

DEPARTMENT OF COMPUTING SCIENCES

Research Seminar – 4 November 2019

	<i>Science Faculty Auditorium</i>	
09:00	Welcome - HOD Prof B. Scholtz	
09:05	Keynote Speaker: Prof N Pillay (UP) - <i>Artificial Intelligence for 4IR: A Myth or Reality?</i>	
	<i>Venue A - Chair: Dr L. Barnard</i>	<i>Venue B - Chair: Prof J. Greyling</i>
10:00	Dumani Kunjuzwa - <i>Embedding Indigenous Knowledge into Appropriate Technologies to Promote Awareness of Water Resources Issues</i>	Timothy Musharu - <i>A Hybrid Model for the Recognition and Tracking of Users and Activities in a Multi Inhabitant Smart Environment</i>
10:25	Anthea van der Hoogen - <i>A Value Alignment Model for Smart City Initiatives</i>	Philip le Grange - <i>Flexible Automotive Manufacturing Systems: Intelligent maintenance scheduling for Mercedes-Benz South Africa (Pty) Ltd.</i>
10:50	TEA BREAK	
	<i>Venue A - Chair: Prof A. Calitz</i>	<i>Venue B - Chair: Dr M.C. du Plessis</i>
11:15	Malibongwe Twani - <i>First year CS and IS students' Career Choice Influencers</i>	Ilze Hibbers - <i>A Model to Predict Stress in an Office Environment using Technology</i>
11:40	Ife Fashoro - <i>Applications and Challenges of Social Media Big Data for Sustainability: A Review and Research Agenda</i>	Bongo Bakaco - <i>A Fault Prediction Model of Automotive Press Shop Assembly Machines for Part Quality Optimization</i>
12:05	Lindsay Westraadt -	
12:30	LUNCH	
	<i>Venue A - Chair: D Kunjuzwa</i>	<i>Venue B - Chair: Dr D. Vogts</i>
13:30	Oitsile Maponyane - <i>A crowdsourcing toolkit for eliciting millennial worldviews – A marine and coastal environment case study</i>	Mareike Hinrichs - <i>Using Design Thinking to generate and visualise target-group-oriented research results – The Persona Method</i>
13:55	Obrukevwe Okuah - <i>A Social Media Method for Eliciting Millennials' Worldviews on the Coastal and Marine Environment</i>	Tongai Chiridza - <i>A Multi-User Framework to Support Behavioural Modelling in a Smart Space</i>
14:20	Charles Dyason - <i>Dynamic collaboration between heterogonous Smart Environments for enhanced service composition</i>	Maxine Malgraff - <i>A Methodology for Modernising Legacy Web Applications</i>
14:45	TEA BREAK	
	<i>Science Faculty Auditorium</i>	
15:15	Anthea van der Hoogen - <i>Building a Conceptual Model</i>	
15:50	Closing Remarks - DOS Prof J. Wesson	

Abstracts

Using Design Thinking to generate and visualise target-group-oriented research results – The Persona Method

Mareike Hinrichs

The purpose of this research was to investigate how stakeholders in the Nelson Mandela Bay start-up ecosystem can enhance awareness of digital tools. Firstly, challenges that aspiring entrepreneurs in South Africa face in their early start-up activities were identified by the researcher. Secondly, barriers to using digital tools on their entrepreneurial journeys were discovered. Lastly, implications of these challenges and barriers for the efforts of relevant stakeholders in Nelson Mandela Bay were identified in order to propose strategies for effective and target-group-oriented start-up support. The researcher used a case study approach and qualitative data was collected through a) focus group discussions with twelve incubatees from two business incubators in Port Elizabeth, South Africa, and b) participant observations during a three-month research stay. Design Thinking workshops were facilitated to conduct further research and to come up with strategies that will help enhance awareness of digital tools in the regional start-up ecosystem. Data analysis methods included keyword cloud analysis, qualitative content analysis, and an in-depth target group analysis. Up until now, incubatees of business incubators in Nelson Mandela Bay have not been able to exploit opportunities presented through information and communication technologies and their needs in this area have, therefore, been largely neglected. This is due to a lack of communication and cooperation between relevant stakeholders in the Nelson Mandela Bay start-up ecosystem and the fact that the digital divide has not yet been fully recognised by existing business incubation programmes. This study has proposed several strategies – in the form of future scenarios – that can ultimately enhance awareness of digital tools. In order to create a better understanding of barriers to using digital tools amongst the target group, personas and empathy maps were created. Furthermore, the researcher developed a comprehensive overview of digital tools. The in-depth target group analysis revealed four types of aspiring entrepreneurs who could potentially represent the whole of South Africa. Early start-up activities, which can enable aspiring entrepreneurs to establish their business successfully in a dynamic market, were also identified. This research has also made a theoretical contribution to the Theory of Knowledge Spillover Entrepreneurship and Schwartz's Theory of Basic Values by applying these to the South African context. The Lean Startup and Design Thinking methodology enabled the researcher to generate practice- and goal-oriented results due to their potential of meeting the underlying needs of this study's target group.

