A Context-Aware Business Intelligence Framework for South African Higher Education

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INTRODUCTION

- A number of HEIs are falling below expected proficiency levels **(Piedade & Santos, 2010)**

- Universities have to measure, monitor and understand various metrics that constitute their performances

- An ICT infrastructure that facilitate the management at HEIs to get meaningful information for decision making is indispensable **(Guster & Brown, 2012)**

- Many HEIs find it difficult to leverage existing information stored as independent silos and implement integrated ICT infrastructures that assist providing analytics and reporting.

INTRODUCTION (cont.)

In South Africa:

- Universities need to standardize technologies that provide management information , for example, HEMIS and Operational data from peripheral Systems

- Institutions have to achieve organizational intelligence by developing contextualized decision support systems

- Institutions have to harness skills, processes, technologies, applications and practices that leverage external and internal data assets that support and improve decision making

(Sharman, 2010, Piedade & Santos, 2010; Lock, 2011;Guster & Brown, 2012)

Problem Statement

The problems facing higher education institutions include:

- Shrinking government budget to institutions

- Attracting and admitting high quality students, including attracting skilled and competent staff

- Large amounts of data stored in silos and the data integration capability is almost non-existent

- Implementation of BI using one-size-fits-all approach

- Selecting a technology and linking it with the theoretical foundations of Information Systems Research

The overarching aim of this research has been; to bring out the scientific nuggets that elucidate that MIS technologies in HEIs should be based upon theory and supported by suitable academic practices.

Research Question one

RQ1: *What are the conceptual foundations of the business Intelligence frameworks currently used in the South African public Higher Education Institutions, and are these technological entities theoretically and practically contextualised?*

- The research question guides in scanning the R.S.A. HE sector and solicit information concerning the *current BI solutions and frameworks* and contextualize them.

- We then *Customize a Business Intelligence Framework* for the sector.

Data Collection instruments for this Research include -:

- *Desktop Research,*

- *Surveying & Interviewing MIS champions in the SA HEIs,*

- *Relevant Documentation for SA HE (Statutory, legislative etc.)*

Research Question Two

RQ2: *What Context-Aware Business Intelligence Framework is Suitable for South African Higher Education Sector, and Why?*

Grounded on the first research question, it is further authenticated by:

- *Design Science Research as theorised and publicised by Gregor and Hevner (2013)*

- *Design is what derives innovations and artifacts in the field of information systems.*

- *Constructs, models, methods and instantiations of design theory in BI for HE are solicited to come with a CABIF*

- *Synthesis and analysis of the data collected is fundamental in collective intelligence from the Higher Education sector*

Research Question Three

RQ3: How and what technology can the Context-aware business intelligence framework be implemented as a vehicle for decision making processes at the university of Venda?

Practical implementation of the developed CABIF:

- *Soliciting Information Systems Theory as theorised and publicised by Gregor and Hevner (2013)*

- *Contextualizing reports for decision making.*

- *A Performance Evaluation Balanced-Scorecard implemented within the realm of CABIF and selected technology*

- *Predicting and presenting useful data for Strategic Planning*

- *Determining the end-users' perceived adoption and acceptance of the implemented technology*

Data Collection instruments include:

– *Technology Acceptance Survey*

– *Desktop research*

Hypothesis

- **Hypothesis 1**: There is a negative relationship between the age of the user and (a) perceived ease of use and (b) perceived usefulness for using the context-aware business intelligence solution at university of Venda

- **Hypothesis 2**: There is a positive relationship between the experience of the user and (a) perceived ease of use and (b) perceived usefulness for using the context-aware business intelligence solution at university of Venda

- **Hypothesis 3**: There is a positive relationship between perceived ease of use and the attitude for users of the context-aware business intelligence solution.

- **Hypothesis 4**: There is a positive relationship between perceived usefulness and the attitude for users of the context-aware business intelligence solution.

