Work Level Related Human Factors for Enterprise Architecture as Organisational Strategy

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***Abstract*—Enterprise architecture (EA) is an organisational strategy increasingly used to describe the integration of business and information management in complex enterprises. Organisations can prevent human–related problems and promote acceptance of new organisational strategies, such as EA, if they know what behaviour to expect from stakeholders and why people act and react in a certain way. People react differently to strategic initiatives, such as the introduction of EA, depending on their work level and how a new initiative such as EA may impact them. Through identification of work level related human factors known to impact on introduction and use of EA as strategy, organisations can ensure that the implementation and execution of EA succeed. The acceptance of technology and the socio-technical issues affecting the acceptance of new strategies in organisations have been researched for many years. Work level related human factors impacting EA acceptance have, however, not explicitly been described in past research. In this paper, research towards identifying the human factors that impact on the acceptance of EA as strategy is described. The contribution of this paper is an extensive list of work level related human factors that organisations can use to identify and address human factors that impact on or hinder the acceptance of EA as organisational strategy.**

Keywords—human factors, work levels, enterprise architecture, adoption, acceptance, strategy

I. INTRODUCTION

The focus of this paper is on individual human factors that impact on the implementation of new strategies, such as enterprise architecture (EA) used for integration of business, information management (IM) and information technology (IT), within the context of a socio-technical organisational / enterprise environment. For the purposes of this paper, an *enterprise* is defined as a system of systems consisting of interrelated, interacting entities (organisations) and processes, operating in a socio-technical defined environment with the purpose of achieving common goals [1-4]. The business of an enterprise is contained within its declaration of existence and operation.

Humans are not only responsible for management of business and information exchange operations of enterprises, but modern enterprises are perceived as human-driven. Employee involvement is therefore considered to be conditional for enterprise success [5]. The emphasis in modern organisations is very much on the work roles of people in context of the 'business' purpose and goals of the enterprise. Humans in their work roles fit into various work levels in organisations. The internal organisation of an enterprise creates the behavioural context in which employees operate [6].

New strategies are continually adopted and implemented to assist in sustaining and improving successful 'business' initiatives. People are the key drivers of successful enterprises [3] and responsible for adopting new strategies. Therefore it is essential to understand human motives and issues when new strategies are implemented.

Modern complex enterprises need to align business services, IM and IT to be successful and competitive. In a constantly dynamic and changing business environment agile adaptation is needed to be able to reach business goals and manage change effectively [7]. For enterprises to maintain a competitive advantage, sustain their business initiative, and improve their business, it is necessary for humans (employees) to understand the integration process of its business, IM and IT aspects.

EA is an organisational support strategy increasingly used to describe the integration of business, IM and IT in complex enterprises. EA provides organisations with tangible, descriptive artefacts that enable them to understand their complexity and

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assist them with the management of change [8-10]. The adoption of EA as organisational strategy is often motivated by the complexity of organisational business activities, technology support and information needs in a constantly changing and competitive environment. But EA's adoption as a strategy does not come without its problems.

The research described in this paper contributes insight into why the adoption of EA as organisational strategy might be challenged from a human factors' perspective. A study to identify and classify work level related human factors affecting the acceptance of EA as organisational strategy is described. The contribution of this paper is an extensive list of work level related human factors that organisations can use to identify and address human factors that impact on or hinder the acceptance of EA as organisational strategy. To our knowledge, no earlier work exists that explicitly describes the effect of work level related human factors on the acceptance of EA as organisational strategy.

Section II of the paper provides the background to the research by defining the concepts of an enterprise and enterprise architecture as used in this paper. It also explains the difference between the concepts of adoption and acceptance used in the paper. Section III briefly describes the research method followed to determine the list of human factors. Each of the steps followed in the research is described in more detail in sections IV to VII. Section VIII discusses the overall findings and section IX concludes the paper.

II. BACKGROUND

A. The Concept of an Enterprise

The terms 'enterprise' and 'organisation' are often used interchangeably in literature to describe the socio-technical systems of humans, procedures, processes, information and technology, all working together towards the achievement of common goals. In this paper the terms are related, but describe distinguishable entities.

An *organisation* is defined as a discrete, concrete, open and dynamic entity/system with its own environment and properties [11, 12]. As such, an organisation is a "self-contained unit of resources with line management responsibility, goals, objectives and measures" [4:33] that may include external parties and business partners. Resources may include people, processes, information and technology.

An *enterprise* is defined as a system of systems consisting of interrelated, interacting entities (organisations) and processes, operating in a socio-technical defined environment with the purpose of achieving common goals [1-4] and/or a single bottom line [13]. Enterprises can be simple or complex networks of joined entities (organisations), making use of available resources and having objectives of success and gaining a competitive advantage in the context of their business [14]. An enterprise is therefore a diverse human-driven entity where people (stakeholders and employees), who are the knowledge (information) owners, work towards common organisational goals and have the ability to handle complexity and volumes of information [4, 15, 16]. Humans and business processes, with the support of technology, generate masses of organisational information that is used to assist in business operations and decision-making processes [17].

B. Enterprise Architecture

Although the concept of EA has been used since the 1980's, there is still no agreement on what EA is and what its impact on organisations is, once introduced [18-21]. Even though there is no consensus on what EA is, two major themes can be identified, namely that of EA as an artefact (product) and that of EA as a process [13].