First year CS and IS students' Career Choice Influencers

Malibongwe Twani

Research has indicated that scholars choosing a career and specifically IT careers are influenced by parents, teachers, career counsellors and role models. Recent research indicates that exposure to new technologies and programming concepts at school level can influence a scholar's IT career choice. Other influencers are knowledge of IT career opportunities, the reputation of IT related fields in society and good career prospects, e.g. salaries. The number of first year students registering for Computer Science (CS) and Information Systems (IS) degree programmes have remained stable and in certain cases have shown increases in South Africa. Scholars presently can access various platforms to obtain career advice and guidance. Understanding first year students' academic career choices, behaviours and influencers would assist academic departments to improve methods and strategies to recruit first year CS and IS students.

The purpose of this exploratory study was to examine first year students' influencers of their BSc CS and BCom IS career choices, their perceptions of IT at school and the career advice they received. A questionnaire was completed by first year CS and IS students. The results indicate that students still regard friends and family as the advisors for IT career decisions. Additionally, many students indicated that they did not receive any career advice, specifically from teachers, therefore they conducted their own research or relied on social media. This study forms the basis for future research into the factors influencing a student's IT career choice at South African Higher Education Institutions.

A Fault Prediction Model of Automotive Press Shop Assembly Machines for Part Quality Optimization

Bongo Bakaco

The press shop assembly process is an intricate process that requires the flow of process from one activity and sub process to another in order to achieve complete integration of Body in White (BiW) components. The use of stamping tools in the critical press shop operations is essential in order to realize a safe and reliable production build. Therefore, in order to deliver a complete production value chain, industrial tools work interdependently during the press shop assembly process. It is for this reason that if one or multiple press machines experience a fault(s) there is a possibility that a major part of the press shop assembly line could stop, resulting in downtime, which would lead to production loss (Kubota et al., 2016). As such, it is highly important and necessary to study the fault detection and maintenance of systems and processes in the press shop assembly process. The aim of this research study will be to determine how to acquire fault data from press shop machines in order to ensure proper execution of system and equipment maintenance in the press shop assembly process. This research study will seek to produce a model for the detection, classification and prediction of faults in press machines used for car sheet metal forming in the press shop (Bassiuny, Li and Du, 2007). At this point, literature points towards the use of signal processing and machine learning for extraction of data from machines and prediction of future faults in the press shop assembly process, respectively. In order to evaluate the design, simulation will be done by simulating the press shop assembly process and comparing the modelled measurements with that of the actual press shop.

A Value Alignment Model for Smart City Initiatives

Anthea van der Hoogen

Smart city initiatives are profoundly becoming part of the world agenda to address crises and to identify smarter ways of managing resources while providing better living conditions for all. This study aims to identify what model can support the alignment of value in smart city initiatives. To address this aim a systematic literature review (SLR) was conducted to find what smart city initiatives have been addressed in empirical studies, and which factors are linked to these initiatives. The second round of the SLR identified who should be regarded as stakeholders, and what their roles should be in these initiatives. The process to identify the benefits of smart city initiatives includes five phases. These phases are seen as the steps to create and identify value for a smart city initiative. The complex value typology theory guided the understanding in this study that the nature of the benefit can classify value. Finally it was necessary to address whether the value of these initiatives is realised and if the stakeholders perceive the outcomes as beneficial. This paper proposes a value alignment model for smart city initiatives to support the alignment of value.

