

Revenue Capture using Ontology-based Tantra Framework

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Abstract—Governance and Social Change are ongoing processes. In this paper we propose Tantra Framework for good governance to catalyze social change. Tantra Framework makes use of concepts from Zachman Framework to manage aspects of Social Information through different perspectives and concepts from Unified Foundational Ontology to represent interrelationships between aspects. In addition, Tantra Framework interoperates with models such as Balanced Scorecard, Theory of Change and Theory of Separations. The use of distributed global ledgers is proposed to enable change management. The paper describes the Tantra Framework and how it can be applied to a case study on Revenue Capture.

Keywords— *framework, information management, ontology, theory of separations, revenue capture, good governance*

I. INTRODUCTION

In India only 7 out of 100 paid tax as per the Economic Survey of Government of India released in 2017[1]. The survey also talks about under-recovery of property tax from civic bodies. During property transfer assets are routinely undervalued to escape higher taxes. It can also detect asset owners who should be paying income tax but not doing so. Even the recent economic survey deplors that Tax-to-GDP has remained stuck around 10% for India despite decades of economic growth. Having an all-encompassing Information Management Framework can handle these issues more easily.

In this paper, we propose a novel framework named Tantra Framework that can help achieve this objective. Tantra Framework is used to structure, organize and manage Social Information. Tantra Framework builds a model of society i.e. its constituents, concepts, constructs and interrelationships to represent society as completely and holistically as possible.

Rest of the paper is as follows. Section II covers a review of Frameworks and Models; Section III describes Tantra Framework; Section IV covers application of Tantra Framework for Revenue Capture scenario and Section V concludes the paper.

II. FRAMEWORKS AND MODELS

A. Defining the Framework

From a researcher's view-point, "a framework is a way of representing the empirical relations between every aspect of inquiry. It describes the general direction and the constraints of the theory or research. It is an organized structure of ideas, concepts, and other

things that are involved. A well-developed framework should be coherent and serve as a communication tool to stakeholders”.

B. Zachman Framework

As per Zachman, his framework is analogous to what “Periodic Table” is to Chemistry. Zachman Framework [2] has rows and columns that can capture information in a holistic and comprehensive manner. Zachman Framework is illustrated in Table 1.

Here the columns are primary interrogatives of English Language – who, what, when, where, how and why. The rows represent the perspectives of Planner, Owner, Designer, Builder, Implementer and Operator respectively [3]. The purpose of rows is given below.

The purpose of row 1 artifacts is to define the boundaries of the enterprise, which includes the scope of the enterprise.

Row 2 artifacts’ purpose is to conceptually define what the enterprise owners have in mind.

Row 3 artifacts design how the concepts of the enterprise will be realized systematically.

The purpose of row 4 is to define the enterprise implementation keeping in mind the technology constraints.

C. Unified Foundational Ontology

Another important topic when building a generic framework such as Tantra Framework, is Ontology. UFO Ontology defines Universals which map to concepts that get instantiated as Individuals. The individuals can be *endurants* or *perdurants* (events). There are relationships which are more like attributes and other type of relationships which need an intermediary called relator. In [4] ARIS method is developed that makes use of UFO ontology and applies it to organizations. The UFO constructs are explained in Table 2 and Table 3.

D. Balanced Scorecard

A commercial enterprise can be managed and led using a balanced score-card framework [5]. It is possible to apply the same approach to Government. The same four perspectives may be applicable that apply to an enterprise namely

- Financial
- Customer (Citizen/Community/Business)
- Internal Business (Process of Governance)
- Learning and Growth (Innovation and strategy)

In the last couple of decades there is focus on Ethical Perspective, as yet another perspective. This applied to businesses as well as society. The score card can be created and tracked in terms of Strategies, Objectives and metrics in line with mission and vision of an organization, as illustrated below:

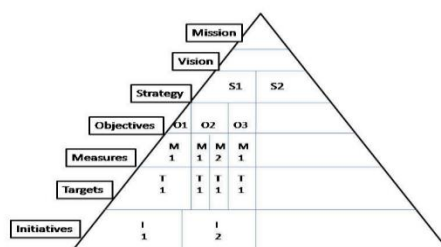


Figure 1: Balanced Scorecard Pyramid (Kaplan and Norton 1996)

E. Theory of Change

Theory of Change [6] is focused on mapping out or “filling in” what has been described as the “missing middle” between what programs or change initiatives do (its activities or interventions) and how these lead to desired goals being achieved. It does this by first identifying the desired long-term goals and then works back from these to identify all the conditions (outcomes) that must be in place (and how these related to one another causally) for the goals to occur. This leads to better planning, evaluation and monitoring of the initiatives.