- **Hypothesis 5**: There is a positive relationship between attitude and the intention of using the context-aware business intelligence solution at university of Venda

- **Hypothesis 6**: There is a positive relationship between intention to use and the actual usage of the context-aware business intelligence solution at university of Venda

- **Hypothesis 7**: There is a positive relationship between facilitating factors and the actual usage of the context-aware business intelligence solution at university of Venda

Research Aims and Objectives

This study aims to develop and implement a Context-Aware Business Intelligence for the South African Higher Education Sector

This aim can be achieved through:
a) Leveraging the collective knowledge of the existing BI Systems in the sector to accommodate a CABIF for the sector
b) Establishing practices and processes for management information to end-users
c) Streamlining the collection and integration of institutional data assets and provide comprehensive reporting for management information
d) Measuring the institutional performance against its strategic objectives
e) Providing institutional data valuable for strategic planning
f) Evaluating the technology acceptance on the rolled out technology based CABIF

Theoretical Framework

The theoretical Framework for this research study is being informed by:

- The field of Management Information Systems (MIS) in the Higher Education Sector

- The role played by Business Intelligence in Higher Education

- Therefore the *theories*, *constructs* and *concepts* of Business intelligence have been explored to form a fundamental basis for the construction of a Context-Aware Business Intelligence within the South African Higher Education Sector

History of Business Intelligence

- **Business Intelligence, phrase was coined in 1865 by Richard Millar Devens in his book "Cyclopaedia of Commercial and Business Anecdotes"**

- **It was with the 1958 publication of a landmark article entitled "A Business Intelligence System", written by IBM computer scientist Hans Peter Luhn, that the potential of BI was recognized**

- **First Generation Business Intelligence (1990s – Early 2000s)**

- **Second Generation Business Intelligence Technologies (2000s)**

- **BI and the Proliferation of Internet Technologies (2000s)**

- **Self-Service Business Intelligence**

- **Cloud BI and Mobile Business Intelligence (Current)**

Business Intelligence Maturity Models

- TDWI BI Maturity Model

- Business Information Maturity Model

- Gartner's Maturity Model for Business Intelligence and Performance Management

- AMR Research's Business Intelligence/Performance Management Maturity Model, Version 2

- Business Intelligence Maturity Hierarchy

- The Infrastructure Optimization Maturity Model

- Oficina de Cooperacion Universitaria (OCU) Maturity Model for Institutional Intelligence

- Joint Information Systems Committee (JISC) BI *InfoKit V*

The proliferation of BI maturity models, is an indication that BI has become an essential element of the information pipeline and an important ingredient of organizational success

Previous Research

- Many higher education institutions are faced with the problem of the "Execution Gap", (Beckett & McComb, 2012; Covey, 2012)

- Creation of business value through IT implementations in HE(Van Dyk, 2008; Guster & Brown, 2012; Wagner& Weitzel, 2012)

- BI in HE has been researched and documented (Angelo, 2007, Beckett & McComb, 2012; Grabova et al., 2010,Guster & Brown, 2012; Wagner& Weitzel, 2012)

- Previous research has been **focusing on *technology* and *information security***

- This research take a context in Higher education as a premise for BI implementations in Higher Education

Context-Aware

"Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object considered relevant to the integration between user and an application, including the user and the application themselves"
(Anagnostopoulos & Hadjiefthymiades, 2010,2013)

In our research context we refer to context as _business processes, statutory requirements, technology resources and human resources_ involved in management information systems within the South African Higher Education Sector

Findings from Literature

- The link between BI maturity, organizational success and the impact of BI initiatives is not quite clear

- The BI maturity models concentrate on addressing classical IT topics rather than embracing the organizational structure, the legislative framework governing the operations of the organizations, efficiency and organizational strategies

- The alignment of BI strategy, technology, and business strategies are rarely addressed within the maturity models described in literature

The BI initiatives within organizations have should be conceptualized on the basis of information systems success models and the inherent underlying conceptual frameworks

Research Design & Methodology

- The MIS field has provoked debate whether it has native research theories, i.e., *"theories specifically developed to describe, explain, predict or design management information system phenomenon"* (Straub, 2012)

- In our research we use **Mixed Method Research** design as theorised and publicised by (Venkatesh, Brown & Bala, 2013; Zachariadis, Scott, & Barret, 2013)

- The **Design Science Research Approach** as developed by Gregor & Hevner, 2013 is used in the development of CABIF

- A modified **Technology Acceptance Model** (Davis, 1989) is used to measure the adoption and acceptance of CABIF at UNIVEN

