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# How Factoring Ethics Encourages and Stimulates Innovative Development of IT Systems Responsive to Stakeholder Needs and Requirements

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## Abstract

Human beings have become increasingly dependent on IT in running their daily lives and doing business. The development and the increase in use of Autonomous Intelligent Systems in the last few years is making it increasingly impossible to ignore ethics in engineering and building IT Systems as more factors other than the traditional ones like financials come into play. As the use of technology continues to grow among people of all ages, there is also a growing awareness of the potential social harms such systems can have on human well being. Where there is such an awareness (of potential harms the systems may have on humans), there is a likelihood of resistance in adoption and use of the technology resulting in the loss of the benefits such systems are supposed to bring with them. Where potential harms have been ignored and people went ahead and adopted and used the technology, but eventually experienced cases of social harm, possible abandonment of the technology becomes a reality - a situation which also results in the loss of all the gains the technology could have potentially brought. Some good examples are societies which continue to keep under-aged children away from technology as a way of safeguarding them from the harms caused by technology. Situations like this have set limits to the effectiveness and reach of technology driven services such as autonomous eHealth systems and even educational programmes. There has also been a view mainly among technology creators that Ethics considerations are slowing down or getting into the way of innovation. In the proposed chapter, and driven by the theme “Ethics Considerations to drive innovative thinking in building systems which are responsive to the needs of the user and promote adoption, and safe use of IT” the writer argues for a unified front in the development of IT systems in an ethical manner - That is, it is time users and creators of technology start working together to build systems for the future. And with well-being among the UN Development Goals, and technology taking centre stage in many aspects of development and growth, Ethics in technology cannot be ignored.

**Keywords:** ethics, IT Systems, values, well-being

## **1. Introduction**

Information Technology and specifically AI holds the potential to be a major driver of economic growth and social progress, if industry, civil society, government, and the public work together to support development of the technology with thoughtful attention to its potential and to managing its risks.

On 27 December 2020, Elon Musk tweeted ‘Focus on making products and services people truly love, so that the total economic pie is bigger, instead of engaging in zero-sum / negative-sum corporate power struggles. This is the good future’. Of the 200 responses to this tweet read, only 3 did not directly agree. Some notable replies and comments to this tweet were:

- Profit Maximisation = Better products/services = Customer Retention + New Customers
- His logical approach of being a consumer, his passion, and futuristic vision for humanity speaks volumes for his products and companies. Corporations ran by MBA’s are profit driven and have no belief in their product. They are not the same
- This is the root cause of why many innovative organisations atrophy over time. After success, they attract people who are more focused on the pay off than making something great. A team that truly cares about the product is often the number 1 competitive advantage in the long run
- After all, how is value created
- I suspect most companies do not have a strong, clear, or inspirational enough mission statement, otherwise this would be less of a problem
- What Elon says here is perfect. This should be read out at every board/senior staff/ offsite meeting that companies to set strategy. Unfortunately, legacy companies in industries getting disrupted do not think like this and that’s why they are in so much trouble
- Well said, build great products that build value to people
- I agree but you need to really think all your products, process and people are the best innovations ever. Many great process and product innovations has not been hired for you
- This right here is why major companies used to live 60+ years. They made the consumer the general focus. Now its all about doing things the cheapest way so that all the corporate Titans can deepen their pockets which has nosedived the life expectancy of major companies to 18 years.

In response to a recent proposal to deploy an Electronic Health (e-Health) System for use with young people aged between 15 and 25, an East African NGO requested that alterations be made to the age group include to only those aged 18 and above because the country’s laws did not allow those under the age of 18 to own personal mobile devices which were to be the main platform for deployment of the proposed solution. This meant that although studies had concluded that some

under-18 age groups needed interventions provided for by the autonomous e-health system, those groups would be left out in deployment of the solution because of regulatory and cultural reasons.

Elon's tweet and replies to, and the above e-Health system scenario raise the following important issues in delivery of IT Systems and Services which are the subjects of discussions in this chapter:

- Understanding Values and Ethical Considerations in Systems, Products and Services
- Why values should be seriously considered when building IT systems and products
- How to incorporate values into IT systems and products and how this promotes innovation
- Implementing values and ethics in an organisation is a collective endeavour requiring active participation from all stakeholders
- Why and how incorporating values into systems and products promotes innovation

## **2. Concepts: values and ethics and why they matter**

### **2.1 Understanding values**

This chapter uses the Organisational Behavioural definition which defines values as the collective conceptions of what is considered good, desirable and proper or bad, undesirable, and improper in a culture or setting. That values set the standard for what one subscribes to or chooses. For example some common business values would be fairness, innovations and community involvement. It is not always easy to clarify the fundamental values of a given grouping, setting or society because of sheer breadth.

