ISSN (Print): 0972-2467
ISSN (Online): 0976-2477
SRELS Journal of Information Management, Vol 55(6), December 2018, p. 299-308 DOI: 10.17821/srels/ 2018/v55i6/137988

Knowledge Management using Ontology Based Tantra Framework for Good Governance

Shreekanth M. Prabhu*, K. N. Balasubramanya Murthy and S. Natarajan

PES University, 100 Feet Outer Ring Road, Banashankari 3rd Stage, Banashankari Bangalore – 560085, India;
shreekanthprabhu@pes.edu, vice.chancellor@pes.edu, natarajan@pes.edu

Abstract

This paper proposes *ontology-based Tantra Framework* that accommodates *Societal Information* in an orderly, compact and unified manner to achieve *Good Governance*. In this work, *Zachman Framework* for Enterprise Architecture is used as reference and it is extended to address information operating at societal scale. The complexity of social information gets accentuated due to myriad possibilities of relationships, say compared to information pertaining to an Enterprise. In light of that, two additional columns namely relationships and relators have been added to Zachman Framework in Tantra Framework. The existing six columns of Zachman Framework namely who, what, how, when, where and why are interpreted as People, Assets/Attributes, Process, Event, Location and Objectives respectively. In addition to the six interrogatives of Zachman Framework that are ontology based, the concept of relationships and relators has been derived from *The Unified Foundational Ontology*. Even though Zachman considered his framework as *Ontology*, some researchers regarded it as taxonomy. Tantra Framework has addressed that perceived gap by extending the Zachman Framework by adding two additional columns. The utility of Tantra Framework is analyzed by applying it to a set of ***Application Scenarios*** pertaining to *People and Locations information*, *Revenue Capture*, *Social Benefit Coverage Analysis, Financial Inclusion* and *Metrics analysis*. Tanta Framework interoperates with *Balanced Score Card* approach to set objectives, *Theory of Change* to lay out a process of change and *Bartels' theory of Market Separations* to assess the access barriers within Society. This research study is focused on Indian context. *Tantra Framework* relies on eliciting the inherent order in social information to make it complete, correct and current. For example, in Chemistry, discovery of periodic table by Mendeleev led to a unifying scheme which not only captured the present but allowed for place-holders for future discoveries. A similar focus on eliciting inherent order in social information, can potentially reveal latent 'facts', 'truths' and 'relationships.

Keywords: Financial Inclusion, Framework, Good Governance, Knowledge Management, Ontology, Theory of Separations

1. Introduction

Over the years, the Government of India has faced many Governance challenges. Some of the challenges are:

- Delivering services to needy people within reasonable time, serving the neediest first,
- Ensuring that all the people pay their taxes,
- Ensuring that tax revenue is spent in an optimal manner, and
- Ensuring that economic and social indicators make strong and sustained progress.

In this paper the objective is to define a framework that addresses Good Governance objectives.

From a researcher's view-point, "a framework 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".

1.1 Good Governance

Good Governance is human-centric in contrast with process-centric nature of E-Governance.

*Author for correspondence

Kautilya in his treatise Arthashastra elaborated the traits of the King of a well governed state thus: "in the happiness of his subjects lies his happiness, in their welfare his welfare, whatever pleases himself, he does not consider good, but whatever pleases his subjects he considers as good".

Mahatma Gandhi propounded the concept of "Su-raj". As per him "Good governance" has the following eight attributes, which link it to its Citizens: 1. Accountable, 2. Transparent, 3. Responsive, 4. Equitable and inclusive, 5. Effective and Efficient, 6. Follows the rule of law, 7. Participatory, and 8. Consensus oriented.

To achieve good governance in a human-centric manner we need to fulfill aspirations of people. Here Maslow's motivation hierarchy come handy (Figure 1).

A good governance model that can address different needs of people is shown in Table 1 (Prabhu, 2017).