The purpose of an EA as *artefact* is to provide a strategic top-down/holistic view of an organisation to enable executives, business managers, architects, engineers and technicians to coherently coordinate, integrate and conduct their activities [4, 13, 22]. Since an enterprise can span multiple organisations, an EA may likewise span several organisations and indicate how these organisations interrelate.

Considered in many spheres as the earliest published work on EA, the 1987 article by John Zachman [23] on a framework for information systems architecture, and its later versions of The Zachman Framework for Enterprise Architecture [22], is an example of EA as an *artefact*. Zachman [10] defined EA as the "total set of descriptive representations, artefacts or models relevant for describing the knowledge infrastructure of an enterprise". In this context EA is a 'thing' that enables the enterprise to do something. Although The Zachman Framework for Enterprise Architecture [22] does not provide prescribed methods and processes, Zachman [24] hints at EA supporting other processes by stating that EA *focus on engineering the enterprise and facilitating culture change*.

EA as a *process* perspective focuses on EA as the recurring methodology of describing the 'as is' and 'to be' states of an enterprise and all developments, interventions and processes to take you from the one state to the next [4, 25]. In this context the active nature of EA is focused on the creation of artefacts such as models, viewpoints, processes and tools [13].

As example, The Open Group Architecture Framework (TOGAF) [4] portrays (enterprise) architecture as a description (artefact) of the structural organisation of the enterprise, including the components of the organisation and their inter-relationships, and the principles and guidelines governing their design and evolution over time. In addition it proposes the Architecture Development Method (ADM) as a means (process) to create an EA.

There is, however, a third view on EA, and that is of using EA as an organisational *strategy* for business execution. It combines the artefact and process views of EA. A strategy is the "framework of choices that determine the nature and direction" of an organisation [26:51]. To effectively address organisation

structure, the organisation's strategy and the business processes that support that strategy must be examined. A strategy cannot be formatted or implemented without leadership. Organisational culture cannot be changed without developing human capabilities. According to Brache [26], the key to successful change is the identification and integration of all these relevant variables. EA is therefore also progressively seen as a strategic tool for enterprise governance [27].

As an example, Ross et al. [3] see EA as the coordinating logic for business processes and IT infrastructure, manifesting the integration and standardisation requirements of the organisation's operating model. The operating model refers to the business process integration and standardisation for the delivery of the organisation's products (goods and/or services) to customers. In this context EA provides a long-term view of the organisation's processes, systems, information, technologies, and customer interfaces, to enable individual projects to build capabilities matching the strategic objectives and vision of the organisation, and not just fulfil immediate needs.

The strategic relevance of EA, and specifically EA management, is also highlighted by Radeke [28], who suggests that its application throughout the strategic change process adds to an organisation's strategic change capability. The dynamic enterprise of today needs to adapt to new ways of strategy planning and implementation, for example, through flexible organisational infrastructures, effective alignment of strategic planning and decisions with organisational infrastructure, and continuous coordination of strategic business plans with IT infrastructure. EA can assist organisations in achieving these goals.

C. Adoption versus Acceptance

The concepts of 'adoption' and 'acceptance' are often used interchangeably in literature and industry to describe the decision to use, or introduction and actual use of, new technologies or strategies by organisations. In our research a distinction is made between adoption and acceptance of a new organisational support strategy, such as EA. *Adoption* refers to the process of decision to use new technology or strategy and the follow-up actions of planning, acquiring and implementation of such technology or strategy in organisations. *Acceptance* refers specifically to human acceptance of technology and strategies in organisations [29]. Acceptance is related to receptiveness and described as the intention to use [30, 31]. Acceptance is concerned with human traits such as awareness, attitude, intention, motivation, approval, taking responsibility and more.

As argued above, EA has overall organisational impact. EA adoption is motivated by the complexity of organisational business activities, technology support and information needs in a constantly changing and competitive environment. However, in many instances, EA was, and still is, conceptualized and misunderstood as relevant only to an enterprise's information systems and its IT. Consequently the need for EA is often expressed by information managers and technologists, and EA adoption is often driven by IT or engineering work levels in an organisation. The premise in this paper is that the adoption of EA resides with top management, and that the acceptance of EA as an organisational strategy filters down through the various work levels and roles after EA has been adopted as an organisational strategy.

III. Research Method

The goal of the research presented in this paper was to determine the effect of work level related human factors on the acceptance of EA as strategy in an organisation. The research contributes insight into why the adoption of EA as strategy might be challenged in organisations. The work level related human factors were determined by means of:

- *An in-depth literature review*: A study of literature on acceptance models and theories and their possible impact on the acceptance of EA as strategy and a study to identify human factors particularly related to EA.
- *An exploratory enterprise study*: Executed in a single complex enterprise to identify the human factors impacting on the acceptance of EA as strategy in that enterprise. Semi-structured interviews and a focus group were used as data collection methods.
- *Compiling an extensive classified list of human factors*: Using thematic analysis, the results of the literature review and the enterprise study were analysed and integrated, and an extensive list of human factors, mapped to work levels, affecting the acceptance of EA as strategy in a complex enterprise was compiled.
- *A verification study*: A study in different enterprises to that of the first enterprise study. Data collected via a questionnaire were analysed using frequency analysis to determine the validity of a specific human factor.