Topic of interest: BI in SA HEIs

- - - → Iterative process
──→ Research progress

Theoretical propositions: Literature Review

exploratory Interviews/ Surveys — Data collection - - - → Data analysis

Qualitative Research design

Quantitative Research design

Survey Research; Technology Acceptance Model — Data collection - - - → Data analysis

Semi-Structured interviews — Data collection - - - → Data analysis

University of Venda: Case Study — Data collection - - - → Data analysis

Quantitative Inference

Qualitative Inference

Assessment or Elimination Phase
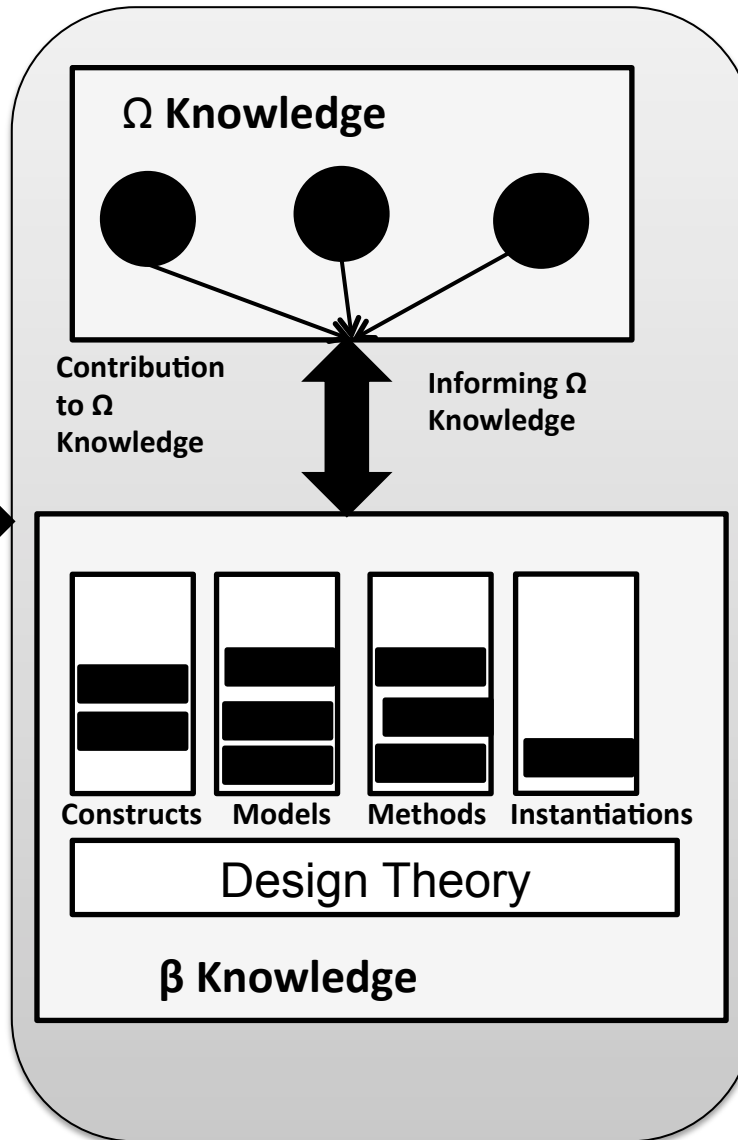
Meta-inferences & Causal Mechanisms

Application Environment: South African Higher Education

Research Opportunities and Problems

Vision and Imagination

Research Questions(RQ2)