F. Theory of Separations

Major objective of Governance is economic development. Here we would like to leverage ideas from Bartels theory of market separations[7]. This framework developed as a marketing theory is applied to several domains. Bartels proposed that “new markets could be developed if the following four kinds of market separations (between producers and consumers) are reduced:

Spatial separation or the physical distances between producers and consumers.

Temporal separation or the time difference between production and consumption.

Informational separation or the informational asymmetry between producers and consumers related to products and market conditions, and

Financial separation or the lack of consumers’ purchasing power when they are willingness to fulfill their needs”.

The concept of market separations is developed further to cater to a broader development paradigm. Certain researchers have added Knowledge/Capability based separation as the 5th separation [8]. We can look at how we can use the concept of separations in the Governance domain.

G. Blockchain and Paxos

The blockchain often described as a distributed ledger, is a secure protocol where a network of computers collectively verifies a transaction before it can be recorded and approved. In Schwab’s view blockchain in essence: “a shared, programmable, cryptographically secure and therefore trusted ledger which no single user controls and which can be inspected by everyone”[9]. The blockchain is often contrasted with Paxos protocol of Leslie Lamport[10].

III. TANTRA SOCIAL INFORMATION MANAGEMENT FRAMEWORK

The name Tantra Framework is chosen to reflect enormous connectivity of information through the framework. Etymologically in Sanskrit “tantram”, literally means "loom, warp," hence, figuratively, "groundwork, system, doctrine". Tantra Framework extends Zachman Framework by adding two additional columns namely relators and relationships. The relationship column is used to represent any relationship which may correspond to a data-map or structured map, between framework columns. A relator column is added to represent any entity/concept that is integral part of any relationship. Yet another column namely separations is used to represent lack of relationship or the level of difficulty to access the relationship. Table 4, gives the view of Tantra Framework.

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A. Aspects of Tantra Framework

The aspects of Tantra Framework can be used to expresses social information as follows:

- People (Who)
- Places/Addresses/Locations/Zones (Where)
- Assets/Attributes (What)
- Events (When)
- Processes (How)
- Metrics to measure development (Why)
- Relationships (between aspects)
- Relators (enable relationships)
- Separations (express lack of or difficulty of establishing a relationship)

In addition, under “Who” aspect, we can model communities, categories of people as well as businesses and institutions.

B. Tantra Framework as Good Governance Framework

Tantra Framework as defined above can be converted into a normative framework by interoperating with models that can help achieve Good Governance. Here Goals can be set using Balanced Scorecard Framework and interventions can be modeled and managed through Theory of Change Framework. The Separations can be expressed by drawing on Bartels’ Theory of Separations. See Figure 2 below.

Goals (Balanced Scorecard)
Interventions (Theory of Change)
Networks (Structured Maps) and Separations (Disconnects)
Relations (Aspects)
Domains/Roles/Entity Sets (Instances)
Discrete Information Space

Figure 2: Tantra Good Governance Framework

C. Tantra Framework in detail

- Table 5 describes how five different perspectives are modeled using different data modelling methodologies.
- Table 6 describes how People Domain is reified
- Table 7 describes how the Addresses are reified. The addresses in turn are located in Zones or Geographic contexts which are uniquely identified.
- Table 8 covers asset perspectives. The assets belong to “what” Aspect. In the same manner Loans, Taxed and duties paid/payable can be modeled in the Tantra Framework under “What” aspect.
- Table 9 describes reification of relationships and relators. Any facility such as bank or Financial Institution can be modeled as relator and service enabled by them is modeled as relationship.
- Table 10 describes the Separations with the example of Formal Credit.