Sections IV to VII present the outcome of each of these activities.

IV. Determining Human Factors from Existing Research

Over the years, researchers and practitioners from many different disciplines have agreed that complexity in organisations resides in the interaction of people, resources, systems, processes, culture and finance [3, 5, 12, 32-34]. In the sections to follow, the theories and models identified during the literature review as of importance to the human-technology relationship in a socio-technical environment, such as an enterprise, are briefly analysed, and their relationship to, or possible impact on EA, highlighted.

A. Review of Theories and Acceptance Models

Although EA is primarily considered as strategy in this paper, as opposed to primarily being a technology, EA's close relationship with the 'business', information and technology of

an organisation calls for revision of relevant technology acceptance models and theories.

1) Structuration Theory and Actor-Network Theory

It is postulated that the way in which non-technical human issues and change are managed in organisations are problematic, and are responsible for waste of time, money and effort in complex enterprises [34-40].

Two theories identified from the literature that specifically has to do with human action and interactions in a socio-technical environment were identified and are briefly discussed. These theories are actor-network theory (ANT) [41, 42] and structuration theory (ST) [43, 44]. Critical analysis of the human factors referenced by these theories showed similarities to the issues and factors identified in the enterprise study and literature on EA.

Structuration theory (ST) and adaptive structuration theory (AST) describe how humans as stakeholders in institutional contexts generate social constructs and change through everyday human action and human interaction [43, 45-47]. ST was analysed in the study for its relevance on human action and interaction in the structure of an enterprise. Table I (first column) lists the identified ST elements, extracted from Giddens [43], and mapped to their implications for the acceptance of EA as strategy (second column).

TABLE I. STRUCTURATION THEORY ELEMENTS AND THEIR IMPLICATION FOR EA ACCEPTANCE

Structuration Theory Elements	Implication for Acceptance of EA as strategy
Humans are able to describe the why, what and how of their actions	Stakeholders of EA are knowledgeable about their vocations and should therefore accept EA to contribute to its successful implementation
Human knowledge about their actions is restricted by their perceptions of their actions (bounded by unconsciousness about actions, unacknowledged conditions or unintended consequences of their actions)	Human action is not controllable but change which inevitable happens and may be the cause of resistance and anxiety can be minimized if EA is accepted and maintained
Human descriptions of their actions are reproductions of events and should be understood in the context of social- and system integration	There is a definite link between social structure in context and roles of humans/stakeholders
Most everyday human actions are routine and not specifically motivated	Human action and interaction are dynamic and therefore stakeholders in an enterprise can benefit from research on social issues to adapt their action
Human interaction is time-space bound and affected by human identities, roles and communication in its different forms (words, gestures, body-language, etc.)	Context (organisational, environmental and social) will always have a direct influence on EA acceptance and implementation
Structures, principles, power, knowledge, skills, rights, obligations, behaviour and sanctions are all elements associated with human action and interaction within a social system	Every enterprise has a different context and character defined for example by its resources, social structure, norms, power relations, mission and vision, to name but a few, and of which all are human-driven.

TABLE II. HUMAN FACTORS IDENTIFIED FROM ACCEPTANCE MODELS AND THEORIES

References to Acceptance Models and Theories	Human Factors Identified from Acceptance Models and Theories
Theory of Reasoned Action (TRA) [48]	Attitude Subjective norm
Technology Acceptance Model (TAM), TAM2 and TAM3 [48-50]	Behavioural intent Subjective norm
Extension of TAM [51]	User involvement and participation IS professionalism Subjective norm Management and user support Training
Motivational Model (MM) [48]	Extrinsic motivational factors Intrinsic motivational factors
Theory of Planned Behaviour (TPB) [52, 53]	Intention of behaviour Attitude Perceived behavioural control Implementation Intention Commitment Conscientiousness
Model of PC Utilization (MPCU) [48]	Long-term benefit Affectivity Social behaviour
Innovation Diffusion Theory (IDT) [48]	Relative advantage Manifestation of results
Social Cognitive Theory (SCT) [48]	Performance and personal expectations of outcome in the working environment Self-efficacy Affect Anxiety
Unified Theory of Acceptance and Use of Technology (UTAUT) [48]	User intention factors: Performance expectancy Effort expectancy Social influence Facilitating conditions impact on use behaviour
Social Actor Model [54, 55]	Identity of humans Interaction Affiliation with usage Environment of use
Actor Network Theory (ANT) [41, 56, 57]	Human use of information Human fit in organisations Tacit human knowledge and distribution Culture Politics Moral issues
Structuration Theory (ST) [43, 44, 58]	Structure: organisational, domination, legitimation Interaction: communication, power, sanction Responsibility for own actions Trust Interaction

The elements of ST that were found to relate to the human actions and interactions affecting EA acceptance, were identified during the interviews (see section V) and literature review of acceptance models. These human factors from ST that could play a role in the acceptance of EA are listed in Table II (with those identified from acceptance models).

Actor-network theory (ANT), originally described by Callon [56] and Latour [59], depicts and highlights how any society is

continuously changing as a result of action, collective action and interaction of its components or 'actors' (human, non-human or a combination of both).

