definition for Big Data was formed by Laney (2001), big volume, velocity, and variety. Governments believe Big Data reinforces national challenges involving economy or healthcare (Kim et al., 2014). This document proposes options to create services to server citizens and enhance response time for critical situations. Clark & Golder (2015) talk about "big data revolution" as a system to produce, collect, store, and analyse vast amounts of data that is going to transform our political world. The big data methods include aggregation of data, extraction, deduction, pattern detection, network analytics, trend evaluations, model creation, prediction and more. This Include wide information input and intense automatized analysis of information. Big Data suppose an area of investigation due to Still public administrations are learning how to use big data as development tool (Isaza & Zarate, 2021). New challenges appear when public services and data must be joined together to create innovative services. It is important (Leoni et al., 2023) collect not only traditional data also is needed non-traditional data (Rae, 2019). Those can be: Transactions - Digital interactions with people result in large-scale collection of passive data by institutions and service providers. Sensing - Remote sensing, satellites, sensors, open data sources, tollbooth or highway cameras, meters, POS scanners, job vacancy postings, Yelp data.

Digital twins are proposed for authors (Husni et al., 2022)(Proper et al., 2021) for technology governance. Kopponen et al. (2022) propose a Digital twin of a citizen and provide a model. In (Lasse, 2020) explain 250 classifications of a digital twin using three axes: lifecycle phases (6 options), most common uses (propose 7 but must be more), and hierarchical levels (6). A proactive service could accommodate could fit any of the indicated options.

In Temkin Goup (2011), the author develops a "Six Levels of Proactive Support" (Ignore, react, Alert, Self-heal, pre-empt and avoid) where categorize proactive support and blend multiple criteria. Later, we revised this to adapt to public service.

What is a proactive service?

Proactive Computing is not a new area, already in Tennenhouse (2000) describe proactive computing but nowadays scientific researchers does not yet provide dedicated PAS literature (Hhasmammadli & Erlenheim, 2022). One way to reduce this gap is create a complete taxonomy. Services is in two types based on who makes first move. Proactive or Reactive. Reactive customer service, as describe Brown (2022), "is when a customer has to reach to a company representative". Same author describes Reactive "means anticipating customer needs and actively reaching out with a solution, whether that's by communicating a potential problem that is cropped up or allowing customers to self-service their issue". Henriques et al. (2019) expose a definition for proactive services as "... an automatic provision of services, without the need to wait for citizen". Other definition in (Khasmammadli, 2023) refer to a service provision model in which government anticipate citizens' needs and provide a service before citizens request it. Must be in exact moment not too early not too late. Anticipate to events or after an event. Perfect customer service must ensure perfect timing with proactive customer service. This does not say that is personalize for every customer: "Proactivity and customization are independent and do not necessarily go hand in hand." (Andersen & Henriksen, 2006)

Not only customers or citizens' relations can be classified, share data with other organizations or data from own organization change notification can be proactive too. This is, data interchange/communication must be started by producer, consumer must only wait data reception.

Proactive models react to something. In this case, instead of reacting to a citizens' request, they react to regulations or policies and changes in data. Depending on the vision, we have on the part of the citizen, they will be classified as reactive and proactive. While if we see then at other levels (analysts, policians, etc). They are conditioned on the events. Increase, decrease, change, or remain unchanged could be events. They do not act on their own. They are triggered by data changes not for citizens' actions. Considering all this we propose a new definition. Proactive services are those that flex react to data changes. Reactive only to citizens' action. Proactive services might be efficient in comparison with reactive services.

Proactive services must be periodically evaluated due to changing characteristics of data. Therefore, the data volume is increased dramatically when settings must be evaluated in multiple time points.

Some author as Lemke et al. (2020) wrote about a new state of eGov proactive government decision making maturity "Due to the involvement of Big Data and data analytics".

Why are best proactive services o reactive services? The following tips may help to balance between reactive services and proactive. First tip is

based on higher productivity on process proactive designed. Next tip is a higher service revenue that in public administrations must be enunciated as citizen satisfaction. And last one is the increase of satisfaction and loyalty scores.

Martinez et al. (2020) propose a classification for degree of personalization but we propose a new classification for the facts that explore.