#### *2.1.1 Some characteristics of values*

- They can be different for each person or cultural setting.
- The degrees to which they are valued differs
- They inspire and motivate
- Normally stable but can change e.g. can change over time
- Can be specific to a person or situation (e.g.) or general (e.g. health, love)
- Core values can be learnt from family, neighbourhood and various sources within a setting or society
- Where common values are shared, they build up societies and integrate social relations

- They influence people's behaviour providing standards for performance and morality, and serve as a way of evaluating their actions and behaviour
- They have a role in the conduct of social life and help to build the norms to guide day-to-day behaviour
- give energy for doing something meaningful

### *2.1.2 How values are acquired*

- From Parents, teachers, friends
- From groupings or settings such as the place of work, Religious grouping, learning institute
- From environmental interactions and influences
- From beliefs: values are derived and these can be correct or incorrect but still hold true for those who believe in them.

## **2.2 Ethics**

Ethics are the set of rules or guidelines which govern behaviour and are usually established by a group or culture. They are derived from values. Ethics are implemented in the organisation to protect the interests of stakeholders (clients/customers, suppliers, employees, society and government. Thus they are needed to create conformity and order, and can enable members of a grouping (organisation, business) to interact harmoniously and are an enabler to achieving goals that would not be achieved individually.

Being ethical means supporting the realisation of positive values or the reduction of negative values [ISO/IEC/IEEE 42010:2011].

## **2.3 Why values and ethics matter**

Values are the driving force in ethical decision making.

- They guide decision making. They represent viewpoints from which people make decisions
- They regulate our day-to-day behaviour and are a guide in setting objectives
- In the case of a company or organisation, ethics influence how the company or organisation works with and serves its stakeholders or stakeholder community. It is therefore expected that an organisation or company will have an ethical conduct which impacts on its processes, policies, procedures and supporting systems
- They help to set the boundaries between professional / business codes of ethics and personal codes of ethics.
- Organisations which practice ethics tend to be Agile for the following reasons:

- They will strive to provide excellence by working to deliver the greatest quality of service or products to the community / clients they serve. Such organisations will pursue creativity and innovation to deliver services and goods, and continue working to improve performance and stakeholder (client, employee etc) satisfaction and morale
- They will work to build and maintain positive reputation, keep stakeholders engaged (getting feedback on operational effectiveness)
- They take responsibility and accountability for the decisions they make and admit mistakes when these are made
- They are trustworthy, fulfilling commitments to stakeholders
- They show compassion and demonstrate kindness and care for others. This implies that decisions made seriously consider options put forward and how each option affects the other person or community with the aim of reducing the negative impacts or potential harms
- They manage risks(to achieve the above) to remain agile.

### **3. Incorporating values/ethics in IT systems and products**

#### **3.1 Why we should incorporate values/ethics into IT systems and products**

Incorporating values / ethics into IT systems and products enables creators or developers to build products which better serve humans through functionality and behaviour which prioritise human values such as security, transparency, accountability, including the traditional organisational values such as efficiency, effectiveness and whatever values the organisation concerned subscribes to.

Although the significance of values and ethics is beginning to be realised more now and in the age of 4IR, the need to incorporate values / ethics in IT systems and products was realised some years ago. Notable early efforts include those made by Professor Mumford who developed an integrated methodology for systems implementation called Effective Technical and Human Implementation of Computer Systems (ETHICS) which incorporates job design as an important component of any systems planning and implementation effort [1]. Professor Mumford is known to have participated in the socio-technical movement which advocated for improvements of the quality of working life at the forefront of organisational design. ETHICS was viewed as a method of work design and change related to the introduction of computer systems. The methodology was developed to become a method of participatory systems implementation and is said to have evolved with each case study to suite an organisation's needs. It was popular because it promised management better success and gains, and workers better involvement and democracy in the workplace. Although there was no specific mention of terms such as values and ethics, the methodology's approach had focus on human values.

#### **3.2 Some current methods of factoring or incorporating values into IT systems and products**

In this chapter we will look at some of the existing and upcoming methods and frameworks which can be used to facilitate incorporation of ethics/values into IT



systems and how these methods encourage innovation. A proposed framework on how the individual frameworks can be integrated to drive innovative development of IT systems, products and services will be also presented and discussed.

The importance of values in IT Systems, Products and Services started receiving attention in recent years with one of the key drivers being the Fourth Industrial Revolution (4IR) and AI. In the past, the focus was on requirements for economic gains and achieving operational efficiency with little or no attention to other values. The following are some of the methods:

### *3.2.1 Through corporate and IT governance frameworks*

The IT Governance framework has matured over the years and is continuously being improved to meet the requirements of the modern organisation and the ever changing technology solutions delivery methods. The framework is modular and flexible and can be adapted to meet the requirements of organisations of different sizes. Typically, the governance framework delegates responsibility to the Executives to ensure that the enterprise's IT sustains and extends the organisation's strategies and objectives. ISO/IEC 38500 [2], the international standard for corporate governance of IT is more specific and identifies six principles for good IT governance which are as follows:

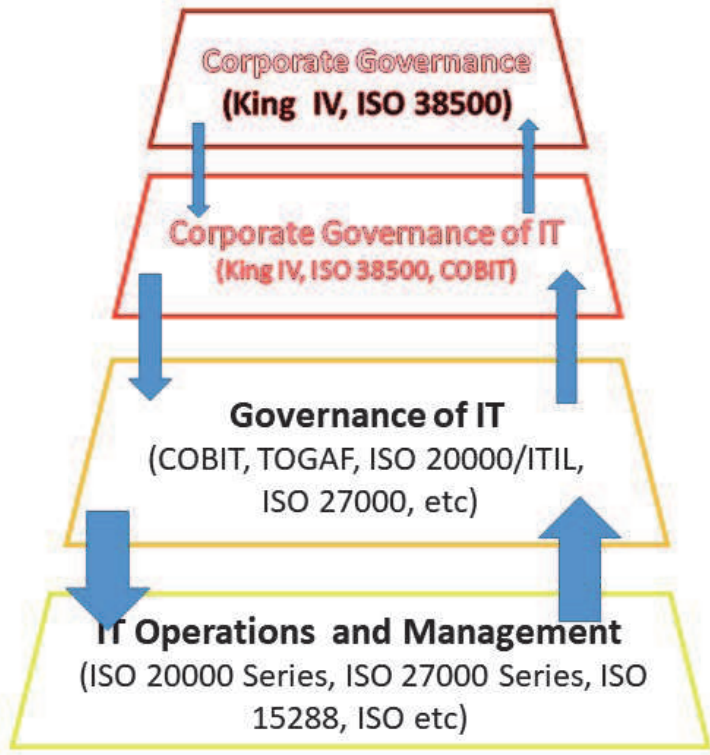
- Responsibility– the need to establish clearly understood responsibilities for IT
- Strategy – the need to plan IT to best support the organisation's business
- Acquisition – the need to acquire IT validly
- Performance – the need to ensure that IT performs well whenever required
- Conformance – the need to ensure that IT conforms with formal rules and regulations
- Human Behaviour – the need to ensure that IT respects human factors, through IT policies, practices and decisions

By implementing the above principles, the framework caters very well for factoring values into the organisation's structures and systems. The framework has been adapted and applied in public and private sectors and has proven to be effective in implementing the above principles to achieve the following key objectives regarding corporate governance of IT:

- Unlocking the value of IT. In addition to its traditional role of supporting business, IT is increasingly becoming an enabler and innovator of business
- Regulatory and Compliance issues which are changing rapidly. It is increasingly becoming important for organisations to comply, for example, to Protection of Personal Information
- Facilitating the acceptance by the Strategic Leadership of IT as an enabler of business
- Facilitating the provision of relevant resources, organisational structures, capacity and capability to enable IT delivery

- Implementing governance of IT based on known international standards and practices
- Appropriately empower and supporting IT leadership to ensure efficient delivery of the IT function
- Complying with Acts of Law.

**Figure 1** is illustration of the adaptation of the framework which has been effective in both public and private entities.



**Figure 1.**  
*Illustration of corporate IT governance framework implementation.*

*3.2.2 Ethically aligned design, development, management and implementation of IT systems, services and products*

There are currently a number frameworks and methods some of which have already been released, and others in their advanced stages of development. Although the frameworks have been designed and developed with Autonomous Intelligent Systems (AI/S) in mind, they can all be applied to semi-autonomous and other types of systems, products and services. In a way, they all come in as a response to early calls by the likes of Mumford and others [1] for incorporation of ethics into the development of IT systems and products. The key drivers to these frameworks are an Ethical or Values based approach to the entire Systems Engineering and Systems Development Processes, and of Data Engineering and Management

- **Ethical Value Based Requirements Engineering(evb-RE) for systems/products/services:** The Systems Engineering Body Of Knowledge (SEBoK) states that “System Requirements are all of the requirements at the system



level that describe the functions which the system as a whole should fulfil to satisfy the stakeholder and requirements, and are expressed in an appropriate combination of textual statements, views and non-functional requirements, the latter expressing the levels of safety, security, reliability etc that will be necessary”. The SEBoK further states that System requirements play major roles in systems engineering in that they form the basis of system architecture and design activities, form the basis of system integration and verification activities, act as reference for validation and stakeholder acceptance and provide a means of communication between the various technical staff that interact throughout the project. Incorporating Ethics/Values into Requirements elicitation adds another layer to traditional System Requirements [3] by incorporating ethics / values elicitation activities relevant to the domain culture and the surrounding environment where the system is to be deployed into a step which necessitates the introduction of additional activities or work items and skills requirements in the organisation. It further requires the involvement of a wider audience for quality purposes, dedication to human values. Falling short of using the term values, Bergman, et al., 2002, argues that effective requirements engineering brings together technical, social, economic and institutional factors, an approach which broadens the understanding which one gets of the domain of the System of Interest and helps to improve the effectiveness of the Requirements Engineering process [4]. The concept of evb-RE can be applied to Requirements Management in the TOGAF Enterprise Architecture Framework [5].

Figure 2 is an illustration of how evb-BRE can be applied to TOGAF.