The nature of EA involves a structured and explicit description of the enterprise and humans are responsible for the adoption, acceptance and establishment of EA. ANT was used as a reference theory to extract human elements or factors that could be related to EA acceptance. The human factors identified from ANT that could play a role in the acceptance of EA, is listed in Table II (with those identified from acceptance models).

2) Acceptance Models

Technology acceptance is cardinal to modern organisations due to their reliance on technology as support system. There is, however, strong evidence that human acceptance of technology is no longer a primary obstacle in the business and technology divide [34-40]. Although acceptance of technology is no longer a cardinal issue in organisations, the human factors identified in technology acceptance studies are still relevant in other contexts. The factors related to technology acceptance were therefore reviewed, compared to human factors identified in the enterprise study in section V and included in the list of human factors related to EA acceptance, where applicable. The human factors identified in existing technology acceptance models as playing a role in human acceptance of EA are listed in Table II.

B. Human Factors Particularly Related to EA

1) The Zachman Framework for Enterprise Architecture

Existing EA frameworks were reviewed to identify work level related human factors that could impact on EA adoption and acceptance. The Zachman Framework for Enterprise Architecture, TOGAF and the Generalized Enterprise Reference Architecture and Methodology (GERAM) are, for example, three of the popular EA frameworks used worldwide, also in the South African EA context [7, 60-62].

According to Zachman [9, 22, 24, 63], The Zachman Framework for Enterprise Architecture provides an enterprise with a detailed description necessary to understand its own composition and complexity and to facilitate culture change. The Framework is a logical normalised structure that proposes a set of descriptions or models to help 'engineer' an enterprise. The Framework is presented by a matrix where abstraction names represent an enterprise's work focus and audience perspectives represent the work level actions of stakeholders (see Table III).

TABLE III. THE ZACHMAN FRAMEWORK FOR ENTERPRISE ARCHITECTURE ABSTRACTIONS AND AUDIENCE PERSPECTIVES

Abstractions	Audience Perspectives
What - inventory sets	Executive – business scope contexts
How – process flows	Business management – business concepts
Where – distribution networks	Architect – business logic designers
Who – responsibility assignments	Engineer – business technology builders
When – timing cycles	Technician – business component implementers
Why – motivation intentions	Enterprise - users

It was the only EA framework found to link the architecture audience perspectives to various work level actions.Therefore, The Zachman Framework for Enterprise Architecture [22] was used as a source of reference to identify the work levels in organisations relevant to EA. Furthermore, no EA framework explicitly discusses human factors affecting EA acceptance, but Zachman [64] describes the importance of human roles, responsibilities and actions in enterprises. These descriptions and observations by Zachman were used to abstract human factors relevant to EA, as presented in Table IV.

TABLE IV. HUMAN FACTORS ABSTRACTED FROM THE ZACHMAN FRAMEWORK FOR EA

Zachman Statements	Human Factors Abstracted From Zachman Statements
People have to state their definition of 'enterprise'	Use a simple and commonly understood business and EA language
Describe reason for EA	Communicate and understand the reason for using EA to describe business, IM and IT process integration
Adopt a consistent EA language	Stakeholders should use and understand EA concepts and EA language
Define the enterprise change process (engineering)	Management and stakeholders should share and understand the 'as-is' and 'to-be' roadmap of the organisation
State the purpose for EA ('as-is' and 'to-be')	Communicate the EA benefits of business, IM and IT integration for specific purposes and needs such as addressing user and stakeholder requirements, managing change and organisational growth Management and stakeholders should share and understand the 'as-is' and 'to-be' roadmap of the organisation Understand and share the long-term vision associated with EA
Resistance-management problems	Lack of vision, understanding, communication, risk taking, time, and resistance management Understanding user and stakeholder concerns Continuous sharing of the perceived and real value of EA Share positive and negative results Human interaction is needed in EA initiatives across different work levels
Commitment to EA and change	Management should facilitate and manage transformation and cultural change after adoption of EA as an organisational strategy Support for EA should be organisation-wide Early identification of possible human-related risks and human acceptance of EA as an organisational support strategy Acknowledge and utilise cultural differences when called for in EA initiatives
Perseverance	Show perseverance with projects and processes when organisational change happens and accept that change will continuously happen
Being facilitators and not directors	Enterprise architects should act as facilitators of EA EA team members should provide for EA guidance and not only concentrate on EA governance The need and importance of good interaction should be understood by all managers, architects, stakeholders and users Acknowledge and allow stakeholders'- and users' initiatives in support of EA
Establish an enterprise	Managers should take responsibility and ownership of