A Model to Predict Stress in an Office Environment using Technology

Ilze Hibbers

Stress is a process a person's body follows when they are stressed. The effects of stress are an increase in heart rate, breathing, focus and reaction time. However, stress negatively affect a person's health when they are stressed for a long period. My research aims to reduce stress in an office environment. Smart devices can be used to monitor a person's physical data such as his heart rate. Stress theories and models suggested that changes in a person's behaviour can determine whether that person is stressed. The presentation will explain how it is possible to predict a person's stress level by monitoring his physical and behavioural data. Stress can be reduced by preventing situations that cause stress. These situations, as well as relative interventions to reduce its occurrence, will be discussed in the presentation. An initial list of technologies that can be used to measure a person's data, as well as to perform interventions will be listed in the presentation. An initial model that uses the listed technologies to predict and reduce stress will also be presented.

A Hybrid Model for the Recognition and Tracking of Users and Activities in a Multi Inhabitant Smart Environment

Timothy Musharu

Sensor based Human Activity Recognition has become of increasing importance to the smart environment research community. Smart environments have evolved from being single inhabitant spaces to multi-inhabitant living spaces. Multiple-inhabitants do not just perform single activities at a time but vary their actions in multiple Activities Of Daily Living. Tracking of users, recognition of their activities and activity status in a multi inhabitant smart environment is a complex problem. Human Activities are not simple, involving complex subsets of actions performed in sequence which makes it more difficult for Human Activity Recognition using sensor based readings. An activity such as sitting or standing is not as complex as having coffee with cake as it involves sitting and standing as subsets of the overall activity. Modern approaches have used conventional machine learning methods to implement Human activity Recognition, however recent studies have seen the introduction of deep learning techniques. This study seeks to propose a hybrid model for Human Activity Recognition to support user and activity tracking. Using a smart environment simulation tool, this study focuses on generating a synthetic dataset which will be used for testing and validation of the proposed model. The Design Science Research methodology is used to find the research relevance, design and implementing of the hybrid model. Evaluation of the model will be done by carrying out experiments in which the proposed model will be refined to perform in sensor based Human Activity Recognition tasks. This study is limited to the dataset generated by the simulation tool which may result in varying results depending on the complexity of the tasks being performed. The research aims to propose a hybrid model for Human Activity Recognition to support user and activity tracking in multi-inhabitant smart environments.

Dynamic collaboration between heterogenous Smart Environments for enhanced service composition

Charles Dyason

Smart Environments are physical environments populated with sensors, actuators, and various devices aimed at collecting information about the Environment, processing this information based on user preferences or environment settings, and applying this information to the environment through actuators such as changing the temperature to suit the individual's preferences. A Smart Environment's purpose is to add intelligence and automation capabilities to a physical environment, to make it 'Smart'. However, Smart Environments are single entities that do not directly communicate with one another. The lack of communication, and collaboration hinders sharing devices and services across multiple Smart Environments, be it over physical areas or via the internet. Further, since Smart Environments rely on web services to communicate with the outside world, this design limitation hinders Smart Environments to be Smart in sharing resources between one another, thus requiring redundant sensors or services present in each Smart Environment to fulfil that Smart Environments needs. Several advantages present themselves in addressing the lack of collaboration between Smart Environments. Firstly, with Smart Environment communicating with one another, services in each Smart Environment is accessible by another Smart Environment. This is advantageous as one Smart Environment may be limited in its resources, but can now be accessed from another Smart Environment. Secondly, Smart Environments utilize services to present information to various devices and users. Having the ability to access resources from other Smart Environments, a service which was previously not capable of running due to a lack of data, is now available to both Smart Environments. Lastly, a Smart Environment sharing its information through services allows service composition between multiple Smart Environments, that is the merging of 2 or more services from different Smart Environments to form a more useful 'umbrella' service presenting even more information that previously was available. This research aims to create a model for Smart Environments to be designed around, focusing on collaboration with other Smart Environments and service composition between multiple Smart Environments.