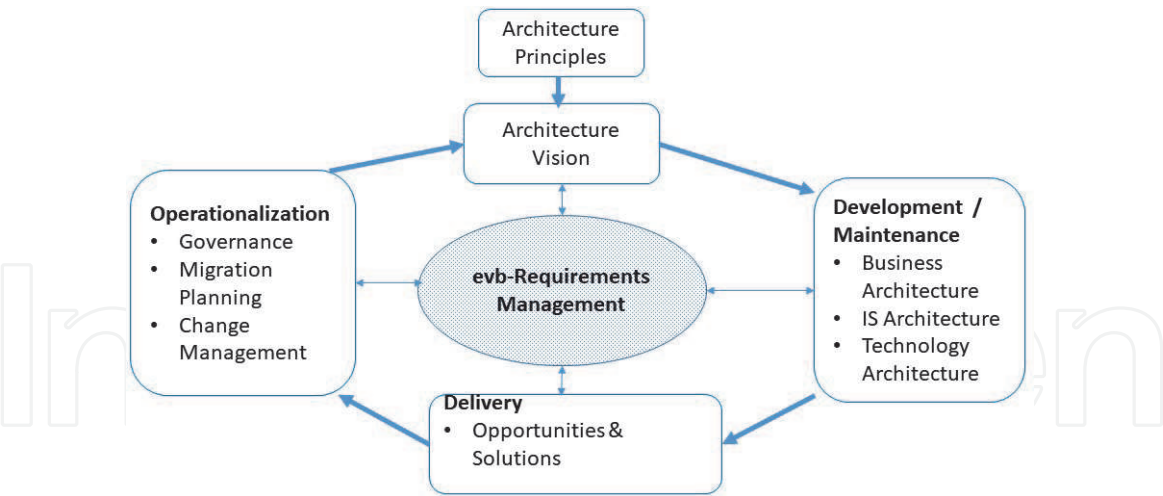


Figure 2.  
Illustration of how ethical values based requirements engineering could be applied to TOGAF.

- **Ethical Risk Based Design:** The method works hand in hand with the Ethical Values Based Requirements Engineering [4]. It works by declaring identified values as values at risk (Ethical Value Risks) during the proposed system development effort. The identified values risks are treated through a repetitive and rigorous design process which aims to eliminate or minimise the risk to acceptable levels. Risk based design focuses on identifying stakeholders’ attitudes and feelings about products and prototypes as an aid towards refining requirements with human centred values.

### 3.2.3 *Using an appropriately designed well-being impact assessment framework to incorporate values into organisational processes, systems(including data), products and services requirements management systems*

The proposed framework defines well-being as the continuous and sustainable physical, mental, and social flourishing of individuals, communities and populations where their economic needs are cared for within a thriving ecological environment. Through an iterative well-being impact assessment (WIA) process during conceptualization, analysis, design, development, and throughout the life span of a system, product or service the method establishes values of various stakeholders including creators/developers and uses the assessment findings to develop and improve a product, service or system of interest. It makes use of known knowledge bases or databases of values and the indicators of how those values can be impacted by the proposed system, service or product. New values and indicators can be identified during well-being impact assessment processes and these new findings are added to the database thereby continuously improving its content.

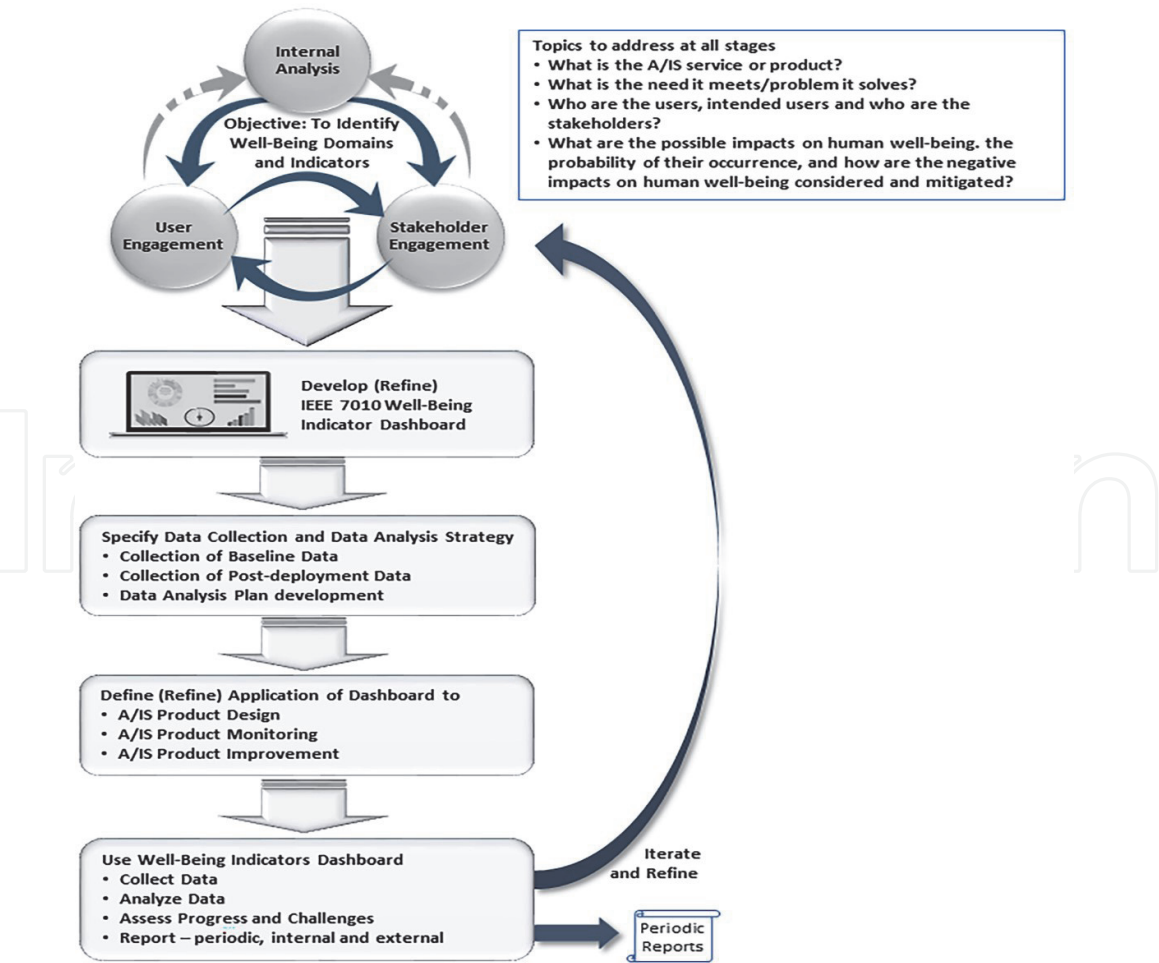
The Well-being Impact Assessment framework can be applied to any process and at any stage or phase in the life cycle of a system, product or service. However, in the case of systems, services and products it is strongly recommended that it be applied right from the beginning or start - at ideation, right through specification, development, testing, implementation, use, management and decommissioning. In this context, the use of the Well-being Impact Assessment Framework may be illustrated as follows:

- At the Governance and Executive Levels the WIA framework helps to initiate discussions by providing knowledge (to initiate, drive and guide discussions) from the information derived from reference databases (e.g. OECD)
- During ideation, the impact assessment process can initiate the requirements discovery and in this way makes contributions to comprehensive innovation management and ideation processes
- During system, product or service requirements elicitation and specification processes, it widens scope and coverage encouraging participation and contributions from all stakeholders
- During development, it opens up for a continuous engagement process between system/product/service creators or developers and all stakeholders. Values and related requirements are continuously reviewed and refined, and used to comprehensively define sprints in development
- During testing the framework is an enabler for collaborative and all-inclusive testing processes
- During live use and operation, the framework further opens up for collaborative and all inclusive system/product/service improvement processes. It strengthens and puts transparency into failure management processes
- At the decommissioning or retirement phase, the framework opens up for detailed engagements on user(all levels) experiences and performance levels achieved

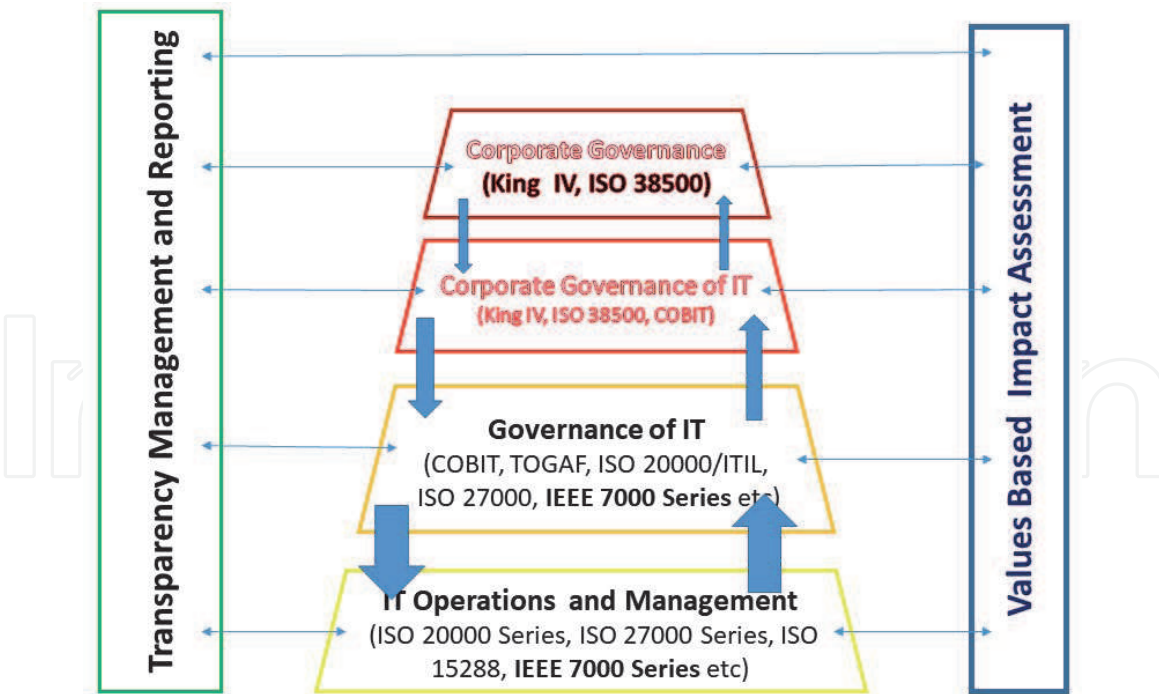
- from all of the above, the values reference databases are continuously updated with information which is used to continuously drive innovative thinking in building and improving products, systems and services.