- **Duties based.** Help to some types of duties. Tax obligations, labour obligations, contractual duties, or financial liabilities.
- **Procedures based** – Periodically report estate of procedure o matter that concern.
- **Profile based** - Automatized grant of social benefits or aid based on profile of the person, family or community.

The existence of some authenticated means of communication or with sufficient guarantees is necessary (mail, whatsup, telegram, signal, citizen' box, etc.). Like all entities, they understand that a cell phone or mail is already a sufficient means for communications and administration, but not yet in public administration. Proactive services not only have external stakeholders. In some cases, internal stakeholders can receive help from them. Alarm or advisory systems can be implemented using similar approximation and notify to public servant to take measures.
Reactive suffer off a long lead time based in long number of steps before resolution or conclusion. Centering to a event (Customer request or event triggered) we propose create this figure whith multiple cases of services.

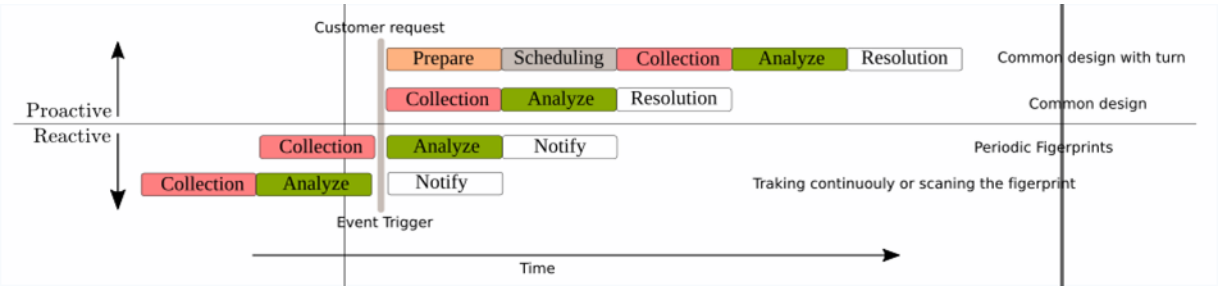

Figure 1: Proactive and Reactive services steps

We will begin by preparing the creation of laws and regulations necessary to achieve our government's goals. Scheduling will involve setting aside time in the day to make presentations. Collection entails gathering the necessary data for our purpose. Next, we will analyze the collected data and subsequently resolve any issues identified. Notification, similar to resolution, involves informing relevant stakeholders about the outcomes, albeit solely in the notification step.

Some administrative functions must be defined for proactive services: Supervision, regulation, or service delivery (Laney, 2001). Usually, services categorized as proactive have not end. Processes or jobs are testing a condition or are waiting an event to run response. Only once-run designed processes are executed as response of a political event (see topology in planner strategy criteria).

Similarly, the method by which we assist homeless individuals does not involve evaluating personal profiles or examining social exclusion profiles. Instead, it includes providing proactive citizen services based on public administration data. As long as this approach is not the sole method for obtaining benefits, it should not pose a legal problem.

Sometimes, with the passage of legislation, it becomes mandatory to include information regarding economic expenditures necessary to carry out the actions outlined within the regulation. To create this economic assessment, it is needed to evaluate quantity and target nature of the projected consequences. Previously we needed assessment, which it should be published compulsorily with the draft act. This will enhance the effectiveness of lawmaking and improve the outcomes of law production.

Finally, implementing proactive services involve a new challenge for government structure. Legal and technological teams have a new proposal in a risky area. A mistake can lead organization to an unexpected situation. Create regulations to autorize proactive services are a funcion of experienced personnel in laws. But analyze historical data to give clues for law drafting is a function of experienced data analysts.

Some examples

The best way to understand how proactive services improve effectiveness is through examples. A service provided as proactive, others served as reactive and the straightforward way to change it, and even, proactive one with designed with some reactive parts.

- PAS#1 - As describe on Khasmammadli (2023) and (Hhasmammadli & Erlenheim, 2022), some user case describes the potential for these types of services. Firstly, advanced data analytics can be used to identify citizen who might be at social risk for poverty or financial distress. A proactive e-service can then be implemented to help before they face difficulties. A second example is analysing housing data, identifying citizens facing housing instability or homelessness and provide proactive assistance such a rental subsidies or support services. Finally, a more centred to improve parents' life creating a proactive service to childbirths allowance, as exemplified in Azerbaijan in Figure 2.