Embedding Indigenous Knowledge into Appropriate Technologies to Promote Awareness of Water Resources Issues

D. Kunjuzwa

The task to manage water as a resource is critical and has become relevant due to the increase in water resource issues. The problem of water shortages is increasingly reported as a compromising threat to the sustainability of developing countries worldwide. The lack of water knowledge is a key factor for many water resource issues. Reducing water shortages requires an understanding of water knowledge of the specific characteristics of resource usage. The knowledge should incorporate indigenous knowledge, which is unique, more relevant and confined to a particular culture. The data revolution and emergence of relevant technologies present the potential to transform the way citizens consume natural resources, including water. A systematic literature review was used to rigorously review literature on factors that affect water resource issues and to guide the development of a conceptual framework for embedding indigenous knowledge into technologies to promote awareness of water resource issues. The proposed framework can guide other researchers to design knowledge-based systems for promoting awareness using indigenous knowledge.

Applications and Challenges of Social Media Big Data for Sustainability: A Review and Research Agenda

Ife Fashoro

Sustainability has been a concern for several decades but has become the focus of development agendas in recent years. This is due to advancements in technology and urbanisation, which bring about new challenges. Sustainability is described as a social challenge that requires change in human behaviour. Researchers, governments and industry are looking to technology as a solution to sustainability challenges. Social media is a technology that is at the forefront of research into sustainability due to its social nature and ability to monitor human behaviour. Evidence of the current application and impact of social media big data on sustainability is currently not available or easily accessible.

This paper seeks to answer the question “How is social media big data used to address sustainability issues?” This question is answered through a systematic literature review that assesses 99 research articles. Based on this review, central themes were identified and linked to the Sustainable Development Goals (SDGs). Social media applications, challenges and future research directions related to these SDGs are identified. It is hoped that the findings will heighten awareness of social media applications and their potential to address sustainability issues.

A Social Media Method for Eliciting Millennials' Worldviews on the Coastal and Marine Environment

Obrukevwe Okuah

A lack of involvement by participants with traditional data collection methods for research has led to insufficient data regarding millennials' worldviews on the coastal and marine environment. Understanding millennial worldviews would provide insights for policy and interventions for sustainable use of the marine and coastal environment. The aim of this research is to design and use an appropriate social media method to elicit millennials' worldviews on the coastal and marine environment.

This section of the research study utilises the Design Science Research methodology and represents the design and development stage of the DSR activities. This section supports the design of a social media method that involves the use of Social Media Analytics (SMA) for eliciting millennials' worldviews. The social media method consists of SMA processes that must be followed when conducting an SMA project. Among a host of various techniques that can be utilised for conducting SMA, this research focuses on sentiment analysis as a technique for identifying and extracting subjective information from vast amount of user generated content.

The social media method designed will be measured for success by NMU researchers from the field of social sciences who require a social media method for eliciting millennials worldviews. One of the contributions made to the social media method is a Social Media Influencers' (SMIs) model that shows the relationship between SMIs' characteristics and techniques for creating engagement on social media.

A Multi-User Framework to Support Behavioural Modelling in a Smart Space

Tongai Chiridza

The key components for Internet of Things (IoT) are becoming increasingly affordable, making the technology attractive to consumers in third world countries (Kshetri, 2017). The adoption of IoT technologies and services in South Africa is on the increase (Maseko, 2018), with an estimated 30 million IoT devices expected by the year 2020 in South Africa (Liebenberg, 2017). Consumer trends also show that more users are buying wearable devices and sensors to install in and around their surroundings (Liebenberg, 2017). As a result of this trend, Smart Spaces are becoming a common feature in our everyday surroundings.