Ω **Knowledge**

Contribution to Ω Knowledge

Informing Ω Knowledge

Constructs Models Methods Instantiations

Design Theory

β **Knowledge**

Human Capabilities

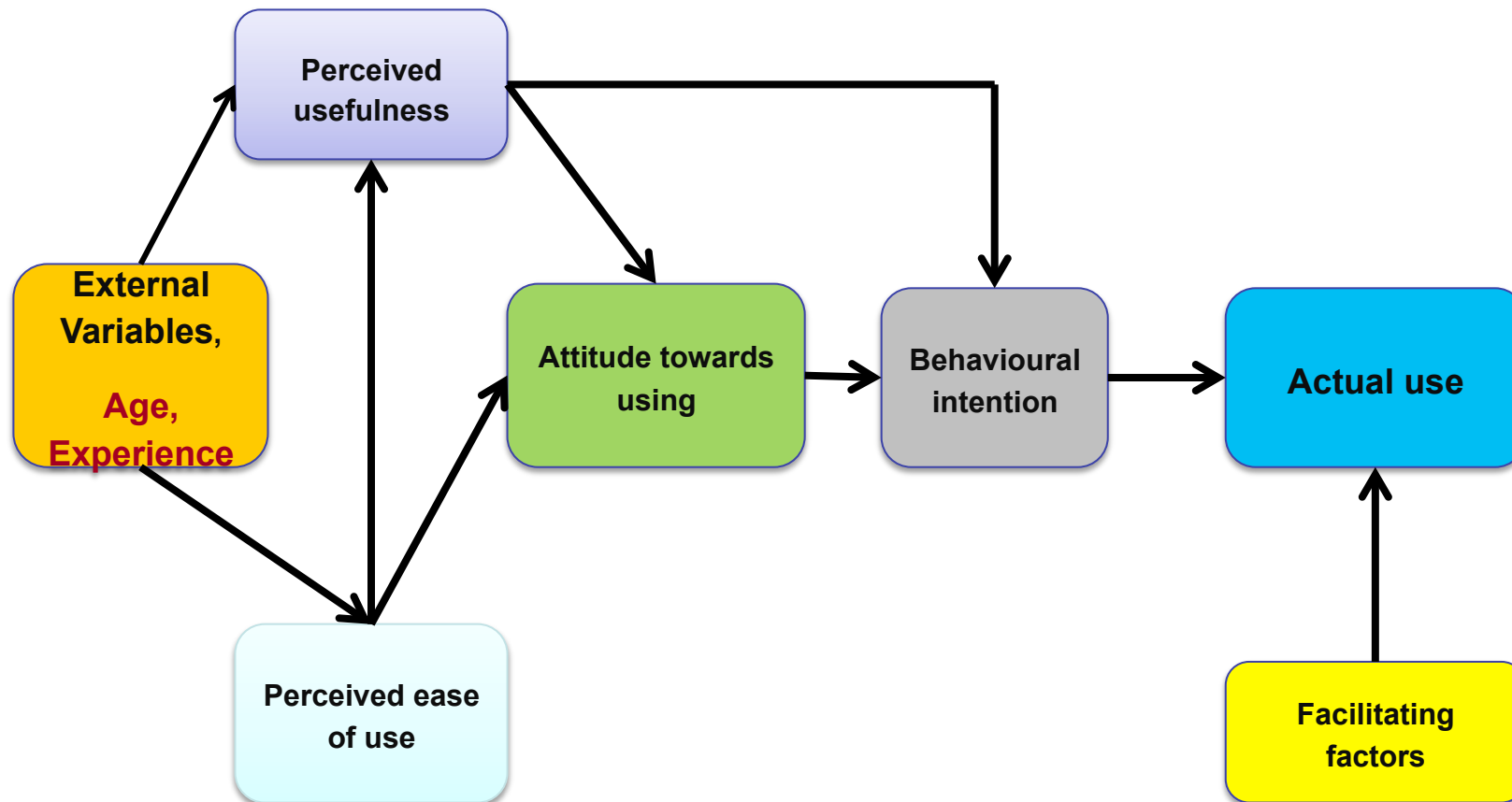**Cognitive**
- Creativity
- Reasoning
- Analysis
- Synthesis

Social
- Teamwork
- Collective Intelligence

Design Science Research, Gregor & Hevner, 2013, p.344

Technology Acceptance Model

External Variables, Age, Experience

Perceived usefulness

Perceived ease of use

Attitude towards using

Behavioural intention

Actual use

Facilitating factors

Why Mixed Research?