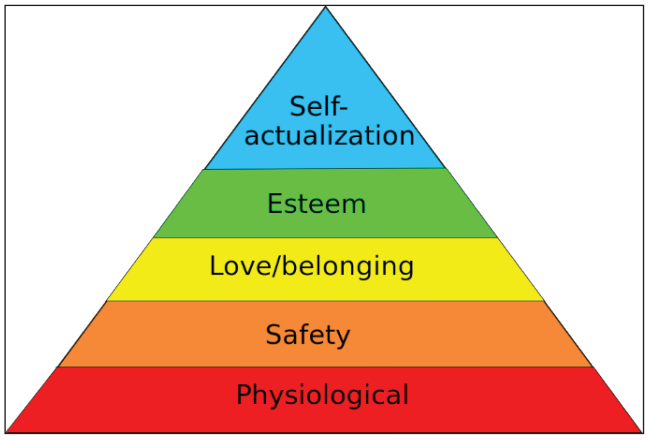

Figure 1. Maslow's motivation hierarchy.

Table 1. Good governance model

Layer (sub-model)	Focus
Strategy and Competitiveness Model	To gain strong global position, power and prosperity
National Innovation Model	Business model innovation, technology innovation, new competencies and processes
Common Economic Model	Ecosystem that balances interests and serves optimally
4 D's development model	Financial Inclusion, Balanced Growth
Safety and security model	Physical, financial, social, emotional well-being
Empowerment Model	Access to nutrition, education, health-care and employment/ livelihood
Core Governance Model	Access to information, Access to timely service and opportunity to participate

1.2 Research Problem

The research reported in this paper closely relates to the task of arriving at Architecture for complex system. According to Crawley, "*system architecture is the embodiment of concept: the allocation of physical/ informational function to elements of form, and the definition of interfaces among the elements and with the surrounding context*" (Crawley, 2007; Crawley, et al., 2004). Taking a cue from this definition, our research problem needs to dwell on three important questions:

- How is information organized? (Form),
- How is information used? (Function), and
- How is the form mapped to function? (Concept).

Table 2 elaborates on the modeling of Research Problem using Function-Form-Concept paradigm.

Rest of the paper is structured as follows:

Section 2 dwells on *Frameworks, Models and Ontology* in the context of managing knowledge pertaining to complex systems such as Governance Systems.

Section 3 describes the *Ontology-based Tantra Framework.*

Section 4 describes a set of Application Scenarios that can take advantage of Tantra Framework.

Section 5 describes the Knowledge Management *Methodology* using Tantra Framework with the above application scenarios in mind.

Section 6 concludes the paper.

Table 2. Modeling research problem using Function-Form-Concept paradigm

Form	Function	Concept
• Choose an appropriate framework to capture dimensions and level of details in each dimension. • Model each dimension to ensure compactness. Considering the discrete information space, each dimension can be modeled as a set. • Establish a mechanism to define relationships across dimensions.	• The Framework should store social information in an orderly and compact manner. • The framework should be able to address operations needed to manage social information • The framework should help achieve good governance and social change objectives, by inter-operating with appropriate models. • A mechanism is needed to validate the state of "good governance" using appropriate metrics.	• A mechanism is needed to visualize the social information and to update it with new data. • A shared social information infrastructure can be an enabler for Good Governance.

2. Frameworks, Models and Ontology

This section discusses Frameworks, Models and approaches to arrive at a useful Ontology for Tantra Framework.

2.1 Zachman Framework

Zachman Framework (Zachman, 2003) has rows and columns that can capture information in a holistic and comprehensive manner. Zachman Framework is illustrated in Table 3.

Table 3. 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

Here the columns are primary interrogatives – who, what, when, where, how and why. The rows represent the perspectives of Planner, Owner, Designer, Builder, Implementer and Operator respectively (Zachman, 2007).

2.2 Unified Foundational Ontology (UFO)

Ontology is extremely important when building a generic framework such as Tantra Framework. The Aspects of Zachman Framework derive from Ontology. The UFO (Santos Jr, *et.al.*, 2013) constructs are explained in Table 4 and 5.