Similarly, events that occur during life-time of a person can be reified and given a unique ID. These include birth, attaining maturity, migration, enrollment, emigration, immigration and

death. The objectives and processes can similarly be covered. The processes and objectives also can be similarly reified.

Tantra Framework is modeled using Neo4J graph database. Here nodes contain properties (key-value pairs). Nodes can be labeled with one or more labels. Relationships are named and directed, and can also contain properties.

In summary, Tantra Framework can be a great resource to Social Scientists supporting research methods such as *Action Research, Ethnography, Case Study and Grounded Theory Methods* [11].

IV. REVENUE CAPTURE USING TANTRA FRAMEWORK

Tantra Framework can be used to assess revenue capture for any kind of tax. To enable the revenue capture Tantra Framework needs to have a process how to get the information from concerned departments as well as people periodically and on demand. To facilitate collection of information periodically, *Know-your-Citizen* process should be unveiled where each citizen provides information about him to Government annually, with option to update if need be.

Tantra Information Framework should evolve into *Tantra Digital Governance Framework* where multiple institutions participate through information champions/agents. See Figure 3. This is modeled after TM Forum's Framework[12].

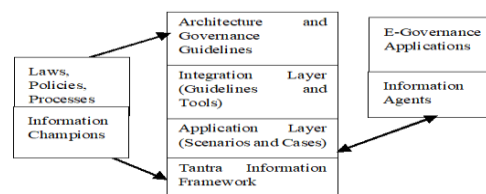


Figure 3: Tantra Digital Governance Framework

Next, we look at the case of Property Tax collection, which is abysmally low in India. The processes are yet to be standardized and automation is sporadic.

Case Study: Property Tax Capture

The Economic Survey of India [28,29,30] says both Urban Local Governments and Rural Local Governments have overwhelming reliance on funds devolved from Center and State Governments. In the case of Urban Local Governments, 56% of funds come outside receipts and only 44% are generated locally. In the case of Rural Local Governments 93% of funds come from outside and only 7% are generated locally. In this context, property tax and land tax are one big source of untapped revenue.

Tantra Framework can present assets where property tax has been paid and not paid. It also gives asset holder details as property tax may vary depending on whether a property is used for self-use vis-à-vis when it is leased out. For properties where tax has not been paid, it provides all details regarding the owners, their whereabouts and associated information. Asset Owners and Asset Holders are roles on People Domain. Table 11 describes how Tantra Framework can be operationalized for Revenue Capture. Table 12 deals with modeling of Revenue Capture using Tantra Framework and Table 13 describes how analysis can be conducted thereafter.

V. CONCLUSIONS

Many decades ago Zachman suggested that IT systems needed to be architected by keeping the whole Enterprise in mind, as Enterprises outlive IT systems. We have applied the same line of thinking at the level of society and have proposed highly generic Tantra framework that can manage the entire information pertaining to society in one place. In this paper, we have looked at using Tantra Framework to handle revenue capture scenario by taking property tax collection as a particular case. Tantra Framework can help enhance revenue capture manifold with high degree of transparency and accountability.

Table 1: Zachman Framework (Zachman 2013)

	What	How	Where	Who	When	Why
Contextual	List of things important to business	List of core business processes	List of business locations	List of important organizations	List of Events	List of business goals Strategies
Conceptual	Conceptual data / object model	Business Process Model	Business Logistics System	Work Flow Model	Master Schedule	Business Plan
Logical	Logical Data Model	System Architecture Model	Distributed System Architecture	Human Interface Architecture	Processing Structure	Business Role Model
Physical	Physical data/ Class model	Technology Design Model	Technology Architecture	Presentation Architecture	Control Structure	Rule Design
Detailed	Data Definitions	Program	Network Architecture	Security Architecture	Timing Definition	Rule Specification
Functioning Enterprise	Usable Data	Working Function	Usable network	Functioning Organization	Implemented Schedule	Working Strategy