A Smart Space is an environment, mainly equipped with IoT technologies, able to provide services to occupants, helping them to perform daily tasks by monitoring the space and autonomously executing actions, giving suggestions and sending alarms. Sensor data inherently contains activity based behaviour information of occupants of a Smart Space (Mora, Matrella, & Ciampolini, 2018). The behavioural information obtained can be used to infer the well-being of the occupant/s, health status, resource usage, comfort and security among other applications. Deviations in normal activity patterns and forthcoming actions has been popular in identifying significant behaviours and life threatening complications in the daily routines of the occupants (Mahmoud, Lotfi, & Langensiepen, 2013). Behavioural modelling therefore yields two important benefits, reinforcement of good behaviours if normal patterns are observed, and adequate intervention when abnormal events are observed.

Existing systems mainly focus on personalisation and behavioural modelling of single user or occupant of a Smart Space, but very often a Smart Space can have multiple occupants at any given time (Emi & Stankovic, 2015). Each of these occupants can have multiple devices that they can bring into the environment. Furthermore, a Smart Space should not only adapt to the number of users it can support but also their changing needs. The availability of a multitude of sensors, interaction devices and multimedia presents complex challenges for the development of Smart Space applications and services (Grzegorz, 2017). The aim of this research is therefore, to develop a multi-user framework for behavioural modelling in a Smart Space.

Flexible Automotive Manufacturing Systems: Intelligent maintenance scheduling for Mercedes-Benz South Africa (Pty) Ltd.

Phillip le Grange

This research paper investigates the use of machine learning techniques to predict future manufacturing system states to enable intelligent maintenance scheduling and reduce unplanned machine downtime. Automated robots found within the body shop at MBSA require regular maintenance to optimise machine availability and lifespan. Maintenance occurs during periods with no production, such as weekends, as to not cause any halts in production. This results in massive additional costs due to overtime pay and maintenance testing. Buffers between machining stations provide the manufacturing system with volume flexibility and reduces the impact of halting a station for short periods by enabling other stations to keep working, using parts from their respective buffers. Stations can keep working, taking parts from their buffers, performing tasks and then placing the parts into successive buffers until a buffer runs empty or reaches its capacity. Such a blockage or starvation results in station stoppages until the entire production line ultimately comes to a complete halt. Using machine learning techniques to predict station cycle times in order to simulate future buffer levels, short maintenance opportunities can be identified during production, thereby eliminating the need for weekend maintenance and thus reducing overtime costs.

A Methodology for Modernising Legacy Web Applications

Maxine Malgraff

One problem faced in the domain of Information Systems (IS) is that of poorly maintained, poorly documented, and/or unmanageable systems, known as legacy information systems (LISs). As a result of the everchanging web development landscape, web applications now also fall prey to becoming legacy, known as legacy web applications (LWAs). In an effort to retain the business process support and to continue meeting business requirements, one method of recovering vital legacy applications is to modernise them. System modernisation aims to recover business knowledge, as well as providing an enhanced system that overcomes the problems plagued by LISs. Modernisation methodologies provide models, tools and techniques that serve as guiding principles for the modernisation process.

Although many modernisation methodologies exist, very few provide a comprehensive approach to the modernisation, that provide guidelines for each phase in the migration, tools to assist in the migration and techniques that can be used. Existing methodologies also do not cater for cases that include both the legacy web and migrating to web-specific environments.

The aim of this research was to investigate modernisation methodologies, or parts thereof, that could be adapted for modernising LWAs. Existing methodologies were analysed and compared using the criteria required for a holistic modernisation methodology for web environments, as well as other factors that improve the modernisation process. Upon investigation, it was found that the ARTIST methodology provided the most comprehensive modernisation methodology of those researched and was selected as the most appropriate methodology for the modernisation of an LWA. ARTIST was extended to ARTIST++ so that it could cater for web-based environments. ARTIST++ was used in the modernisation of an existing LWA, called OldMax. The findings and lessons learnt related to the adoption of ARTIST++ were reported on and recommendations made for modifying it.