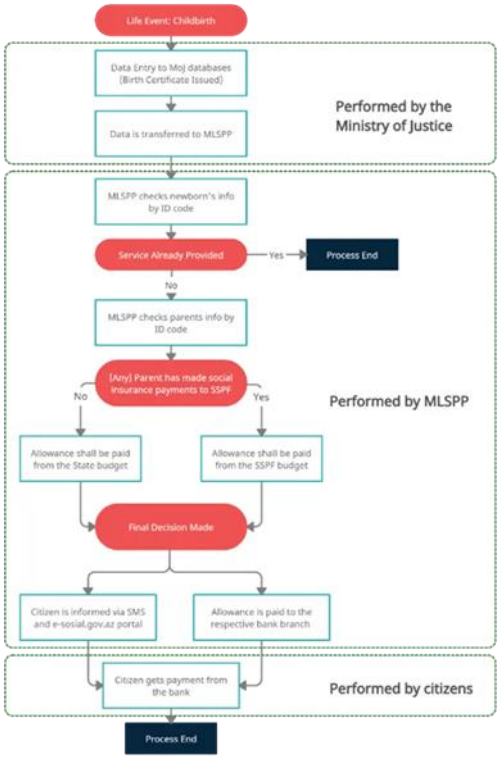

Figure 2: From Ministry of Labour and Social Protection of Azerbaijan.(Khasmammadli, 2023) (Hhasmammadli & Erlenheim, 2022)

- PAS#2. Spanish government has created a wallet with some money for new voters, young individuals who turn 18 years old in 2023. This service is excellent for promoting cultural services in Spain. Young people need actively apply for this wallet by filling out a web form and waiting for it to be processed for several months or years. A proactive service proposes to all people born in 2005 that have a wallet ready to use.
- PAS#3. Portugal government offers a Social Energy Tariff utilizing data from energy companies, tax authorities and social security system. By combining data from this source, government is able to automatically provide eligible individuals with an energy tariff tailored their social circumstances.
- PAS#4. Annual tax returns are pre-filled with existing information in multiple countries (UK, Netherlands or Spain). Citizens only accept or correct information before submitting the return.
- PAS#5. Recommendation system is a proposal for reactive service where based in a profile, system recommend some product or service.

Proactive services Taxonomy

Improving (Lasse, 2020) and (Temkin Group, 2011) previously mentioned on introduction, we create a new taxonomy based on multiple criteria that are simple and clearly defined. This taxonomy is nearly defined to users and developers to create better understanding and plainly defined.

Table A: Taxonomy for proactive services

Relationship	Criteria	Options
Related to trigger	Decision position on time	Anticipate, Recognize
	Planner strategy	Continuous, Periodically, Sometimes, Triggered for event
	Trigger type	Data, time, location, status, revenue, etc.
Related to data	Data used	Citizen data, External data, Mixed
	Personalization level	Personalized, Grouped
	Facts	Duties, Procedures, Profiles
Related to Results	Outcomes	Solve, Notice
	Profits	For citizen, for service provider, third person
Related to Technology	Processing	Emulated, simulated, IA, Digital Twin, etc...
	Notify system	Mail, SMS, message app, etc.
Related to entitlement	Authorized by law	Laws, directives, Decisions, Recommendations, Regulation, etc.
	Company Strategic alignment	Goals, targets, objectives, corporative aims, aspirations