change process	EA EA users and stakeholders should take responsibility for EA tasks, processes and projects Allow for flexibility in processes and projects
Culture change	Personal, group and organisational dynamics are needed in EA initiatives
Shared vision	Management and stakeholders should share and understand the 'as-is' and 'to-be' roadmap of the organisation Stakeholders and users should agree to follow standardise EA procedures
Admit there is a problem and share problems	Provide feedback on EA tasks and report on EA results Share information across different work levels
Set realistic expectations	Managers, stakeholders and users should have realistic expectations of EA and allow for long-term EA benefits
Prove the concept	EA engagement is needed by all EA stakeholders Stakeholders and users should be able to identify reusable information
Use symptomatic solutions to buy time	Share EA motives and small EA victories
Decide on the analytical target	Understand the long-term vision EA analytical skills have to be implemented practically
Understand the implications of EA	Understand the 'as-is' – 'to-be' roadmap of the organisation Demonstrate compliance with 'EA-way' of work EA engagement is needed by stakeholders
Accurately reflecting your intent	Management and stakeholders should share EA motives Stakeholders should share knowledge and information about EA Stakeholders should allow for information retention and preservation
Accept ownership of EA	Managers should take responsibility and ownership of EA Stakeholders and users should understand the importance of their work roles in EA initiatives such as modelling, standardisation and optimisation of EA processes
Assess, adopt and adjust	Stakeholders should commit to continuous validity checking of EA guidelines EA stakeholders should be open-minded and participate, coordinate and cooperate when EA initiatives need to be adjusted
Ensure that enterprise acquires skills, capabilities and tools	Stakeholders should be prepared to accept and provide EA and work-related skills training Management should accept ownership of EA and provide for tools and training Accepting EA is the responsibility of management and all other stakeholders
Measure the process not the people	Humans should have trust in self, co-workers and management
Compromise	Human input in EA initiatives should be acknowledged Humans are responsible for the coordination of EA processes Good social relationships, interpersonal networking and human cooperation expedite EA acceptance

2) Other Human Factors Applicable to Enterprise Architecture

The literature review also unveiled human factors relevant to EA as identified in other studies or research, and these are presented in the remainder of this section.

Jeyaraj, et al. [65] review and list best predictors of IT innovation adoption classified into individual and organisational predictors. For individual adoption of IT innovations, factors impacting are perceived usefulness, top management support, computer experience, user support and behavioural intention. For organisational adoption, factors identified are top management support, external pressure, professionalism of the IS unit and external information sources.

Ross, et al. [3] list the human factors of discipline, commitment to EA, creativity, senior management's responsibility to accept EA and enforce EA governance, coordination and communication.

Human factors identified from the work of Kwon and Zmud [66] include management's ownership of EA, social interaction, 'as-is' and 'to-be' understanding of EA, communication and EA training, using a common EA and business language, accepting responsibility for EA-related tasks, EA involvement, communication skills, and behavioural factors of motivation, innovation, satisfaction and performance.

Magda [67] lists top-level support, communication, training and education and considering and involvement of target users.

Markus et al. [68, 69] list communication, ownership of KPI's, stakeholder politics, challenging of untested assumptions, lack of long-term support, gaps in knowledge and skills, acceptance of the need to change and flexibility.

Other human factors identified to be related to EA include self-examination [36], attitude [70], organisational culture and discipline [34, 71, 72], communication [73] and behavioural dimension [74].

V. Human Factors Identified through Enterprise Exploratory Study

In addition to the results from the literature review, an exploratory study of the human factors impacting on EA acceptance was performed in a single complex enterprise. The enterprise consists of several organisations. The aim of the enterprise study was twofold: first to investigate the organisational setting in which EA was adopted as strategy and, second, to identify the human factors that impact on the acceptance of EA as strategy. It focused on how people reacted to EA being adopted as strategy in their organisation and the reasons for their actions.

A. Research Method

The enterprise selected for the study was a global, complex, manufacturing enterprise consisting of several organisational units. The enterprise was selected because of its involvement in change management, including alignment of business and IM strategy over the last decade.

Semi-structured interviews and a focus group interview were conducted to gather qualitative data. Individual semi-structured

interviews (five participants) and a semi-structured focus group interview (four participants) were conducted at three different organisations forming part of this complex enterprise. One organisation was perceived by employees as 'centralised' and the two others as 'decentralised'.

In all interviews and the focus group discussion, participants gave background information of how business and IT related processes were initialised in their perspective work divisions, and why changing into a 'new direction' became inevitable. Using the Zachman Framework for Enterprise Architecture 'Who' abstraction and role descriptions of the perspective work levels, interviews were conducted at the executive leader, architect, engineer and technician levels.

Narratives and answers of participants during interviews were recorded and transcribed, and notes were taken. Interview data analysis was used on these texts and written notes to transform it into evidence-based interpretations forming the foundation for the research. Meaningful words, phrases and segments relevant to the study were identified to locate patterns that could indicate human factors related to EA acceptance. After analysing and assimilating the data, a list of human factors impacting on the acceptance of EA as strategy was compiled.

B. Findings

It was necessary to understand the research context and the meaning that participants attached to EA being adopted as an organisational strategy. With regards to the organisational setting, it was found that EA, as a business and information management strategy, was introduced and adopted at one of several of the decentralised organisations of the enterprise. After an audit on systems and processes more than ten years ago, the need for a new enterprise resource planning (ERP) system focusing on business processes and systems was identified. This was the start of EA being adopted, implemented and accepted as strategy in the enterprise. The original architecture team consisted of employees with an IT or technical background.

From the start of EA implementation, all systems and processes were initialised and based on identified business requirements or user needs. Management approved, adopted EA as a new direction and strategy, and allowed the process team (enterprise architects) and implementers to show how EA could be used to address business and user needs. In a first step, the process team focused their attention on addressing business needs, user needs and solving problems identified by users and stakeholders as urgent and important. Although an EA methodology was implemented and solutions were planned using EA modelling techniques, users and stakeholders were not burdened with technical concepts and terminology. Over time, users, stakeholders and information management technicians were guided in a step-wise process and in simple, understandable and communicable format to cooperate in new ways of information management and reporting (see Fig. 1).