Whilst currently there is no data to support the results of this framework, the theories and features the framework promotes among which are cultures of continuous engagement and collaboration between stakeholders at all levels (legislators, policy makers, business executives, subject matter experts, creators of systems, products and services) point to increased coverage and levels of activity in the ethical values based (EVB) creation, use and management of IT systems, products and services. All these put a lot of pressure on requirements for innovative thinking. The traditional IT Governance framework has tended to evolve mainly from discoveries at the operational and lower levels, and never sounded loud enough in advocating for values. The framework outlined above gives the push at all and from all levels - again putting pressure on a requirement for more innovative thinking at all levels.

An example reference framework is IEEE 7010–2020 Recommended Practice for Assessing the Impact of Autonomous and Intelligent Systems on Human Well-being [6]. It is illustrated in **Figure 3**. **Figure 4** illustrates how it would interface with Corporate Governance and its supporting and implementation Frameworks.



**Figure 3.**  
*The IEEE 7010-2020 well-being impact assessment framework (adapted and reprinted with permission from IEEE. Copyright IEEE 2020. All rights reserved).*



**Figure 4.**  
Illustration of how impact assessment driven values based design can be implemented through the IT corporate governance framework.

### 3.3 Potential challenges with incorporating values/ethics into IT systems, products and services

The following are some of the challenges that can be encountered when working with values

- People rarely express their values directly
- People rarely speak directly about their emotions. They illustrate their emotions through stories or speech patterns
- Values seem to be tacit knowledge – they are recognised when they are encountered. Therefore trying to articulate them before hand is difficult
- Values can be interpreted as a set of issues/value clusters e.g. consequences of automation, conflicts between stakeholders

Dealing with the above challenges requires a lot of effort coupled with creativity

## 4. Important observations

### 4.1 Values are a stimulus to thinking and therefore tend to motivate

Today and the future are about value creation. There is focus on what values a system or product brings into a setting or organisation.



#### **4.2 Organisations which practice and value ethics continuously work to rediscover themselves so as to maintain their reputation as an organisation, and the reputation and quality of the organisation and services and products**

This calls for innovative thinking at all levels in the organisation – from strategy to policy making, policy implementation, operations and service delivery.

#### **4.3 Practicing ethics in an organisation requires people from different backgrounds and with different ways of thinking to work together to achieve the same goals**

There is a need for all involved to continuously think and come up with ideas on how to strike the balance from different views and come up with concepts which bring positive values to the organisation and both its direct and indirect stakeholders. This requires innovative minds from all in the organisation – from the strategists to the frontline workers [4, 7].

#### **4.4 An organisation known by its clients and stakeholders stands a very high chance of getting honest and valuable feedback on its service delivery levels from those clients and stakeholders**

This opens up the organisation and its systems to continuous improvement and enhancements which require innovative minds.

#### **4.5 Organisations design and implement processes and procedures to facilitate implementation of their mandate and delivery of their services**

In fact an organisation's ideas and values are reflected in the way these processes and procedures are delivered. With innovative minds required to continuously rediscover the organisation through review of values in response to the environment, innovation is required to review and redesign the processes which support the ideas and values – striking the balance whenever this is required.

#### **4.6 At the heart of process implementation, and services and products the processes produce are IT and related services and products**

As an organisation continuously strives to rediscover itself to achieve excellence through implementation of its values, so should the organisation's support systems such as IT.

Incorporating values into systems / products/services can affect how teams for systems / product development are assembled and equipped, and how processes to deliver those systems/ products are structured. The following are example value concepts identified for a system/product and how incorporating them would affect the Requirements Engineering Process of producing the system/product

- Value Name/ID: Aesthetics e.g. Beauty, Presentation Potential source(s): Reaction to user interface of a product or system Implications on Requirements Engineering: Team member composition e.g. ensure you have UI designers.
- Value Name/ID: Security e.g. Safety, Privacy Potential source(s): Data Privacy laws, Data management policies Implications on Requirements Engineering



Processes: The process must include a threat analysis activity and must have cyber security experts as part of the project team.

#### **4.7 The significance of value based systems engineering processes (described in paragraph 3)**

The processes are designed to consider values, motivations and emotions. With emotions defined as responses to events, objects and artefacts, negative emotions (from stakeholders) can hinder system acceptance and use. Systems and software development have the ability to change working circumstances and in this way have an emotional effect on some stakeholders [4]. Therefore in order to succeed, systems, products and services are required to observe stakeholder values. For example if a system/product/service changes the power balance, it is important to:

- Consider political and social issues
- Consider stakeholders' potential emotional reactions to system change. These can be a major source of conflict hence system rejection and conflict e.g. stakeholder values of ownership and control
- Consider personal beliefs
- Consider conflicts between stakeholders' values and motivations and solutions proposed by requirements analysts
- Elicit stakeholders' attitudes to potential systems recognizing that:
  - Systems support decision making (Autonomous and Semi-Autonomous)
  - Systems and technology can change power balances in that they can take away or reassign responsibilities in a way which can strip or add powers to role players

All of the above will thrive in an environment where there is continuous engagement and innovative sharing and implementation of ideas from all stakeholders – including service/product consumers or customers.