- **Complementarity**
  - Used to gain complimentary views about the same phenomena
- **Completeness**
  - Complete picture of a phenomenon is obtained
- **Developmental**
  - Questions from one strand emerge from the inference of a previous one (one strands may provide hypothesis to be tested to the next)
- **Expansion**
  - Explain or expand upon the understanding obtained from one approach
- **Corroboration/Confirmation**
  - Used in order to assess the credibility of inferences obtained from one approach
- **Compensation**
  - Enable to compensate for the weaknesses of one approach by using the other
- **Diversity**
  - Used with the hope of obtaining divergent views of the same phenomenon

(Venkatesh, Brown, & Bala, 2013, p.6)

Data Collection Instruments

Online Survey being deployed in South African Public Higher Educations cover the following areas:

- Business and Technology Alignment

- Organizational and Behavioural Strategies

- Technology Strategies

- Business Intelligence
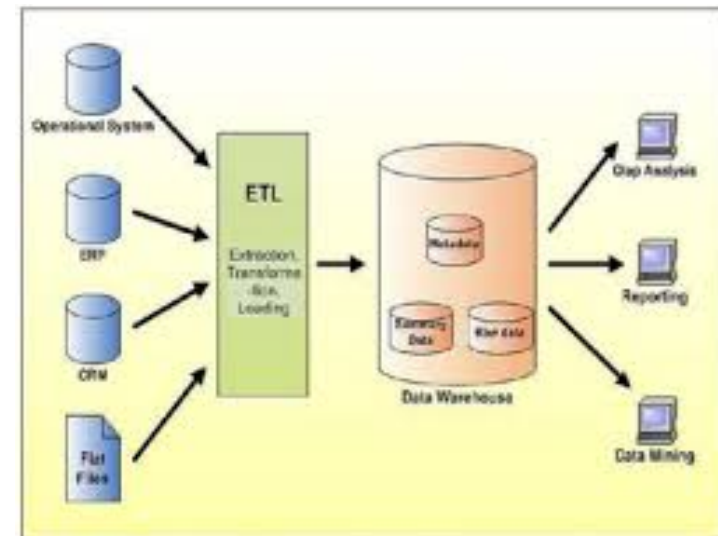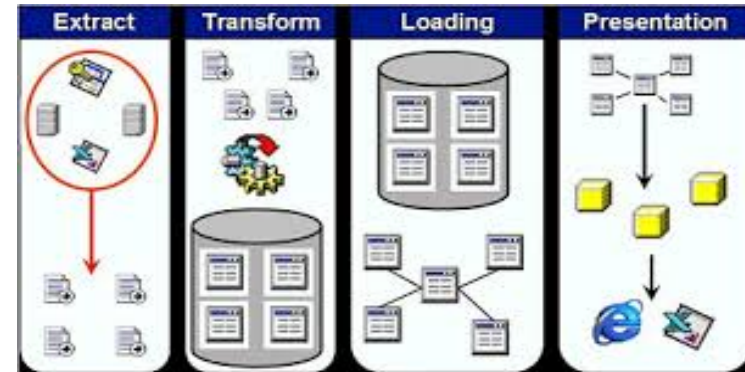
Intentional Population and Sample

- The population & Sample consists of:

  – Information technology professionals at various universities,

  – Institutional Planning members

  – Management information professionals and Institutional researchers and data scientists.

  Selection Criterion is Intentional

Data Analysis Approach

- ## Qualitative Data Analysis

  - Obtaining data from sufficient interviewees in such a way that the likelihood of reaching any kind of saturation point in the data (from a qualitative perspective) is extremely likely.

  - The coding of the data from interviews is going to be explicit in the data analysis and an emphasis in the use of coding text into various themes.

- ## Quantitative Data Analysis

  - Principal Component Analysis is Used to analyse data from Surveys

  - The reliability of each of the measured variables will be investigated with Cronbach's alpha

  - Correlations among variables will be calculated and the variables in each of the seven hypothesis will be explored through regression analysis

Publications from the Research

- Mutanga, A. A Context-Based Business Intelligence Solution for South African Higher Education, *2014 SCIEI International Conference on Information Management and Industrial Engineering (ICII 2014),* Dubai, UAE, August 22-23, 2014

- Mutanga, A. (2015). A Context-Based Business Intelligence Solution for South African Higher Education. *Journal of Industrial and Intelligent Information (JIII)*, 3(2), 119-125