Table 2: UFO Concepts

Level	1	2	3	4	4	5	5	6	7
Concept	Basic Elements	Universals	Individuals	Endurants	Perdurants	Substantial	Moment	Intrinsic Moment	Relational Moment (Relator)
Description	Universals or Individuals	Named level in Zachman	Instantiate Universals	Type of Individuals	Events that make up processes	Objects that exist independently	Exist only if bearer exists	Depend on Single Entity	Moments depend on other entities in addition to the bearer
Examples		People		House, Person, Moon, Enterprise	Business processes, Enrollment processes	Person, a house, a planet, and the rolling stones	John's weight, John and Mary's marriage	Colour of something Temperature of some object	Employment with employer. Mary's marriage with John

Table 3: UFO Relations

Concept	Independent Intrinsic Moments	Dependent Intrinsic Moments	Formal Relation	Material Relations/Domain Relation	Relator
Examples	Size and colour of an object	Colour and brightness of an object	Village belonging to a District. Paul's headache.	Working at, being enrolled at, and being the husband of. Medical treatment to Paul	An enrollment connects a student with an educational institution; A Government Department/policy/process connects a citizen with benefit or privilege.

Table 4: Tantra Framework

Perspectives	Aspects								
	Who	Where	What	When	How	Why	Relationships	Relators	Separations
Contextual (Named and Scoped)									
Conceptual (Defined)									
Logically Designed									
Physically Configured (Schema)									
Detailed/Instantiated)									

Table 5 Framework Perspectives and Data Models

Level	Description
Contextual Level	Entity Set of Names that specify Domains/Roles.
Conceptual Level	Entity Set of Descriptions.
Logical Level	Modeling aspect as a logical relation in Relational Model
Physical Level	Relational Schema implemented as a network in graph model.
Instantiation Level	The node(s) belonging to the aspect Entity Set.

Table 6: Reification of People Domain

Perspective	All people	Citizens	Residents	Resident Aliens	Resident Citizens
Named (Identified & Contextualized)	All the people known and to be known to the framework.	People who are citizens	People who are residents	People who are resident but alien	Resident Citizens
Defined (Conceptually Structured)	What makes one a member of this domain/role	What makes one a member of this domain/role	What makes one a member of this domain/role	What makes one a member of this domain/role	What makes one a member of this domain/role
Logically Designed	Related attributes that map to other aspects.	Related attributes that map to other aspects	Related attributes that map to other aspects.	Related attributes that map to other aspects.	Related attributes that map to other aspects.
Configured	Representation in Graph database as nodes and edges.	Representation in Graph database as nodes and edges.	Representation in Graph database as nodes and edges.	Representation in Graph database as nodes and edges.	Representation in Graph database as nodes and edges.
Instantiated	Instantiate with unique ID.	Instantiate with unique ID.	Instantiate with unique ID.	Instantiate with unique ID.	Instantiate with unique ID.

Table 7: Reification of Addresses

	Residential address	General Address/Location	Commercial Address	Institutional address	Address for public/civic amenity
Named (Identified)	Idea named with context	Idea named with context	Idea named with context	Idea named with context	Idea named with context
Defined (Conceptually Structured)	Concept of Residential address. Membership criteria, entry and exit	Concept of Generic address or location	Concept of Commercial address. Entry and exit criteria.	Concept of Institutional Address Membership Criteria	Concept of utility/amenity – playground, park.
Logically Designed	Attributes of Residential addresses	Attributes of Generic addresses	Attributes of commercial addresses.	Attributes of Institutional addresses	Attributes of amenities.
Configured	Schema for Residential addresses	Schema for storing generic addresses	Schema for commercial address	Schema for institutional addresses	Schema for storing details about address
Instantiated	Instantiate with unique ID (Unique ID+ Address ID)	Instantiate with Unique ID (GPS IS?)	Instantiate with Unique ID	Instantiate with Unique ID	Instantiate with Unique ID