A crowdsourcing toolkit for eliciting millennial worldviews – A marine and coastal environment case study

Oitsile Maponyane

In recent times, companies from around the world have developed and adopted innovative online data collection methods, tools and strategies to great success; for example, YouTube (Huberman, Romero & Wu 2009), Waze (Jeske 2013), Amazon Mechanical Turk (Lowry et al. 2016) and Spotify (Sun 2019). Each of the aforementioned case studies represent a successful and unique viewpoint on the collection, analysis, and implementation of digital data. Though, when the focus of discussion is shifted to academia, one finds that obtaining the worldviews of participants, millennials in particular, is a challenge for social research experts and practitioners when using traditional data collection methods. In addition, traditional data collection methods have many disadvantages, are fast becoming outdated, and are not an acceptable means of data collection, particularly for millennials.

Evidently, the use of traditional data collection leaves room for error, whereas making use of digital data collection such as that in the online domain can provide some guidelines that promote the quality and value of the data (Fitzgerald & Fitzgibbon 2014; Safi, Assemi, Mesbah & Ferreira 2017). In the social and computer sciences, research experts view the online domain through the following perspectives:

As a resource to access existing sources and literature (Poria & Oppewal 2003);

A communication medium that facilitates collaboration beyond borders (Poria & Oppewal 2003); and

As a primary data collection medium (Litvin & Kar 2001; McDonald & Adam 2003; Yang & Beaubouef 2008).

In this research study, the researcher limited the scope of discussion to the third perspective. Through the application of the Design Science Research (DSR) methodology, the researcher critically unpacks online data collection, in particular Crowdsourcing, to support the development of a socio-technical artefact. The contribution of this research study is a toolkit for Crowdsourcing which includes guidelines and a framework for designing, implementing and evaluating a Crowdsourcing implementation. A crowdsourcing implementation is a distributed model that seeks to solve problems commissioning pre-selected participants through open calls made using people-centric online technologies.

The main research problem addressed in this research study is that social science research experts face challenges of finding an acceptable means of data collection for eliciting the worldviews of millennials. To critically unpack the research problem, the researcher used Design Thinking as a strategic tool to solve the research problem in question. By applying Design Thinking as a strategic tool, the researcher sought to empathise and understand the context of the problem domain by conducting an in-depth investigation of Crowdsourcing and participants of Crowdsourcing. The findings synthesized from the literature review are supported by the DeLone & McLean IS success model and Stakeholder Theory to highlight preliminary problems, elements, guidelines and requirements that need to be considered and validated by primary stakeholders. In so doing, the researcher will conduct several iterations of focus group discussions with two participant groups, namely: social science research experts and millennials from the Nelson Mandela University.

The aim of the first focus group discussion is to compare the identified findings and requirements of participants against that of the collected literature through defining the context of the participant. Equally, the purpose of the first focus group discussion is to determine the role objectives, pain points and challenges faced by participants, those being social science research experts and millennials, through empathising and ideation. The expected results are aimed at establishing a baseline of guidelines for the toolkit, which will be synthesized with problems and requirements highlighted in the presented literature. The aim of the second focus group discussion is to then develop and prototype the toolkit components such the overall toolkit takes shape. This is achieved through the creation of simple mock-ups and story boards with the social science research expert group. In addition, an existing systems analysis will be conducted on two Crowdsourcing systems that were described in the first focus group discussion. The purpose of the existing systems analysis is to evaluate the gains

and shortcomings of the described Crowdsourcing systems. The anticipated results are aimed at informing the manner in which the toolkit will be structured and disseminated by social science research experts.

Lastly, the aim of the third focus group discussion is to test the toolkit components, guidelines and related features such that the toolkit itself can be used to select and undertake Crowdsourcing implementations. In so doing, the researcher will use the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) to measure the acceptance of the proposed toolkit from social science researchers. Also, as a means of measuring the recommendations of the toolkit, the researcher will conduct a survey using a questionnaire abstract derived from the PhD of Snow (2018) – adapted to suite the recommendations of the Crowdsourcing toolkit – and compare it with the findings from the work of Snow to determine whether or not there was any improvement in the usability, quality and value of the survey conducted.

The proposed Crowdsourcing toolkit is intended to assist social science research experts when designing, implementing and evaluating a Crowdsourcing implementation to elicit worldviews. In addition, the intended contributions from the proposed toolkit are aimed at reducing the learning curve of implementing a Crowdsourcing implementation, increase data quality and overall value.