- Mutanga, A. A Context-Based Business Intelligence Solution for South African Higher Education, AITEC ICT Southern Africa Summit, Maputo, Mozambique, April 2-4, 2014
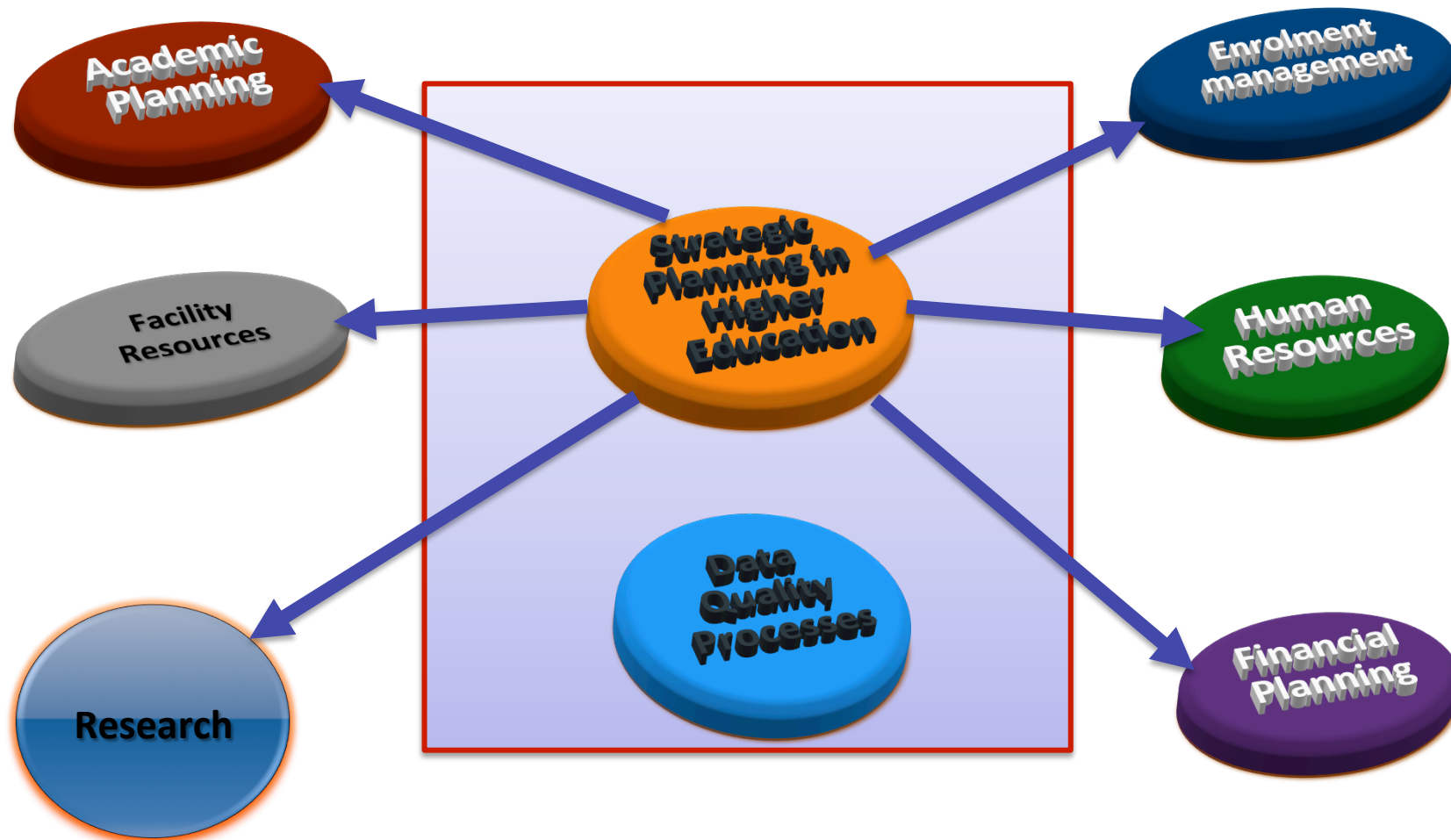
Technology Choice

- **Leverage Existing Systems at UNIVEN**

- **Be Platform Independent**

- **Visualization**

- **Self-Service Capabilities**

- **User driven**

Significance of the Research

- **Contributions to knowledge**
  - Theory and practice of management information systems in higher education
- **Contributions to practice**
  - Promote a culture of evidence to drive decision making processes in the higher education sector
- **Contributions to Policy**
  - Provide for an impetus for higher education executives and management to develop data governance policies
  - Encourage higher education practitioners to develop ICT strategies that align with core business of the institution

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