Table 4. UFO concepts

Level	1	2	3	4	4	5	5	6	7
Concept	Basic Elements	Univer-sals	Indivi-duals	Endu-rants	Perdu-rants	Substan-tial	Moment	Intrinsic Moment	Rela-tional Moment (Relator)
Description	Univer-sals or Indivi-duals	Named level in Zachman	Instan-tiate Univer-sals	Type of Indivi-duals	Events that make up pro-cesses	Objects that exist independently	Exist only if bearer exists	Depend on Single Entity	Moments depend on other entities in addi-tion to the bearer
Examples		People		House, Person, Moon, Enter-prise	Busi-ness pro-cesses, Enroll-ment pro-cesses	Person, a house, a planet, and the rolling stones	John's weight, John and Mary's marri-age	Colour of some-thing Temperature of some object	Employ-ment with employer. Mary's marriage with John

Table 5. 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.

2.3 Balanced Scorecard

A commercial enterprise can be managed and led using a balanced score-card framework (Kaplan, 2010). It is possible to apply the same approach to Government. The same four perspectives may be applicable, namely,

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

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 Figure 2.

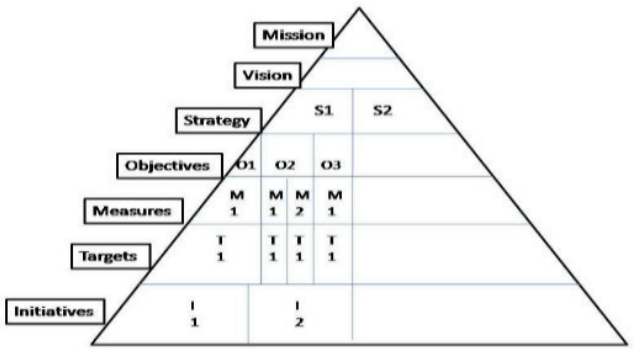

Figure 2. Balanced scorecard pyramid (Kaplan and Norton 1996).

In the last couple of decades there is focus on Ethical Perspective, as yet another perspective. This applies to businesses as well as society.

2.4 Theory of Change

Kurt Lewin famously said, "There is nothing more practical than good theory". Theory of Change (Weiss, 1995) is essentially a comprehensive description and illustration of how and why a desired change is expected to happen in a specific context. 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 relate to one another causally) for the goals to occur. This leads to better planning, evaluation and monitoring of the initiatives.

2.5 Theory of Separations

Major objective of Governance is economic development. Here we would like to leverage ideas from Bartels theory of market separations (Bartels, 1968). Bartels identified four different separations that come in the way of market-development.

- *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".

Certain researchers have added Knowledge/Capability based separation as the 5th separation (Tarafdar & Singh, 2011).

3. Ontology-based Tantra 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 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.

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

- People (Who),
- Places/Addresses/Locations/Zones (Where),
- Assets/Attributes (What),
- Events (When),
- Processes (for enrolment, intervention) (How),
- Metrics to measure development (Why),
- Relationships (between aspects),
- Relators (enable relationships), and
- 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. The Table 6, gives the view of Tantra Framework.

Table 6. Tantra framework

Perspectives	Aspects								
	Who	Where	What	When	How	Why	Relation-ships	Rela-tors	Separa-tions
Contextual (Named and Scoped)									
Conceptual (Defined)									
Logically Designed									
Physically Configured (Schema)									
Detailed/Instantiated)									

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

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 in Figure 3.

In Tantra Framework, as in Zachman Framework, every aspect goes through the process of reification. Table 7 describes how People Domain is reified.

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

Figure 3. Tantra framework with interoperating models.

Table 7. Reification of people domain

Pers-pective	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 Struc-tured)	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.
Instan-tiated	Instantiate with unique ID.	Instantiate with unique ID.	Instantiate with unique ID.	Instantiate with unique ID.	Instantiate with unique ID.