Table 8: Reification of Assets

Assets	Owned House	Vehicles	Land
Named (Identified)	Idea Named with context	Idea Named with context	Idea Named with context
Defined (Conceptually Structured)	Concept, how this comes about, through allotment, transfer, inheritance. Part-ownership	Concept, how this comes about, through allotment, transfer, inheritance.	Concept, how this comes about, through allotment, transfer, inheritance. Part-ownership
Logically Designed	Attributes like location, size, related events	Attributes like Type, Related events	Attributes like location, size, related events
Configured	Schema with nodes, labels, ids and relationships	Schema with nodes, labels, ids and relationships	Schema with nodes, labels, ids and relationships
Instantiated	Instantiate asset with unique ID	Instantiate asset with unique ID	Instantiate asset with unique ID

Table 9: Relationships and Relators

	Banking (Savings)		Loans	
Named (Identified)	Name of the idea and context for relationship (Savings account)	Name of the idea and context for relator (Bank)	Name of the idea and context for relationship	Name of the idea and context for relator (Housing Finance Company)
Defined (Conceptually Structured)	Concept of Relationship	Concept of Role of relator	Concept Relationship of	Concept of Role of relator,
Logically Designed	Related Attributes	Related Attributes	Related Attributes	Related Attributes
Configured	Network Schema	Network Schema	Network Schema	Network Schema
Instantiated	Account No.	Instantiate with unique ID	Account No.	Instantiate with unique ID

Table 10: Separations that come in the way of formal credit

Separation	Remarks
Informational Separation	With larger portion of people having bank accounts, the banks have greater access to their financial history. Still credit history and credit-worthiness information may not be as available. From borrower's view-point information on processes may be hard to access and understand.
Capability Separation	Even though many schemes are available, ability to take advantage of them may not be there. For example, starting a small business requires lot more than mere access to funds. Same goes with agricultural loans. The choice of crops and ability to market goods can affect ability to utilize loans and be viable.
Spatial Separation	Not all bank branches lend. Getting a loan may need multiple trips to remote locations.
Temporal Separation	Banks may take rather long to disburse loans. The people may need to work with Micro-finance companies who may charge higher.
Financial Separation	People may not have access to collateral. Only some banks may accept gold as collateral. If they pledge land, they may lose their source of livelihood.
Social Separation	Communities that are trust-worthy end up getting more loans. The ability to operate as groups that are trust-worthy becomes important. The women are considered more reliable as far as repayments are concerned. Many new age banks rely on community reputation. Loan waivers disrupt the culture of seeing debt as a sacred obligation.

Table 11: Operationalizing Tantra Framework for Land Tax & Property Tax Capture using ITIL[13] methodology

Topic	Remarks
Issues in the current system	Under-recovery of land and property taxes far below the potential. Excessive dependency on devolved funds for development of villages and towns (97% in some cases).
Change Agents	The Civic Agency/Government Department responsible for collection of taxes. People and Businesses. Civil Society members.
Desired Change	Higher recovery of taxes. The ability to generate revenue locally give communities greater say on how these funds are used for local needs thus driving their destiny. Greater decentralization.
List of Services to be built using Tantra Framework	Tax Payment Process. Sustained Communication with Land/Property owner through the tax payment cycle. Tracking of asset owners, asset holders and their whereabouts as well as current mode of use through related processes. Process to collect information from general public.
Strategic Alignment between Objectives and services	The services can make it easy to pay taxes as well as track payment of taxes and share with the citizens how paying taxes benefits them.
Design of change Process with Purpose	Using Tantra Framework broad social data from formal and informal sources is collected and communication with stakeholders managed more effectively. Easy to have views at different tier of Government. Remove barriers for paying taxes as well as follow-up. It is also important to ensure the legitimacy of ownership of an asset when owned/sold/leased and validate the source of income when purchased/leased and ensure the asset is used as per law.
Transition Process	Current processes can be reengineered to work in coordinated fashion with Tantra Framework becoming the repository to store all related application as well as platform to build applications that work with latest technologies whether social, mobile, analytics or cloud.
Operational aspects and organizing actors/Institutions	A virtual organization is needed that cuts across Government Organizations and NGOs as well as people that are interested in facilitating better tax collection and development using the taxes.
Process for collecting feedback	Feedback from all stakeholders can be collected and shared as appropriate. Feedback should be used to achieve continuous service improvement.
Training Plan	The officials and people need to be trained with online material as well as off-line programs.
Future Roadmap	The application's footprint can be expanded to include agricultural land..