#### **4.8 Values considerations and Agile**

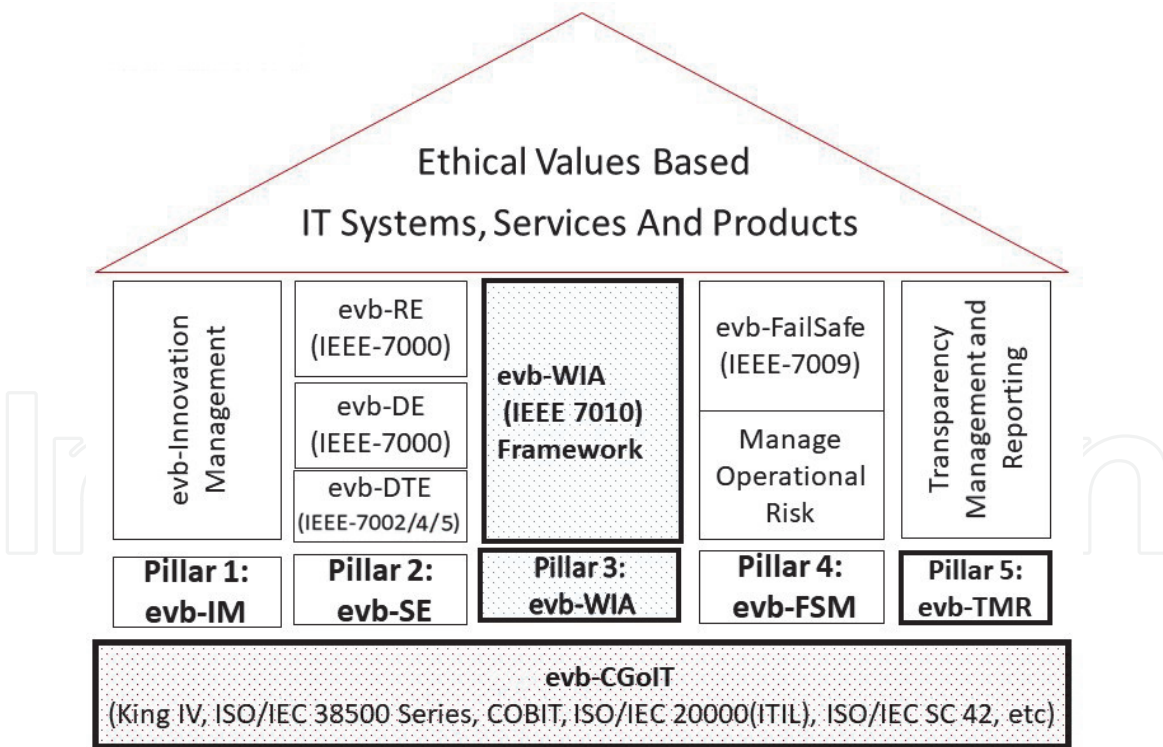
It is believed that Agile was born out of a desire to create value. Where values come to play, there is agility and innovation. Responsive organisations are agile.

### **5. Recommendations**

For a total sum, relevant organisational policy and policy implementation models and frameworks will need some form of integration or interface so that there can be an organisation-wide integrated response to the call to consider and incorporate values in the organisation's brand. Implementation of a suitable Corporate Governance Framework such as the one illustrated in **Figure 4** of which IT is a direct component is important and would be the key driver of this integrated response. This can drive and makes it possible for an organisation which adopts and implements such or similar framework to experience innovation resulting from the

introduction or incorporation of values across its operational/business units and systems. Such a governance framework will guide implementation of operational frameworks such as Ethical Values Elicitation, Ethical Requirements Elicitation and Ethical Risk Based Design as discussed in paragraph 3, and a suitable Failure Safety Management Programme. In **Figure 5**, is an illustration of a proposed integrated framework showing the pillars for ethical values based IT systems, products and services and how all the frameworks discussed earlier work together to drive and support innovation to achieve the desired goals. It is designed to be adaptable and will target to consist of the following at a minimum:

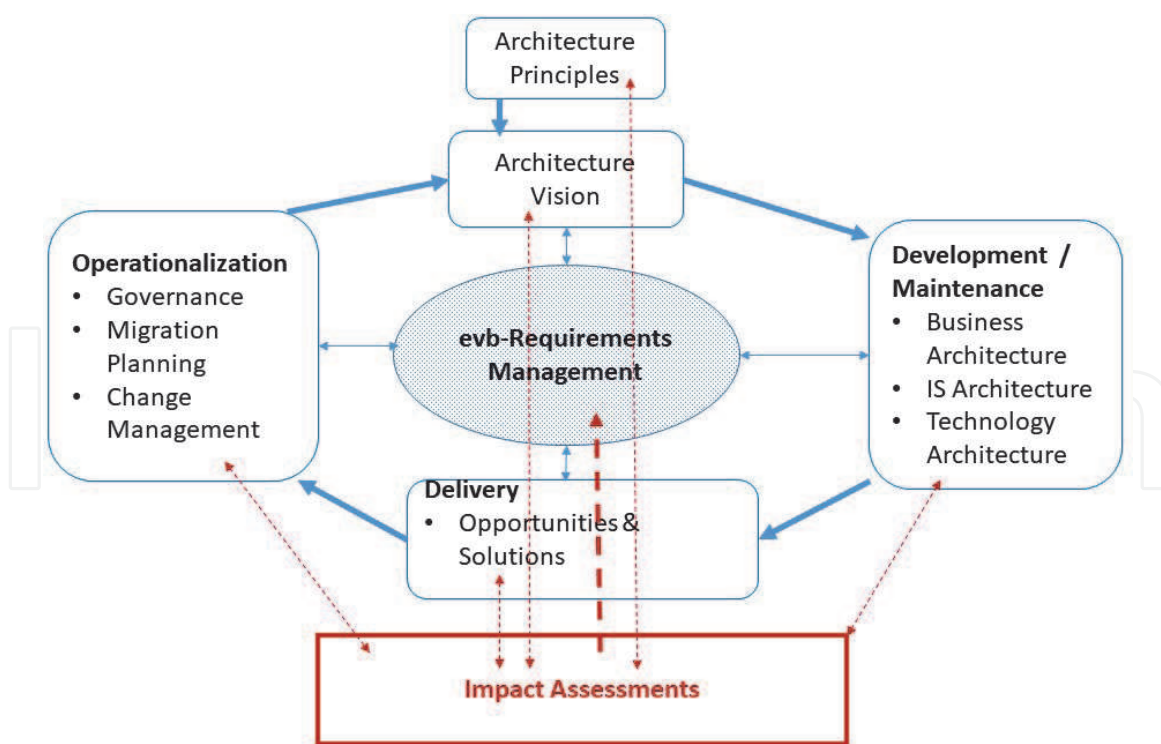
- A values-based Corporate and IT Governance Framework
- A values-based Innovation Management Framework [8]
- A values-based Solutions Delivery Framework
- A values-based Well-being Impact Assessment or Monitoring Framework: This is an enabler of continuous review, learning and improvement of systems, products and services [6, 9]
- A values-based Operational Risk
- A values-based Failure Safety Management Framework.



**Figure 5.**  
*The pillars of innovative ethical values based IT systems, products and services.*

The position of the Impact Assessment Framework pillar is indicative of its central role as a monitor and assessor of the performance of the other frameworks and also as the key driver of continuous learning, innovation and improvement of systems, products and services.

**Figure 6** is an illustration of how Impact assessment and values based design could be applied to TOGAF 9.



**Figure 6.**  
 Illustration of how impact assessment and values based design can be applied to TOGAF.

## 6. Conclusion

1. Ethics Considerations drive innovative thinking in building systems which are responsive to the needs of the user and promote adoption, and safe use of IT. It is when our most deeply held values such as safety, security, transparency, accountability, well-being are at stake that ingenious new solutions are needed most. It is therefore right to conclude that ethics are a driver of innovation and a source of competitive advantage.
2. Ethical considerations and shared moral values can be used to shape the world of tomorrow and should be construed as stimulus and opportunities for innovation, and not impediments and barriers.
3. Stakeholders' VME(values, motivations and emotions) can have significant impact on the outcome of a project. Innovative thinking is required to maximise positive impacts and minimise or even eliminate the negative(s)
4. It is useful to understand and have awareness of values and emotions as a guide and managing tool to the requirements analysis and elicitation processes when building systems and IT products.
5. Value Analysis may alert the analyst to potential stakeholder conflicts, when negotiations are needed to reach a common set of values. E.g. System configurations / customizations may need to be considered or when different levels of security controls mapped to stakeholders who regard security as very or not important. Balancing the act to make everyone happy requires innovative thinking.

## Conflict of interest

The author declares no conflict of interest.

Nomenclature

CGoIT	Corporate Governance of IT
GoIT	Governance of IT
evb	Ethical Values Based
VME	Valiues Motivations Emotions
evb-CGoIT	Ethical Values Based Corporate Governance of IT
evb-FSM	Ethical Values Based Failure Safety Management
evb-IM	Ethical values Based Innovation Management
evb-DE	Ethical Values Based Design
evb-DTE	Ethical Values Based Data Engineering
evb-SE	Ethical Values Based Systems Engineering
evb-WIA	Ethical Values Based Well-being Impact Assessment
VBRE	Values Based Requirements Engineering
4IR	Fourth Industrial Revolution

Abbreviations

CGoIT	Corporate Governance of IT
GoIT	Governance of IT
evb	Ethical Values Based
VME	Valiues Motivations Emotions
evb-CGoIT	Ethical Values Based Corporate Governance of IT
evb-FSM	Ethical Values Based Failure Safety Management
evb-IM	Ethical values Based Innovation Management
evb-DE	Ethical Values Based Design
evb-DTE	Ethical Values Based Data Engineering
evb-SE	Ethical Values Based Systems Engineering
evb-WIA	Ethical Values Based Well-being Impact Assessment
VBRE	Values Based Requirements Engineering
4IR	Fourth Industrial Revolution

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