Table 8. 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 describes how the Addresses are reified. The addresses in turn are located in Zones or Geographic contexts which are uniquely identified.

Table 9 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. This can help get a complete financial profile of borrowers.

Table 10 covers the reification of relationships and relators and Table 11 covers separations with access to Formal Credit.

Table 9. 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 10. 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 of Relationship	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 11. Separations that come in the way of formal credit

Informational	Capability	Spatial	Temporal	Financial	Social
From borrower's view-point information on processes may be hard to access and understand.	Capability to utilize funds may not be there. For example, starting a small business requires lot more than mere access to funds.	Not all bank branches lend. Getting a loan may need multiple trips to remote locations	Banks may take rather long to disburse loans. The people may need to work with Micro-finance companies who may charge higher.	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.	Communities that are not considered as trust-worthy end up getting less loans.

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.

In summary, Tantra Framework can be a useful resource to Social Scientists supporting research methods such as *Action Research, Ethnography, Case Study and Grounded Theory Methods* (Myers, June1997).

4. Application Scenarios

Tantra Framework can be used in the following Application Scenarios.

4.1 Master Networks

Master data on people, addresses and assets will be extremely useful for Governance in India.

4.2 Revenue Capture

In India tax to GDP ratio is around 10%. Even though the number of tax payers has increased, it is a far cry from what is seen in developed countries. There is also serious under-recovery of property tax from civic bodies. Tantra Framework can help connect the dots to track under-recovery.

4.3 Social Benefit Coverage Analysis

Government of India provides varieties of subsidies to citizens. The targeting of subsidies is an issue. The subsidies are also subject to leakages through identity fraud and quantity fraud. Tantra Framework can provide a rich repository of credible information to do the analysis.

4.4 Financial Inclusion

Tantra Framework can help address issues related to Financial Inclusion.

4.5 Metrics Analysis

Tantra Framework enables systematic capture of Social and Economic indicators.

5. Methodology

Tantra Framework can be populated using data-sets available to the Government.

Table 12 gives indicative list of Data Sets of Interest to build Master Data.

Once the Primary dimensions are captured in Tantra Framework, other possible relationships can be captured using network model. These may include the relationships such as People-People, People-Assets, People-Benefits, People-Attributes, People-Locations, People-Events, People-Processes, People-Objectives, Assets-Locations, Events-Locations, Assets-Processes, Events-Processes and so on... etc. network of offices of a company as registered or reported.

Table 12. Data sets of interest

People	Locations	Relators
Voter ID Holders Aadhaar Card Holders Ration Card Holders MGNREGA Card Holders PAN Card holders Passport holders LPG Consumers Data PF beneficiaries Students Enrolled Mobile Subscribers Utility consumers Property owners Licensed Drivers Customers of Banks Electricity Subscribers Land Line Subscribers Water connection users	Wards Assembly Constituencies Parliamentary Constituencies Villages Towns Districts	Electoral Booths Post offices PDS Shops Income tax wards LPG distribution outlets Schools, Colleges Phone Companies Banks Civic bodies RTOs Utility offices Police Stations Employers

5.1 Analyzing the Data in the Framework

To establish *Master Networks*, there is a need to uniquely resolve entities. For example, a person is known through IDs given by the Government, through his relationship with his family and through his relationships where he associates for a particular purpose such as education, employment, financial or medical services.

Once the entities are resolved, establishing veracity of information becomes important. At times the information may be stale. An ongoing process is needed to recertify the veracity of the information. A Social Information Management Process needs to be defined to cater to these needs.

To address *revenue capture* for property tax coverage we may need to collect data about owner, license-holder, type of property, legal status, mode of approved use and actual use, along with valuation and zoning information. The data can be maintained on defaulters as well those who generally comply and it can help lead to the cause of non-payment between intent and process. The tax collection offices can be relators. The status of payment of taxes can be visualized using networks and as also the tax compliance behavior of owners across tax categories.