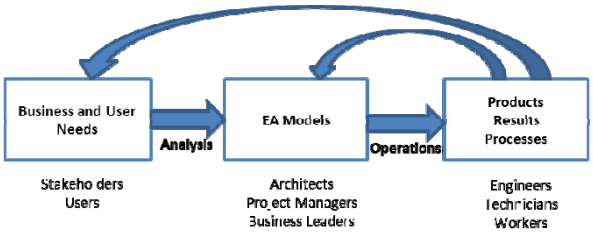

Fig. 1. EA acceptance process

Unfortunately EA was not universally accepted across other organisations of the same enterprise. Some of the responses captured from the success story of EA adoption, implementation and acceptance in one organisation of the enterprise, and some of the responses of the not so successful implementation of EA in another organisation of the same enterprise, are listed below. The human factors identified, and of significance for the research, are provided in brackets.

- Traditionally, IT system development and maintenance were conceptualised as separate from business issues. IT specialists were consulted when business and information problems called for a technology solution. Vendors provided technology solutions, or IT systems were designed and built by local technical teams. Today technology is regarded as an infiltrated core and basis for the business of any organisation. The message is that the broad, complex enterprise cannot function successfully without good integration and alignment of business vision, information management and technology support, with all of it human-driven. [Need for EA acceptance]
- Managers of organisations, sections and departments within the scope of an enterprise have to accept ownership and responsibility for architectural business and information management alignment or EA. [Management taking ownership for EA]
- Enterprises and all its organisations and sub-sections are human-driven. Human acceptance of 'new' directions and technology innovation are prerequisites for business and IT alignment. Acceptance sometimes calls for a 'mind change'. [Open-mindedness]
- Culture and organisational politics influence acceptance of 'new' directions in organisations. [Facilitate and manage transformation and culture change]
- Implementation of EA is a long-term, on-going and engineering process. Commitments often need adjustment and reformation. New ideas need reification. [Understand long-term ROI of EA and share long-term vision; Coordinate diversity and change; Foster engagement into EA; Understand enterprise culture, vision and principles; Establish future architecture vision and principles; Adapt and adjust to EA when needed; Facilitate stakeholder involvement, cooperation and

understanding; Accept input and innovative ideas from stakeholders]

- Good and frequent communication is not negotiable. [Use of a common EA language; Request early and continuous updates; Explain/understand perceived benefits and competitive advantages of EA; Share knowledge with architects; Communication skills – accurate reflection of intentions, information flow, allow decisions to filter through; Share knowledge and skills with stakeholders and provide training; Enable information exchange and preservation; Interaction and social networking]
- Start the EA process where the need for business and IT alignment is high. Address stakeholders' needs. Long-term vision is impaired by urgent problems. [Continuous adaptation (short term) and confirmation of process (long term); Understanding business, IM and IT and stakeholders' and users' concerns; Acknowledge user/stakeholder requirements; Understand balance between needs, quality of work and expenditure on resources]
- Every project or process needs consistent and thorough planning. Use the 'as is', 'to be' approach. Start with what the situation is and why it needs improvement or change. Then describe what the outcome needs to be. The roadmap of how to get the required results is the last step. A business development and implementation model is now followed to convince humans to follow the correct procedures. [Follow as-is and to-be roadmap; Follow standardised procedures; EA guidance rather than governance; Understand EA meta-models]
- The benefit of EA in an organisation should be visible to stakeholders from the instantiation of and throughout the EA process. [Group/organisation affiliation and dynamics]
- Adoption and implementation of EA as a strategy should be a top-down process. To start with implementation of technology systems (a bottom-up process) means turning the clock back. Enterprises have become too complex. [Management adopt EA; Take ownership of EA]
- Enterprise architects should be involved throughout the EA implementation process to set and maintain the focus, guide the process and check validity. [Realistic expectations – continuously share benefits and results of EA; Acknowledge different maturity levels; Mediators; Understand and deal with global issues]

VI. Classifying Human Factors related to Enterprise Architecture Acceptance

The results of the literature review and the exploratory enterprise study were analysed and integrated using thematic analysis, and an extensive list of human factors affecting the acceptance of EA as strategy in a complex enterprise was compiled, as presented in Table V.

However, during the initial interviews of the enterprise study it became evident that the human factors that played a role were influenced by the work levels (or work roles) of the employees of the organisations and that human factors varied for different work levels.

Since The Zachman Framework for Enterprise Architecture [22] is the only framework that explicitly classifies work levels affected by EA, the audience perspectives of The Zachman Framework for Enterprise Architecture were consequently used as a reference classification scheme to classify the list of human factors identified. Based on the work level awareness experienced during the interviews, the human factors identified were mapped to the applicable work levels of executive/manager, architect, analyst/engineer and technician/worker levels.

VII. Verifying the List of Human Factors

The outcome of this work level mapping and overall list of human factors compiled were subjected to a verification study in different enterprises to that of the enterprise exploratory study. The purpose of the verification exercise was to determine whether the human factors affecting the acceptance of EA as strategy, as identified during the literature reviews and exploratory study, are valid in other contexts than that of the exploratory study.