- Related with the moment to start the event. About when the event will begin.
    - Based on decision position on time, it refers to moment of decision making. It is possible to Anticipate decision with a predictive model or only wait to event happens and detect (recognize) previously defined options. (Anticipate or recognize).
    - Based on planner's strategy, we have continuous evaluation, periodic evaluation that run after an earlier run, and sometime when is executed by an order or event humans produced or triggered by a condition. (Continuous, Periodically, Sometimes, Triggered for event).
    - Based on trigger type. A trigger of date run when arrive the day of running. Maybe is not triggered when is based on other planner strategy (Data, time, location, status, revenue, etc.)
- Related to data used on the process. Regarding the information utilized in the procedure
    - Based in data used refers to use only citizen data provideadd directly for forms or other administration relations., External data referes to data not provided directly for byself , open data, etc and

last case is mix all the data that is possible to have.(Citizen data, External data, Mixed)
    - Based on personalization level is designed to know if it is designed for only one person or a group of people. (Personalized, Grouped)
    - Based on facts was previously explained (Duties, Procedures, Profiles)
- Related to results or effects
    - Based on outcomes refers to if service solve de problem or only notify the possible situation (Solve, Notice)
    - Based In profit is based on who receive most benefits, citizen, service provider (administration in this case) or others (third party) (For citizen, for service provider, third person)
- Related to technology, concerning technology
    - Based on Technologies is a classification that has observes technologies used on implementation. (Emulated, simulated, IA, Digital Twin, etc...)
    - Based on notification system. The way to communicate with citizen is important (Mail, SMS, message app, Feed RSS, etc.)
- Related to entitlement
    - Authorized by law. When some regulation or rules allow exercising service implementation (Laws, regulations, etc...)
    - Company strategic alignment. When some internal decision is made toward a realisation of a common objective (goals or targets) .

These twelve alternatives encompass nearly all proactive services deployed and allow explain characteristics implemented.

Creating interactive e-services

At first sight, proactive services and data universe are concept closer. To run proactive services, we need a lot of data acquired in other parts of government services, open sources or purchasing data. Previously of data acquisition, we define a model to assembly each part. After data acquisition it is mandatory to define phases for creation. We propose a new model and a four phases guide.

Proactive services Model

Our proposal for model of proactive services is based on four well-known layers.

- Data – Incorporating all data sources and data interchange.
- Data Governance – Establishing standards for the ethical and efficient use of data.

- Use of data – Employing data for Operational, Monitoring or Analytical processing purposes.
- Use Governance – Implementing Standard, Policies, Regulations, etc., to govern the use of data effectively.

Monitoring in new for data is based on use of operational data and outcomes of analytical processing. The four-level model, illustrated in Figure 3, is concise and connect proactive services with no-proactive services.

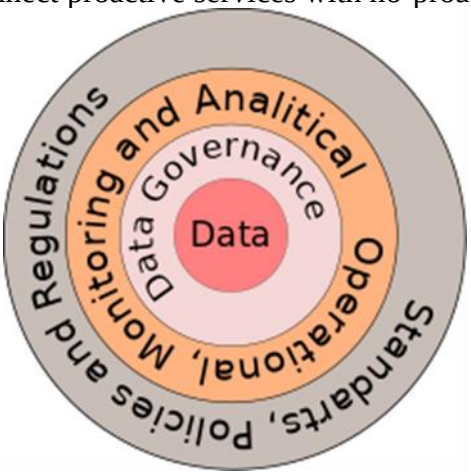

Figure 3: Proactive model proposal

1. Data is the core of PAS. Data-driven analysis relies on information gathered from various sources.
2. Several crucial requirements associated with proactive services, alongside many other domains, include Data Governance to increase a data quality to provide the service and setting up effective communication channels for reporting, notifying, or advising citizens about relevant issues. Ensuring data quality is imperative and features as Interoperability and consistent records (for example, digital IDs) are indispensable. However, challenges arise when collecting data from multiple sources, such as lack of homogeneity.
3. Operational Monitoring and Analytical.
4. Standards, Policies and Regulations that involves all work carried out.

Proactive services creation phases

Some proposals are made to create interactive e-services. One of them are Erlenheim (2019). This document propose a process in steps for proactive service (Define stakeholders, Clarify requirements, prototype

solution and finaly launch service). We propose a four stage definition to create a proactive service.

1. Establishing the terms, laws, rules, conditions and regulatory frameworks that will allow certain beneficiaries receive service.
2. Gather data from various sources.
3. Use technology to solve definition and combination of data using an intelligence engine through Advanced techniques (analytics, Data Mining, Digital twin, IA).
4. Use service. They become useful and usable system.

It is important, especially in public administration environments, the first phase 1. Point 2 and 3 can be repeated until a solution is obtained. Last phase is run to inform to stakeholders.