Community wise analysis can throw insights into coverage of *Social Benefit schemes*. The coverage analysis can help weed out schemes that are not effective and target interventions using *Theory of Change* process.

The *Financial Inclusion* scenario can benefit using *Theory of Separations* approach and *Metrics Analysis* can be done using *Balanced Scorecard Framework*.

6. Conclusions

In this paper Ontology-based Tantra Framework is proposed with the objective to achieve Good Governance in India. Tantra Framework is architected to holistically manage social information. Tantra Framework starts with Ontology-First approach for data modeling where unique dimensions (aspects) are identified, reified through perspectives and then networked.

Tantra Framework uses Zachman Framework as reference. Even though Zachman considered his framework as *ontology*, some researchers regarded it as *taxonomy* (Nick Malik, 2012). Tantra Framework has addressed that perceived gap by extending the Zachman Framework by adding two additional columns. Using Tantra Framework, the Social Information space is modeled as discrete information space, instantiated and enumerated. The information space covers the entire gamut from concept, context, construct and instance, thus providing a single unified epiphany of information. Tantra Framework is normative frameworks that can help India realize its aspirations. Variety of people can utilize Tantra framework: Policy makers, Government Officials, Analysts, Economists, Implementers, Institutions, Ecosystem Players, people and society at large.

7. References

Bartels (1968). The General Theory of Marketing, The General of Marketing, 32(1), 29-33. https://www.jstor.org/stable/1249193?seq=1#page_scan_tab_contents.

Crawley, E. F. (2007). ESD. 34. Theory of Systems Architecture. MIT Lecture Notes.

Crawley, E., De Weck, O., Eppinger, S., Magee, C., Moses, J., Seering, W., Schindall, J., et al. (2004). The influence of architecture in engineering systems. Engineering Systems Monograph. Architecture; p. 29. https://ocw.mit.edu/courses/engineering-systems-division/esd-342-advanced-system-architecture-spring-2006/readings/esd_architecture.pdf.

Kaplan, Robert (2010). Conceptual Foundations of the Balanced Scorecard, HBS Working Paper Series No. 10-074, March 2010. https://www.hbs.edu/faculty/Pages/item.aspx?num=37638.

Myers, Michael David (June1997). Qualitative Research in Information Systems. MIS Quarterly. https://doi.org/10.2307/249422.

Nick Malik (2009). Why the Zachman Framework is not an Ontology. https://blogs.msdn.microsoft.com/nickmalik/2009/12/18/why-the-zachman-framework-is-not-an-ontology.

Prabhu, Shreekanth (2017). Good Governance Model. https://www.researchgate.net/publication/325544499_Good_Governance_Model.

Santos Jr, Paulo et.al. (2013). An ontology-based analysis and semantics for organizational structure modelling in the ARIS method. Information Systems Journal, 38(5), p. 690-708. https://dl.acm.org/citation.cfm?id=2452238.

Tarafdar, Monideepa and Singh, Ramendra (December 2011). A Market Separations Perspective to Analyze the Role of ICT in Development at the Bottom of the Pyramid. Association for Information Systems. Proceedings of the Fourth Annual SIG Globdev Workshop, Shanghai, China.

Weiss (1995). Nothing as Practical as Good Theory: Exploring Theory-Based Evaluation for Comprehensive Community Initiatives for Children and Families. In: 'New' Approaches to Evaluating Community Initiatives, Concepts, Methods, and Contexts, Edited by Connel, Kubisch and Scorr, The Aspen Institute. ISBN 0-89843-167-O

Zachman, John A (2003). Zachman Framework, A Primer for Enterprise Engineering and Manufacturing. Available at http://www.zachmaninternational.com.

Zachman, John A (2007). The Framework for Enterprise Architecture: Background, Description and Utility. https://www.zachman.com/resources/ea-articles-reference/327-the-framework-for-enterprise-architecture-background-description-and-utility-by-john-a-zachman.