A. Research Design

Questionnaires for the different work level categories were compiled. Each of the identified human factors for each work level, were phrased as a statement relevant to that work level. For example, "standardisation in the business, IM and IT integration processes is currently addressed" (executive/manager), "EA is acknowledged as a business, IM and IT alignment platform" (architects), "the issue of standardisation in the business-IM-IT integration process is addressed" (analysts/engineers), "business, IM and IT should be aligned" (technician/worker), etc. Respondents were asked to rate each factor as to whether they are of the opinion that it applies to the work level they belong to. The options to select from were 'strongly disagree', 'disagree', 'agree', and 'strongly agree'. Blank answers were also recorded.

Purposive and snowball sampling was used. The questionnaire was published on-line and a link to the questionnaire was distributed via e-mail to six pre-identified participants from different enterprises. The six participants were asked to distribute the link to the questionnaire to people working in an EA related environment. Twenty-nine responses representing different contexts and work levels were received. Respondents represented organisations from the different contexts of banking, manufacturing and different government and semi-government sections such as national safety, revenue services and national administration services. All the enterprises

represented by the respondents were either using EA as a strategy to address complexity and change or had started implementing EA in sub-organisations of the enterprises.

The responses collected via the questionnaires were analysed using the statistical method of frequency analysis to confirm whether human factors affecting the acceptance of EA as strategy, mapped to different work levels, are valid in other contexts.

B. Findings

Three partially completed questionnaires were discarded and twenty-six full responses were analysed: eleven from executive/manager work level, six from architecture work level, two from analyst/engineering work level and seven from technician/worker work level.

Usually the population should reflect the distribution of the people representative of the different work levels. Workers, technicians, analysts and engineers would normally be a larger group than managers involved in the EA community of an enterprise, and only a few enterprise architects would be involved in the EA adoption and implementation process. More managers than workers, technicians, engineers and analysts completed the questionnaire. The reason for this might have been that EA is perceived by the workers, technicians, engineers and analysts group as a high-level organisational support strategy, and that they themselves are more involved in 'doing the work'. In an interview, one of the participants stated that "technical people find it difficult to relate to business architecture when their main concern is solutions architecture. Their 'business' is to plan, build and run implementations*"*.

Using the outcome of the frequency analysis, the list of human factors and associated work levels compiled were confirmed by the data collected from the questionnaires in the verification study. Table V presents the integrated and verified results of the complete study. The first column identifies the relevant human factor, and the second to fifth column the source of the relevant human factor. The relevant work levels that a human factor applies to are presented in the last column. The four different work levels are numbered as: (1) executive/manager, (2) architect, (3) analyst/engineer and (4) technician/worker.

VIII. DISCUSSION

Apart from the list of individual human factors identified during the study, some significant overall issues related to the acceptance of EA as strategy were identified in the research. These issues include:

- The *need for EA as strategy* was clear and stated by all respondents from all work levels.
- The term 'enterprise architecture' was not universally used and the *concept of EA was not universally understood and accepted*.
- Participants from all other work levels agreed that *managers of business units should not only take ownership of business projects but also responsibility for EA*. They should also share more information on managerial decisions, victories and successes and not only on motives, drives and problems.
- Certain *characteristics (human factors) are required by managers and engineers/workers* to make sure that IT needs are communicated, understood and addressed. Because of the complex nature of an enterprise, EA as strategy is often only introduced in one section or organisation. Since the work culture differ across organisations, work roles and work levels in organisations, problems may arise along the way. For example, IM and IT people are problem-solving-using-technology oriented, and want to produce fast, efficient answers. EA as strategy is however an on-going, engineering process. Therefore complexity in enterprises calls for paradigm shifts and patience when EA is adopted as a strategy to address IT, IM and business integration. Stakeholders and users should be able to see and understand how IT solutions fit into the bigger EA picture.
- *Enterprise architects are the mediators* between business management and IM when EA is introduced as organisational strategy. The message of complexity and the need for preserving information, to ensure effective IM and IT support for business initiatives, should be communicated by the architects.
- The responsibility for EA mostly still resides with IT people. *Responsibility for EA* and cooperation in EA-related tasks should be *shared across all work levels*.
- Stakeholders and users (technician/worker work level) are the driving force behind an enterprise's business. It is at this level where *acceptance of EA is necessary to ensure synergy in business and IM integration*.

Organisations should be aware of these factors and address them to ensure that once EA is adopted as organisational strategy, acceptance and implementation of EA happen at all work levels involved.