Joining proactive service and data universe

As the authors denote, decision-making is based on Big Data and will be able to proactively serve to citizens (Sun et al., 2020) (Lemke et al., 2020). We propose a bundle of technologies that help to create proactive services. Our proposal uses key data technologies, in two areas, that they have proven useful:

- Big Data Frameworks like Apache Hadoop (Hadoop, 2023), Apache Storm (Storm, 2024) or Apache Spark (Spark, 2024). Or Data proactive time axe. No matter if we use batch or streaming processing to obtain results, both are right to achieve a proactive service.
- Digital Twin and AI. Create a digital Twin of a Citizen allow evolve a physical actual citizen status and evaluate next temporal steep conditions, needs and feasible solutions. That is, we have a current state, digital twin can evaluate future states for a person.

A definition of digital twin, proposed in (Kopponen et al.,2022) is "*a virtual representation that serves as the real-time digital counterpart of a physical object or process*". Digital human twin (HDT) for healthcare is common too. We found examples but we need a digital citizen twin, but this is an area based in diseases (Prevention is crucial in healthcare proactive e-services) or medical image processing that it is not within the goals of this document.

Some behaviour of digital twin must be guided by Influence engineering (IE) (Sajid, 2023). This involves developing algorithms that use behavioural science techniques to automate aspect of the digital live. Some techniques commonly used are sentiment analysis categorizing user data as positive, negative, or neutral, Facial Expression Recognition or Voice Analysis to detect emotions.

Big Data have some challenges in this implementation and Government agencies must apply measures to handle security and privacy but manage and share data too. Some organization call this smart governance (Sarker et al. 2018).

Threats

Turning now to other important perspective, we refer to risk involved in using proactive services. In all projects appear risks that can be mitigated. Risk of error in the models for big data methods are high and they are specific in certain cases. A user case in Netherland Illustrates ours fears. Thousands of families were wrongly profiled as being fraudulent and were told to repay child welfare subsidies for a PAS. It eventually led to the Cabinet's resignation (Roobeek et al., 2021).

PAS use may lead these risks, among others:

- Privacy concerns. Public administration functions are creating a fair society and try to improve it.
- Sofware errors can have dramatic results due to proactivity.
- Data quality is always a concern (false phone number, number of middlemen, etc). A great investment in quality is essential and priority.
- Misinterpretation of data.
- Barriers to entry, disadvantaged groups may not have the same access.
- Habits will be hard to break and vested interest.
- Political difficulties or religious beliefs.
- Cheap technologies are not always attractive for firms.
- Potential acts of discrimination.

Conclusion

First and foremost, we must address a fundamental question: While government can create proactive e-services, are citizen ready for this transition? Multiple citizen initiatives focus on privacy and data protection. Public administration should align its goals with the popular will. Developing legislation aimed at helping the creation of proactive e-services is crucial to enable innovation while minimizing any adverse effects on citizen data privacy.

Developing a predictive business model entails inherent challenges yet designing one tailored for use with vast datasets and deployable within a Big Data framework as the vital part for proactive citizen services introduces an even greater level of complexity.

Not just about fixing or empower technicians, a lot of investment in IT infrastructure is needed to complete these tasks. A new way to solve day to day problems must be accepted and promoted by organization.

Indeed, there are ethical risks associated with predictive business models, particularly concerning the potential for discrimination stemming from inaccuracies or biases in data profiling. It is imperative for new developments to be aligned with political concerns and advancements in citizens' daily lives, ensuring that proactive measures are taken to mitigate any adverse effects on individuals or communities. Ethical considerations should be paramount in the design and implementation of such models to uphold fairness, transparency, and social responsibility.

As economic requirements are needed in legislation approval, showing total expenses required to approve official rules. Add information about total members exposed or affected by new legislation it is a good contribution to clarity of action of lawmaker. In the same way that incorporating economic requirements into the legislative approval process and delineating the total expenses required to implement official rules, is paramount. Additionally, disclosing the total number of individuals exposed or affected by new legislation significantly enhances the clarity of lawmakers' actions. This transparency not only bolsters accountability but also ensures that legislative decisions are informed by both financial considerations and their potential impact on constituents.

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