Table 12 Modeling Property Tax Capture using Tantra Framework

Aspect	Remarks
People	Tantra Framework needs to be current with data on asset owners and asset holders with linkages to what assets they hold and attributes of assets.
Locations, Zones	Tantra Framework needs to assimilate data about address of the asset. It also needs to capture the type of address – some addresses are in residential zones and some in commercial zones. Some zones have a higher valuation on potential rental value and may attract higher rates of taxes. The analysis on property tax payment can be done by locations and zones. The address of asset owner needs to be tracked separately if he is different from asset holder as asset owner is liable to pay tax for assets owned.
Events	Events of interest are payment of tax. Registration of asset in the name of new owner leading to transfer of asset to new owner.
Attributes	Attributes of asset. This may be area alone in case of vacant land. For buildings type of construction and area utilized for construction matter in fixing of property tax. Attributes of Asset owners also can be captured here. Artifacts of tax payment and payable can be captured along with records of communication.
Process	Processes to compute tax due. When self-assessment is used the owners need clarity on how to use guidelines. The payment process itself should be simple. In the event of issues in payment, process is needed to raise complaints and timely resolution of complaints. The process is needed to solicit suggestions related to process and policy from public and get back to them. Process is needed to communicate to the people how taxes are used and in particular outlays and outcomes in the locality where tax payers stay. Related Processes that manage asset ownership and residential addresses/communication addresses of asset owners.
Objective	Increase % Recovery of taxes. Increase satisfaction of citizens w.r.t tax payment process as well as policy. Improved living standards with higher recovery of local taxes as well as greater empowerment to people to drive their own destiny
Relator	Property tax payment office, property tax portal, Government offices and officials involved in managing asset ownership records and those responsible for policies, rates and classification of zones.
Relationships	The relationships between different aspects
Separations	Inability to visit Government offices for payment, Inability to use online portals. Lack of clear information – Informational separation and Financial Separation – inability to pay taxes due to lack of adequate income source and financial insecurity. Temporal separation whenever citizens are ready the relators are not available.

Table 13: Analysis of Property Tax case using Tantra Framework

Aspect	Remarks
People	Analysis can be made on compliance of property tax based on classification of asset-owners. Are businesses more likely to default on payment of taxes or home-owners? Is default more among villagers or urban populace? Is it due to lack of will, time, information or easy process? Do all have access to pay tax for their properties? Are their records loaded properly if access is online?
Locations, Zones	Analysis of compliance can be done as per geographic classification as well as based on any other categorization. Analysis can be also made if the tax rates are fair and reasonable across asset categories.
Events	The life cycle of asset as it passes from hand to hand, transforms itself and at times divides into more assets and increases in value along with all payment transactions are tracked using events. The ability to quickly pass on information about events as and when happens is important for maximal recovery of taxes and to ensure sustained communication. It is important to maintain ability to communicate with asset owners and holders. The event chain is useful to detect any fraudulent transaction. The taxes have to be accepted only from legal owners. Any event that indicates unlawful possession of asset needs to be tracked.

Attributes	Analysis based on different asset categories can be done.
Process	Analysis may be made on blockers in property tax payment process as well as update of records when change in ownership or change in zone takes place. Which step in particular is taking time may be analyzed to know which relator is obstructing. How many people are returning without being able to pay taxes may be analyzed. Analysis on complaints and suggestions handled can be done. Tantra Framework provides place-holders for information required to facilitate all the analysis.
Objective	% of taxes recovered relative to potential can be analyzed. Key goal is for every locality at every tier of Government to be self-sustaining where it can handle 2/3 of its needs through revenue collected locally.
Relator	Analysis of how well relators perform. This includes Government Offices, officials, online portals, process documents and so on.
Relationships	Every new 'fact' can be stored as relationships among different aspects. Each relationship in turn may make use of other relationships.
Separations	All the different separations – spatial, temporal, financial, informational and capability can be analyzed that come in the way of payment of taxes.

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