TABLE V. COMBINED LIST OF HUMAN FACTORS RELATED TO EA ACCEPTANCE

Human Factor	Source				
	Zachman Framework	*Other EA Related*	*TA, ANT and ST*	*Enterprise Study*	*Work level Association*
Accept and provide training	X	X	X	X	2, 3
Accept authority and shared values			X	X	4
Accept cultural change	X	X	X	X	3, 4
Accept ownership of business and IM alignment	X	X		X	1
Accept responsibility and accountability for EA tasks		X	X	X	3, 4
Acknowledge and understand 'business', IM and IT viewpoint	X	X		X	3, 4
Acknowledge EA	X	X		X	4
Acknowledge human input and effort	X		X	X	1
Acknowledge maturity level differences				X	1, 2, 3
Acknowledge user/stakeholder requirements	X			X	3
Adapt and adjust to EA when needed (flexible)	X			X	3, 4
Architects and managers act as mediators - advise	X			X	1, 2
Business and technology, human inclusive view	X		X	X	1, 3, 4
Collaborate and promote team work	X			X	2, 3
Communication skills – accurate reflection of intentions, information flow, allow decisions to filter through	X	X		X	1, 3
Communication: request early and continuous updates	X	X		X	1, 2, 4
Architects should be able to conceptualise	X			X	2
Continuous adaptation (short term) and conformation of process (long term)	X			X	1
Continuous validity checking	X			X	1, 2
Coordinate diversity and change	X			X	1, 2
Create collaboration opportunities and educate employees		X	X	X	3
Culture , politics and moral issues	X		X	X	1, 2, 3, 4
Decision making	X			X	1, 3
Architects should be dedicated	X			X	2
Demonstrate support for EA initiatives (accept and provide)	X	X	X	X	1, 3, 4
EA guidance rather than governance				X	2
Enable information exchange and preservation	X			X	3, 4
Establish future architecture vision and definition	X			X	1, 2
Explain/understand perceived benefits and competitive advantages of EA	X		X	X	1, 2
Facilitate and manage transformation and culture change – engineering	X	X		X	1, 2
Facilitate architectural modelling and implementation	X			X	2, 3
Facilitate stakeholder involvement, cooperation and understanding of EA initiatives	X	X		X	2, 3, 4
Focus on enterprise priorities	X		X	X	3, 4
Follow 'as is' and 'to be' roadmap	X	X		X	1, 2, 3, 4
Follow standardised procedures	X			X	4
Foster engagement into EA	X	X		X	1, 2
Guidance provided by architects	X			X	2
Honesty				X	4
Identify reusable information	X			X	4
Integrity, honesty and ethical behaviour				X	1
Interaction and social networking			X	X	3, 4
Involve all stakeholders, address their needs and share motives, problems and small victories	X	X		X	1, 2, 3, 4
Leadership and teamwork skills		X		X	1, 2, 3
Open-minded, accept input and innovative ideas from stakeholders (flexible), perform EA tasks		X		X	1, 2, 3, 4
Optimise and standardise – equipment and services	X			X	4
Participate in EA initiative	X		X	X	3, 4
Show passion for EA – stay focused				X	2, 3
Stakeholders should have patience with EA initiatives	X		X	X	1, 2, 3, 4
Perceived usefulness	X	X	X	X	4
Perseverance in EA work	X		X	X	1, 2, 3, 4
Personal and organisational (group) dynamics needed for EA initiative	X		X	X	1, 4
Positive attitude is needed for EA initiative		X	X	X	2, 3, 4
Prepared to accept EA challenge		X		X	2, 3
Professionalism	X			X	2
Proof of personal strength and leadership skills				X	1, 2
Provide feedback and frequent results	X			X	3
Realistic expectations - continuously share benefits and results of EA	X			X	1, 2, 3
Remuneration of effort expectation			X	X	4
Resolving conflict	X			X	1, 2
Retain and reuse of information resources	X		X	X	4
Risk management and financing	X			X	1
Satisfaction – expectation, disconfirmation, performance			X	X	4
Self-efficacy for workers		X	X	X	4
Share knowledge and provide training	X	X		X	1, 2, 3
Share information	X		X	X	2, 3, 4
Solutions architecture with a purpose – based on design objectives	X			X	3
Stay focused on EA initiatives				X	2, 3
Subjective norm			X	X	4
Think analytically, implement practically	X			X	2, 3
Behaviour characteristics are needed for workers to show support for EA initiatives: trust, dedication, focus, loyalty			X	X	4
Understand and deal with global issues				X	1
Understand balance between needs, quality of work and expenditure on resources				X	4
Understand EA meta-models	X			X	2, 3
Understand enterprise culture, vision and principles	X	X		X	2
Understand long term ROI of EA and share long term vision	X	X		X	1, 2
Understand work role importance	X		X	X	3, 4,
Understanding 'business', IM and IT and stakeholders' and users' concerns	X			X	3, 4
Use of common EA language	X	X		X	1, 2, 3, 4

IX. Conclusion

The study presented in this paper resulted in a list of human factors that affect the acceptance of EA as organisational strategy. The list was compiled with the premise that enterprises are heterogeneous and complex systems that are human-driven. The adoption and acceptance of EA as strategy is, however, a long-term and initial costly investment. The adoption of EA usually happens at managerial and executive levels of organisations within enterprises. To be successful, EA as strategy, once adopted, should also be accepted at all other work levels, including engineering, technical and worker levels. Through early identification of work level related human factors known to impact on introduction and use of EA as strategy, organisations can ensure that the implementation and execution of EA succeed.

Although this study was not concerned with typical or classic work design models, but merely with the identification and work level classification of human factors related to EA acceptance, it is suggested that future research can address the classic work design models and whether other human factors would be applicable based on such models. Also, based on the identified human factors hindering EA acceptance, a model for the acceptance of EA as organisational strategy could be developed. Such a model could be used to suggest creative ways to assist organisations in management of EA acceptance.

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